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Caring for Climate Change Through Socialization and Training on Household Waste Management in Eka Jaya Village

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Abstract

Climate change is an environmental issue that is getting more and more attention in science and daily life. One of the contributing factors to climate change is waste management, which is not environmentally friendly. In RT 01 Eka Jaya Village, Jambi City, there is still a habit of people throwing and burning garbage carelessly, which causes greenhouse gas emissions such as CO_2, N_2O, NO_x, NH_3, and other organic carbon compounds. To overcome this problem, the service team from the Environmental Engineering Study Program, University of Jambi, carried out socialization, training, and the provision of facilities to support the sustainable management and processing of household waste. The activity showed a significant increase in community knowledge and behavior towards waste management, as evidenced by the questionnaire results, namely that 99% of residents understood the correct waste management methods. In addition, the community also gained skills in processing glass waste into paving block products, which has the potential to become a business idea and improve the local economy. This activity shows that an educational and participatory approach can effectively change people's behavior towards better and sustainable waste management.

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INTRODUCTION

Climate change is the most talked-about environmental issue today, both at the scientific level and in daily life. Human activities contribute to climate change. One of the human activities that can cause climate change is waste management (Ismiartha *et al.*, 2021; Rachmawati *et al.*, 2019). Often, humans throw garbage carelessly so that garbage accumulates and becomes the cause of other problems due to garbage (Rarastry, 2016).

Waste is a product produced from a domestic (household) and industrial production process. In Law No. 18 of 2008 concerning waste management, it is stated that waste is the remnants of daily human activities or natural processes in the form of organic or inorganic solid or semi-solid substances that can be decomposed or undecomposed and are considered useless and disposed of into the environment. Waste has a major contribution to increasing greenhouse gas emissions due to accumulation, which results in waste decay (Puger, 2018). Without waste management, it will release methane gas (CH2) (Octavia *et al.*, 2021). Every 1 ton of solid waste produces 70 kg of methane gas (Sudarman, 2010). With the increase in Indonesia's population, it will cause an increase in methane gas into the atmosphere, if action is not taken to reduce it, global warming will occur so that it will become one of the factors causing uncertain climate change so that it can harm humans and the environment (Ahsanti *et al.*, 2022; Wijayanti, 2013).

Eka Jaya Village, precisely in Rukun Tetangga (RT) 01, is an area located in Paal Merah District, Jambi City. The problem of household waste is a common condition faced by the community in Jambi City, especially in RT 01 Eka Jaya Village itself. The most common types of waste are wet and dry waste, such as vegetables, food scraps, plastics, cardboard, glass, and others. Burning waste in RT 01 Eka Jaya Village emits harmful gases (CO2, N2O, NH3), which result in the greenhouse effect and climate change. If no action is taken to address these conditions, it can lead to climate change, threatening global warming and extreme weather that can harm humans and the environment (Sigar *et al*, 2017).

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Many people still throw garbage carelessly, do not sort waste, and burn garbage (Buhani *et al*., 2018; Nalhadi *et al*., 2020). It has great potential to be one of the factors causing climate change that can be produced from waste. With collaboration with partners, namely *the Reduce Reuse Recycle* (TPS3R) KSM Makmur Jaya Waste Processing Site, waste that was previously wasted can be used in useful products if the correct behavior in processing waste is applied, for example, organic waste that can be made into compost (Ningrum *et al*., 2022), and glass waste that can be turned into materials for making paving blocks (Priatama *et al*., 2024; Randiestha, 2022).

Based on this, the environmental engineering study program team of the Faculty of Science and Technology, University of Jambi will carry out mentoring and support activities for partners to increase public knowledge about waste management and processing through socialization and training activities and provide facilities that will support the progress of changes in community behavior in waste management and processing in RT 01 Eka Jaya Village, such as garbage cans, glass hanging bins, and paving blocks.

Paving blocks are one of the alternative layers of ground surface pavement widely used in construction. This material has several advantages, such as ease of installation, relatively low price, and economical efficiency. Paving block products from glass waste treatment show a compressive strength of 9.23 MPa and a water absorption capacity of 8.76%, which is declared suitable for use in buildings (Rahmawati *et al,* 2022). This service activity positively impacts partners and the community, who can now utilize glass waste to make useful and economical products.

MATERIALS AND METHODS

This community service uses the Participatory Research and Development (PR&D) method. Technically, five students carried out this activity, accompanied by supervisors and field supervisors in Eka Jaya Village.

The following stages are carried out: (1) The survey was conducted by reviewing partner locations in Eka Jaya Village, especially in RT 01 Eka Jaya, which is located in Paal Merah District, Jambi City. (2) Coordination with village officials and local communities regarding activities and socialization stages which are the initial stages that will be carried out before carrying out the waste management process, namely waste sorting which is expected to find out how the waste sorting process is good before being disposed of in temporary shelters (TPS) and by distributing questionnaires to the community to find out the community's response to the implementation of the activities that have been carried out. (3) At this stage, socialize materially and directly practice the proper waste sorting process. (4) The program given to the community also provides directions on how to sort waste, but will also provide supporting facilities in the form of garbage cans, special hanging garbage cans for glass waste, and brick molds. (5) In looking at people's behavior, it is necessary to understand enough about waste sorting and get used to practicing sorting; it is necessary to conduct an evaluation (Table 1).

Table 1. Flow of service activities

Problem	Solution	Output
People litter and burn garbage carelessly.	Socialization about the environmental and health impacts of burning and disposing of waste that is not environmentally friendly	Increasing public awareness about the importance of waste management
Lack of public knowledge in sorting and processing household waste	Training on the management of organic waste into compost, as well as demonstrations on the use of glass waste into *paving blocks*	The community understands the techniques of sorting and processing household waste
Glass waste is not used and becomes an environmental pollutant	Innovation in processing glass waste into *paving block* products that have useful and economical value	*Paving block* products made of glass waste with a compressive strength of 9.23 MPa and water absorption of 8.76%
Limited facilities for household-scale waste management	Provision of simple tools for sorting and processing waste (such as *paving* molds and sorted bins)	The availability of supporting facilities that the community can use in a sustainable manner
Absence of economic opportunities from household waste	Community empowerment in environment-based entrepreneurship through the manufacture of *paving blocks* from glass waste	The formation of new recycling-based business opportunities that can improve the community's economy

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RESULTS AND DISCUSSION

The results of the Student Community Service activities consist of several stages, namely socialization, training, and the provision of supporting facilities for waste management and processing in RT 01 Eka Jaya Village. The initial stage of the activity was to conduct a survey and approach the head of RT 01 Eka Jaya Village and the management partner of the KSM Makmur Jaya *Reduce Reuse Recycle* (TPS3R) Waste Management Site, who discussed the plan for service activities.

Household Waste Management Socialization and Training

The socialization and training stage is the next step carried out in community service activities to provide the community with the importance of waste management and processing that can cause climate change, as well as how to process waste into useful products. At the training stage (Fig. 1), the community service team conducts hands-on practice on the types of waste, including organic, inorganic, and hazardous and toxic (B3).

Fig. 1. Socialization of waste sorting in Eka Jaya Village

In socialization activities, pre-socialization and post-socialization questionnaires are given to the community to see whether the community has absorbed the material presented in socialization and training activities. The following are the results of the evaluation of the Questionnaire on Climate Change Knowledge and Household Waste Management in Eka Jaya Village, before and after the activities that have been presented.

In the public knowledge section before socialization, many people still do not know about waste management and climate change materials (Table 2). It can be seen from the answer "I don't know" to the question asked through a questionnaire with a percentage of ignorance of 22%. Even so, there are still people who already know about the material to be socialized, with a percentage of knowledge of 78%. After the socialization of domestic waste management and material on climate change, public understanding was significantly increased, with a rate of 99% of the total respondents of 35 women of RT 01 Eka Jaya Village.

Table 2. Results of questionnaires related to public knowledge

Community Knowledge				
Before		After		Number of respondents
Yes	No	Yes	No	
14	21	35	0	35
34	1	34	1	35
24	11	35	0	35
20	15	35	0	35
28	7	35	0	35
35	0	35	0	35
28	7	35	0	35
35	0	35	0	35
218	62	279	1	280
280		280		

Based Table 2, it can be concluded that there has been an increase in the knowledge of the community of RT 01 Eka Jaya Village related to the knowledge of domestic waste management in the form of waste sorting, the importance of waste sorting, knowing how to sort waste and of course becoming concerned about the importance of sorting waste before it is disposed of, besides that an increase in public knowledge also occurs in the understanding of climate change materials that have to do with waste generation. Another increase in knowledge in the community is to know the importance of waste management for environmental health.

The questionnaire was given to 35 RT 01 Eka Jaya Village women who participated in socialization and training on domestic waste management and its relationship with climate change. There were also questions about individual behavior or habits in managing waste and the availability of each individual to cooperate with TPS3R KSM Makmur Jaya in waste processing, after conducting a questionnaire before and after the socialization activity (Table 3).

Based on the questionnaire that has been carried out, the results have been obtained, namely in the part of people's behavior and habits towards waste selection and management, it is known that there are 20 people out of 35 respondents who are still used to burning garbage, even though they have thrown garbage in their place. By looking at the results of the answers in the table above, many respondents are still taking the wrong steps in waste management, as can be seen from the percentage before the socialization of waste management of 30%. This value is indeed smaller than the correct

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behavior of the community in waste management, which is 70%. However, after socialization and training on household waste management, an answer was obtained with a full percentage of 100% in terms of willingness to participate in managing domestic waste correctly and adequately, such as not burning waste, wanting to sort waste, and willing to cooperate with TPS3R KSM Makmur Jaya to process domestic waste.

Table 3. Results of questionnaires related to community behavior

Community Behavior				
Before		After		Number of respondents
Yes	No	Yes	No	
20	15	35	0	35
35	0	35	0	35
11	24	35	0	35
35	0	35	0	35
10	25	35	0	35
16	19	35	0	35
127	83	210	0	210
210		210		

The people's behavior and habits towards waste sorting and management increased after socialization and training on domestic waste management and the provision of materials on climate change. The community can also find out the importance of waste management for environmental health. Also, from the questionnaire given after the socialization it is known that all communities are willing to sort waste and cooperate with TPS3R in domestic waste processing, therefore it is necessary to have support and support facilities for the community to be more concerned about the importance of waste management in order to achieve service goals in Eka Jaya Village.

Fig. 2. Creation of waste sorting support facilities

Creation of Household Waste Sorting Facilities

After socializing with material on waste sorting, waste processing, waste management, climate change, and global warming, we also need to provide supporting facilities to support the domestic waste sorting process that has been socialized. The facilities made are suitable garbage cans for their type, such as for organic, inorganic waste, and Hazardous and Toxic Materials (B3). It will also provide poles to hang glass waste before TPS3R processes it (Fig. 2).

Placement of Household Waste Sorting Facility

The placement of facilities in various places, namely at six adequate points in RT 01 Eka Jaya Village, such as in mosques, at road crossings, in public facilities, and also on vacant land used by the people of RT 01 Eka Jaya Village as a place to plant a toga. The garbage cans are placed at six points, and iron poles are used to hang glass waste. It is important to make it easier for people to sort waste from home and for TPS3R managers to process waste that has been sorted based on the type of waste.

The results of the waste that are sorted and disposed of at the waste bin facility that has been provided, then the waste will be transported by TPS 3R KSM Makmur Jaya. Furthermore, a waste processing process is carried out where organic waste is processed into compost, and inorganic waste will be sorted again, then handed over to a third party, for B3 waste, such as glass waste, is processed into Paving Block Products.

Waste Generation at TPS3R KSM Makmur Jaya

Based on the activities carried out, it is known that the amount of waste produced at TPS3R KSM Makmur Jaya is that the total organic waste in one month reaches 115 kg. Common types of organic waste include kitchen waste, jengkol shells, fruit peels, vegetable residues, etc. The organic waste source is not only limited to domestic waste in RT 01, but also includes waste from the market around Eka Jaya Village. This organic waste can be processed into compost and liquid fertilizer by TPS3R KSM Makmur Jaya. While inorganic waste only reaches 44 kg a month, the amount is less than that of organic waste. It is because TPS3R does not focus on processing inorganic waste; TPS3R itself only collects and resells it to collectors.

The occurrence of glass waste as much as 61 kg, consisting of types of glass, mainly in the form of bottles, tableware, and household glass, glass waste itself, in addition to being obtained from the surrounding community, turned out to be obtained from other parties who had glass waste. This glass waste is used at TPS3R KSM Makmur Jaya as an additional material or substitute for sand (Cut, 2023) to manufacture paving blocks.

Manufacture of Paving Block Products from Glass Waste

Manufacturing begins by changing glass materials into a smoother shape or powder by grinding them *using a glass crushing tool* at TPS 3R KSM Makmur Jaya. The result of glass smoothing is

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used instead of sand media, since the manufacturing process is almost the same as the method of making it, paving blocks. Generally, this distinguishes only the mixture of materials used, that is, glass waste. The size used is 3:1, meaning that 3 kg of glass and 1 kg of cement mixed with a little water can produce as many as seven paving blocks (Fig. 3).

Fig. 3. Manufacturing of paving block products from waste glass

After the process of making paving blocks, the drying process is carried out in direct sunlight. After drying, the paving blocks were placed in the storage area at TPS 3R KSM Makmur Jaya. The results of processing glass waste into paving blocks can be used or utilized by TPS 3R KSM Makmur Jaya and the RT 01 Eka Jaya Village community (Fig. 4).

Fig. 4. Product results from paving blocks from waste glass

Economic Calculation of Paving Block

The manufacture of paving block products with the dosage used is 3:1. As for the manufacture carried out if you spend 1 sack of cement weighing 50 Kg, 150 Kg of glass powder is needed with the number of products produced as many as 350 paving blocks, with a total cost of Rp 90,000.00 per production (Table 4).

Based on the results of the activities, the products produced by manufacturing can certainly impact economic value because they are environmentally friendly products and innovations, as explained. Utilizing glass waste is one of the efforts to reduce domestic waste disposed of at the Final Processing Site (TPA). However, in this case, further research needs to be carried out so that in the future, paving block making activities from glass waste can be developed into business opportunities, where glass waste can reduce the use of cement in adding sand aggregates. The following calculates the selling value of regular paving blocks using glass waste.

Table 4. Production cost calculation for paving block

No	Information Production costs	Production Materials		Time Production	Product Results
		Cement	Glass Powder		
1	1:3 (Cement) : (Glass Powder) 1 sack of cement	1 kg	3 Kg	15 minutes	7 pieces Paving block
2	IDR 60,000.00 Glass Milling (1 hour 30 minutes) IDR 30,000.00	One Sack (50 kg)	Necessary (150 kg)	12 Hours 30 minutes	350 Pieces of Paving block
Total IDR 90,000.00					

Table 5. Calculation of economic factors of paving block

No	Raw Material Cement + Glass Powder		Raw Material Cement + Sand	
	Cement	Glass Powder	Cement	Sand
1	50 Kg	150 Kg	50 Kg	150 Kg
	IDR 60.000,00	IDR 30.000,00	IDR 60.000,00	IDR 50.000,00
	Entire Rp 90.000,00		Entire Rp 110.000,00	

Based on Table 5, the total cost of raw materials for normal paving blocks is Rp. 110,000, while the total cost of *paving block* raw materials with glass materials is Rp. 90.000. The cost of raw materials for paving blocks using glass powder instead of cement is much more affordable, but the materials needed are not as easy as ordinary paving *blocks*. In addition to the quality of paving *blocks* using glass materials, the results are no less good than *ordinary paving blocks*.

Compost Product Manufacturing

The service team and TPS3R KSM Makmur Jaya make compost fertilizer products. It will be managed by partners or TPS3R KSM Makmur Jaya in the future. The composting materials are taken from the organic waste facilities that have been provided. After the organic waste is collected in the trash, it is then processed into compost by the service team and TPS3R KSM Makmur Jaya, for the type of waste used, namely organic waste that is commonly used and easy or quick to decompose, for example, vegetable waste. Additionally, the source of organic waste for

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the composting process also comes from market waste around RT 01 Eka Jaya Village, so the composting materials are increasingly diverse.

The composting process at TPS3R KSM Makmur Jaya is almost the same as the composting process in general, such as the stages of waste collection, shredding, soaking or fermentation (compost maturation process) and closing the compost and not forgetting to do the stirring process so that the methane gas in the composting process is broken down so that there is no explosion. Furthermore, the compost product will be packaged and distributed to the RT 01 community of Eka Jaya Village who need it. The process of making Compost Fertilizer directly produced at TPS3R KSM Makmur Jaya can be seen and listed in Fig. 5, which is immediately processed and packaged.

Fig. 5. Making compost fertilizer at TPS3R KSM Makmur Jaya

Implementation of Work Results

The service activities by the Student Service to the Community team at RT 01 Eka Jaya Village are divided into three areas: domestic waste management, making paving blocks from glass waste, and making compost. Evaluation was carried out through questionnaires, observations, and discussions with residents. The results showed that 99% of the community understood waste management after the training, a significant increase from the initial condition. The community has also succeeded in processing organic waste into compost. The program has a positive impact on improving environmental knowledge and skills.

CONCLUSION

Student Community Service Program (P2M2) with the theme of Caring for Climate Change through Socialization and Training of Household Waste Management in Eka Jaya Village. Household Waste Management has successfully educated the RT 01 Eka Jaya Village community regarding the importance of environmentally friendly waste management. Through socialization and training activities, community understanding of waste sorting and processing practices has increased to 99%, as a form of real contribution to climate change mitigation.

This program has also succeeded in utilizing glass waste into paving block products that have economic value, with an estimated production of 350 units per cycle, however, there were several challenges during implementation, such as dependence on sunlight for the drying process which caused inconsistent production duration, as well as the use of unrefined glass waste which affected product quality. In the future, the program will be developed by implementing drying furnaces to accelerate production, refining glass waste with simple technology, and expanding education and training to surrounding areas. Hopefully, this program can continue and become a model for innovative, efficient, and adaptive community-based waste management.

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