

Community Empowerment in Transforming Household and Agricultural Waste into Valuable Products towards the Green Village Concept

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Abstract It is essential to manage waste in an integrated manner, beginning at the domestic and village levels. In fact, there are still a significant number of residents who throw trash carelessly. Jurangjero village, a village in Klaten Regency, Central Java, is an example of a village that does not adequately manage its waste. In addition, the village has agricultural waste issues that require optimal utilization, including rice straw. This community service program aims to increase public awareness of organic and inorganic domestic waste management and agricultural waste management so that they can be applied appropriately to the concept of the green village. The program's methods included field observations, waste management outreach, and training. The training included the creation of organic fertilizers, eco-bricks, plastic waste containers, and straw paper. Farmer groups and farmer women's groups have gained an understanding of the management of domestic organic waste into organic fertilizer and compost as a result of the outreach and training activities. Karangtaruna has also gained an understanding of inorganic waste management by applying the recycling concept, which entails transforming plastic refuse into plastic pots and eco-bricks. They have also grasped the production of economically valuable art paper from rice stalks. The descriptive analysis revealed that the average pre-test and post-test scores were 55.58 and 76.67, respectively. Based on these findings, it can be concluded that this community service program has increased residents' knowledge of managing domestic and agricultural waste to create valuable products. The support of the village administration is required for sustainable waste management and the continuation of empowerment initiatives.

1. INTRODUCTION

The issue of waste is urgent and a priority for Indonesia's development. Waste results from the many human activities performed throughout. It is considered a residual product with no further benefits, so it is often thrown away without proper management (Widawati et al., 2014). The improper management and control of waste can pollute the environment and lead to natural disasters such as floods. The waste problem cannot be solved solely by the cleaning staff; all societal and government sectors are required. As

stated in the Tri Dharma of higher education, higher education is a part of the dynamics of society, where universities stand, develop, and play a role in moving the nation toward a sustainable future through the implementation of education and teaching, research and development, and community service. According to the (Global Ecovillage Network, 1994), a "green village" is a settlement that aims to incorporate ecological aspects into environmental sustainability. By instituting education for

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sustainable development in the community, the village becomes a target for creating a center of excellence for implementing the “green village” concept. The concerns include environmentally friendly buildings, alternative energy, green production, refuse management, and putting the social and economic aspects first.

Jurangjero Village is one of the villages located in Karanganyam, Klaten, with an area of about 2 km², and more than 60% of the area of this village is agricultural land. The village is traversed by the river, which runs from the west side to the east side of the village. The flow of river water that passes through this village often brings domestic garbage and household waste that residents throw into the riverbank. Of the total, more than two thousand and six hundred inhabitants work in the agriculture sector, both as farmers and farm laborers. Women and men are almost equal, with diverse educational backgrounds dominated by high school graduates, which is around 31% of the population. The farmers belong to farmer groups that grow various agricultural commodities. Jurangjero Village has agricultural potential with superior rice varieties, namely Rojolele, Memberamo, and Mentik Susu. Other commodities produced besides rice include corn, sweet potatoes, cassava, papaya, cucumber, peanuts, long beans, and so on. From the planting and processing of agricultural commodities, agricultural waste is produced that still needs to be optimally utilized. For example, rice straw has yet to be utilized and is only burned, even though straw has the potential to be used as a material for making art paper and for bioethanol production. Likewise, other agricultural wastes, including bio-briquettes, biogas, and bioethanol, can be used as raw materials for producing biofuels.

In addition to the problem of agricultural refuse, the village of Jurangjero must also address the issue of household waste. To date, there has been no household waste management in the village; as a result, residents have dumped their garbage in their yards, village areas, and rivers. This garbage pollution results in river flows that are frequently clogged with waste heaps, causing flooding. This waste also contributes to a decline in environmental quality, which affects water quality, the attractiveness of the landscape, and the risk of disease transmission due to garbage accumulation. The process of waste management can be accomplished in numerous ways, one of which is the 3R principle: reuse, reduce, and recycle. According to Puspitawati in Agus et al. (2019), the 3R concept is a way of processing waste from upstream, starting with household waste, which can be done by reusing, recycling, and reducing it. The application of the 3R concept is relatively easy but requires full awareness from the community. One of the applications of waste management is composting. According to Nurhayati et al., 2021, composting is one of the efforts to reduce waste generation by involving the process of decomposition of organic matter with the help of microorganisms. Compost, as one of the organic fertilizers, is very beneficial for increasing agricultural production both in quantity and quality, reducing environmental pollution, and improving overall land quality (Ariyanti et al., 2021). According to Syam (2003), using compost can improve the

physical and microbiological properties of the soil.

Therefore, education about waste management for the community is necessary. This service aims to provide outreach and education regarding organic and inorganic residential waste management. Inorganic waste is a difficult-to-decompose form of waste (Affandi et al., 2015). With the participation of farmer groups, farmer women’s groups (KWT), karang taruna (a local youth organization), and BUMDesa (a legal entity of village businesses managed by the village government), the acquisition of organic waste shredding machines and inorganic waste processing equipment was conducted to assist village partners in handling household waste and agricultural waste. A comparative study was also conducted at the beginning of the program to learn how to make organic fertilizer from agricultural waste. The method used to make this organic fertilizer was the Takakura method. The Takakura method is a practical and efficient technique to produce economically valuable fertilizers designed to process organic waste very well on a household scale (Larasati & Puspikawati, 2019).

The efforts and objectives of achieving this village as a “green village” can be supported by implementing community service programs based on achieving the Sustainable Development Goals (SDGs). The programs were tailored to the potential, conditions, and needs of the village and the people of Jurangjero Village that support the development of ecotourism villages. Thus, this activity aims to improve public awareness and the knowledge of Jurangjero residents on managing household organic and inorganic waste.

2. METHOD

This community service activity in Jurangjero Village was carried out in several implementation phases, shown in the diagram in Figure 1, by involving the community, including farmer groups, KWT, and karang taruna. These phases include field observations in the community environment, discussions and initiations of waste management with partners (village representatives and BUMDesa), comparative studies on the use of organic waste materials with the Klaten Young Farmer Community, outreach on waste management and utilization of agricultural waste, training on the use of organic waste into fertilizer, training on processing inorganic waste into value-added by-products, and training on papermaking from rice straw.

The objective of field observations pertaining to domestic waste management is to examine actual community conditions. Waste management discussions and initiatives with partners aim to collect data on village conditions and government strategies for household and agricultural waste management. In the meantime, the comparative study seeks information regarding compost and liquid organic fertilizer production and has invited the Young Farmer Community to collaborate as resource individuals.

The outreach carried out includes education about

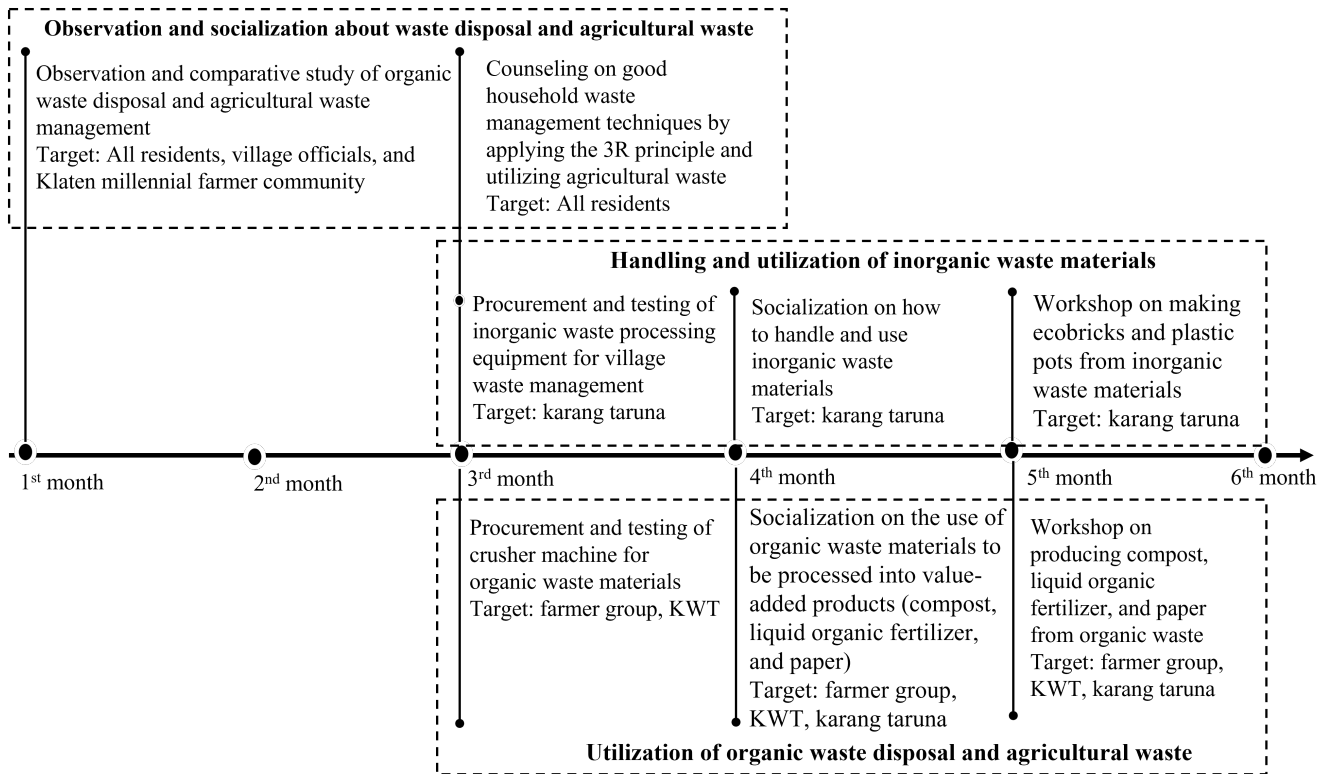


Figure 1 . Activities timeline

household waste management techniques with the 3R concept and the use of agricultural waste by the residents of Jurangjero Village. Meanwhile, the training included training in processing organic waste into compost and organic fertilizers (targets: farmer groups and KWT), recycling of inorganic waste into plant pots and eco-bricks (the target: karang taruna), as well as processing straw into paper (the target: karang taruna). Training support equipment, such as organic material choppers, plastic shredding machines, plastic pot molding machines, and composters, was procured to support the implementation of this training. The method used to measure the effectiveness of outreach and training implementation was PAR (Participatory Action Research) method. The gap generated from the pre-test and post-test results was used as a parameter to measure the increase in residents' knowledge related to household and agricultural waste management. Data was collected using interview techniques, field observations, and documentation. Qualitative descriptive analysis techniques were used to explain the process of community service, starting from observation, initiation, outreach, and training. Community service was carried out in Jurangjero Village, Karanganom District, Klaten Regency, in May – September 2022, with the peak activity taking the form of training on household waste and straw waste management on September 10, 2022.

3. RESULTS AND DISCUSSION

3.1 Field observations in the community

Jurangjero Village still requires a well-integrated domestic waste management system based on the most

recent conditions observed in the area. The waste identified in the village of Jurangjero includes household organic refuse such as food waste, tree branches, dry leaves, and animal waste. Inorganic refuse is waste that is challenging for bacteria to decompose. Plastic waste is one type of inorganic refuse that is abundant in the village of Jurangjero. In addition to the waste problem, the observation results revealed a substantial quantity of rice straw agricultural waste.

The community still manages their waste independently by open burning and open dumping, which has the potential to cause pollution (Fazzo et al., 2017; Ferronato & Torretta, 2019). Waste management that is not done correctly will cause problems such as environmental and health problems. Especially inorganic waste in the form of plastic is found in rivers and rice fields. The cultivation of awareness in handling waste (mainly plastic) must start from the lowest level, namely individuals, households, and villages.

3.2 Focus group discussion with partners in managing waste

Several meetings were conducted with the village head and BUMDesa to collect data on village conditions and village government plans for household waste management and the use of agricultural waste, one of the village's potentials. The village administration of Jurangjero welcomes community service activities because they align with the village's medium-term plan to initiate community waste management. The results of this discussion state that community service activities are focused on the use of technology to process waste (both organic and inorganic waste) and agricultural waste (especially rice straw)

(Ariyani et al., 2017; Ayilara et al., 2020; Edike et al., 2020; Kaur et al., 2017; Phibunwatthanawong & Riddech, 2019). The village requires guidance and assistance from external parties, particularly academics, to address residents' waste and agricultural refuse. Agricultural residues, such as straw and rice husks, must still be extensively utilized. According to the village administration, the majority of rice straw is only burned in the field, used as animal feed, or plowed with tractors and is therefore considered to be directly usable as fertilizer. However, straw must first undergo a fermentation process to become fertilizer. If the straw is plowed in the field without a souring process and planted directly, then during this planting period, the straw has just entered the fermentation stage, which will harm rice plants and may affect rice production.

3.3 Comparative study in utilizing organic waste

With one of the collaborators comparative study was conducted on the production of organic fertilizer from agricultural waste (primarily straw) with one of the collaborators. The partners were Klaten Millennial Farmer Community members of the Aji Berkah Tani Compost Griya in Bono, Tulung District, Klaten. Utilizing the Takakura method, this organic fertilizer is produced.

3.4 3R waste management techniques and agricultural waste utilization

Outreach activities are actions that increase public understanding and awareness of the optimal waste processing system. Exposure to the negative effects of improper organic waste disposal is the first step in outreach. These impacts can take the form of water pollution (rivers), the production of unpleasant odors due to the decomposition of organic waste, the disruption of the natural beauty of the surrounding area, the spread of diseases such as diarrhea and skin diseases, and the attraction of disease-carrying animals such as rats, flies, and mosquitoes (Hasibuan, 2016). Garbage accumulation can also lead to natural disasters such as floods. Exposure to the negative effects of indiscriminate waste disposal is anticipated to increase public awareness so that waste management is conducted correctly and these negative effects are avoided. The presentation on the negative effects of waste was followed by an explanation of the 3R waste management concept (reduce, reuse, recycle).

Extension activities continued with the presentation of the potential use of agricultural waste. According to Rosmainar (2014), rice straw can be used to manufacture art paper and other handicraft products because straw has a unique texture and fiber. Furthermore, straw waste can also be used to make bioethanol. According to research by Baharuddin et al. (2016), straw can produce ethanol levels of 0.24% after a simultaneous saccharification and fermentation process (SFS). Outreach on straw waste management is expected to increase residents' knowledge.

3.5 Training on the utilization of organic waste materials in organic fertilizers

Organic waste usually arises from household activities such as food waste. Organic waste can be processed

into valuable materials such as organic fertilizer/compost. In this training activity, participants were farmer groups and KWT from Jurangjero Village. The material used to make compost is organic waste from household waste collected from the residents of Jurangjero Village. Using organic waste as fertilizer can add value to the waste. This organic compost-making training was in collaboration with Klaten Millennial Farmer Community to help with outreach. Processing organic waste into fertilizer begins with the enumeration of materials using a chopping machine (chopper). Then the organic matter is put into an aerobic composter and fermented for 3-4 months, but it can be accelerated if a bio activator such as EM4 is added (Nurhayati et al., 2021). From aerobic composters, in addition to solid compost produced, liquid organic fertilizer is also produced, which can also be used by residents. The fermentation process of fruit, vegetable, and household organic matter residues into liquid organic fertilizer is one of the effective alternatives to organic waste treatment (Putra & Ratnawati, 2019). One of the organic fertilizers from the training results was used to fertilize vegetable crops grown by KWT in Jurangjero Village (KWT Krajan Lestari) and can also be sold in the market so that KWT members get additional income (Figure 2). KWT Krajan Lestari has also sold vegetables at the Klaten car-free day farmers market, held every Sunday in Jl. Mayor Kusmanto, Klaten. By using organic waste from agriculture and households, the aim is to support farmer groups and KWT in producing and selling organic agricultural products.

3.6 Training and trial of inorganic waste processing equipment to produce by-products

Inorganic refuse, such as plastic waste, will be recycled into products like plastic containers. A plastic shredder will



Figure 2 . Organic fertilizer training: (a) trial of organic matter shredding tools; (b) aerobic composters



Figure 3 . Inorganic waste training: (a) Ecobricks; (b) Plastic pot moulding machine

reduce the size of plastic debris with complex characteristics, such as PET, bottle caps, shampoo bottles, and others. The plastic liquid is then printed in a plastic molding machine using the principle of heating plastic seeds from the previous process with the assistance of a heating oven. Then, additional varieties of plastic, including snack packaging and crackle plastic, are transformed into eco-bricks. The eco-bricks method is regarded as a solution to the plastic waste problem (Zuhri et al., 2020).

The intended participants for this training on inorganic debris collection are Karang taruna. During this pandemic, it is anticipated that this activity will provide additional knowledge and experience as well as occupy the village



Figure 4 . Rice straw paper making training: (a) Pulp making process; (b) Paper making process

youths' free time. The eco-bricks produced by this activity can be used to construct installations that can be displayed throughout the village and in the tourist area to add attractiveness, cleanliness, and originality to the tourist area. Figure 3 displays instructions on the processing of inorganic refuse.

3.7 Training in making paper from rice straw

Rice straw waste is enormous and accumulates in Jurangjero Village, but it can be used. Rice straw can be used as art paper because it has a high economic value (Haile et al., 2021; Kaur et al., 2017). In fact, with a touch of science, technology, and art, this straw waste can be transformed into artistic products of economic value. One

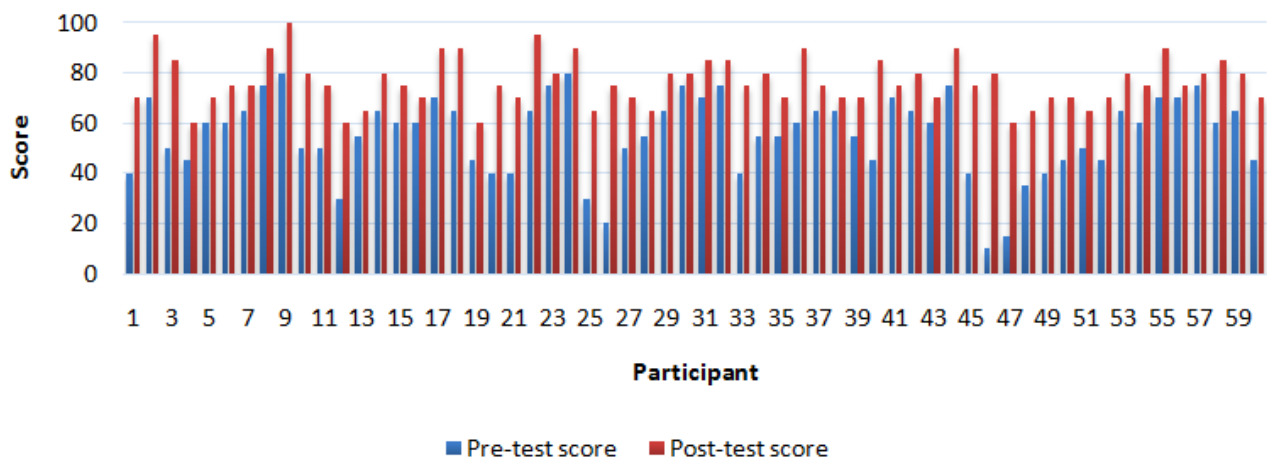


Figure 5 . Changes in knowledge scores before and after agricultural waste and garbage management training in Jurangjero Village

of them is the processing of straw into art paper. This papermaking activity from straws collaborates with art paper entrepreneurs from one of the letterpress printing industries in Yogyakarta. The target of straw papermaking training participants is karang taruna, where the activities can be seen in Figure 4.

3.8 Evaluation of training implementation

The evaluation of this training was carried out by distributing questionnaires to participants before and after the implementation of the training with the same type of questions (pre-test and post-test). The pre-test and post-test results were then analyzed descriptively, so the value of changes in knowledge scores before and after counseling was obtained, which is presented in graphs (Figure 5).

Among the 60 participants who came from karang taruna, members of farmer groups, and members of the KWT, 100% of them experienced an increase in knowledge scores on waste processing and agricultural waste. The mean value of the pre-test and post-test scores were 55.58 and 76.67, respectively. Thus, the score increased by 37.93% from the average initial value.

4. CONCLUSION

The process of converting domestic organic waste into compost and liquid organic fertilizer, which local farmers can use to fertilize rice and vegetables, is now better understood by the residents of Jurangjero Village. Villagers understand how to manage inorganic waste by implementing the concept of recycling. The questionnaire survey results administered to residents indicate that the average pre-test score increased by 37.93% from pre-test to post-test and that all respondents experienced an increase in waste processing and agricultural waste knowledge scores. They were transforming plastic waste into eco-bricks and plastic containers. The results can be used to create art installations that are then displayed in the village's public space to add to the area's uniqueness and serve as the foundation for an ecotourism village. It is anticipated that the use of agricultural refuse in the form of straw to produce art paper with economic value will increase residents' incomes. Suggestions for the sustainability of this community service activity include the village government's assistance to the community so they can engage in sustainable waste management.

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CONFLICT OF INTERESTS

All authors declare that there was no conflict of interest in this community service program.

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