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The Organic Waste Processing as an Alternative Energy Source of Bio-Briquettes For Kedung Klinter Citizen Surabaya

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ABSTRACT

Waste that is not managed and utilized can be a big problem, but on the one hand, if it can be managed well, then waste can bring blessings and benefits to society in realizing a circular economy. Therefore, educational and community empowerment activities are needed in utilizing and managing organic waste as a new and renewable energy source for bio briquettes. The aim of this community service is to provide education to community members to utilize organic waste to become an alternative energy source, bio briquettes. This event was attended by no less than 25 environmental assistants representing RW in the Kedung Klinter area, Kedungdoro Village, Tegalsari District, Surabaya. This activity methods are packaged in the form of education in lectures, interactive questions and answers with participants and practice of making bio-briquettes. The response from the Village Head and residents was very positive and enthusiastic. Participants open their minds and increase their knowledge and skills regarding the management and utilization of organic waste into charcoal briquettes from organic waste. The results of this activity are appropriate technological equipment, Briquette Printing Equipment and Briquette Stoves. The conclusion of this activity is that there is an increase in community knowledge about the process of making bio briquettes, there is still a need for several improvements, innovations, developments and ongoing efforts to improve the quality of community briquette printing results into more prospective products both in terms of briquette printing tools, briquette stoves and material composition. making charcoal briquettes.

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INTRODUCTION

The availability of fossil fuel-based energy is currently in danger of depletion. This is due to the high levels of exploration driven by increased fuel consumption and population growth (Parinduri & Parinduri, 2020). As an alternative, biomass is being developed into bioenergy (Patil, 2019). Biomass materials can originate from organic products or waste from agriculture, farms, households, and forests (Parinduri & Parinduri, 2020); (Suryaningsih et al., 2019); (Ifa et al., 2020); (Kabaş et al., 2022).

Surabaya – the second largest metropolis in Indonesia – generates approximately 1300-1400 tons of waste daily and has only one final waste disposal site (TPA) in Benowo, covering an area of about 37.4 acres (Yuliati et al., 2021). The Government of Surabaya is committed to managing, processing, and utilizing waste by involving all levels of society. Waste management is carried out by providing waste banks, which then process waste into compost, biogas, charcoal briquettes (bio-briquettes), and others (Mulyati, 2016); (Anderson et al., 2017); (Setyadi et al., 2021). Organic waste processed into charcoal briquettes has several advantages over being processed into compost or biogas. The advantages are (1) simpler production techniques, (2) faster processing, and (3) abundance of raw materials (dry leaves and twigs readily available in the home environment) (Mulyati, 2016);(Yuliati, Santosa, H, Lourentius S, 2020). The technique of making charcoal briquettes is relatively simple and can be executed by the community independently (Bhatkar et al., 2017); (Putra et al., 2021); (Romallosa, 2017); (Kowalski et al., 2018); (Fadeyibi & Adebayo, 2021) and (Yuliati et al., 2022).

Charcoal briquettes are a form of solid fuel made by mixing certain materials with adhesive substances and compressing them with a specific force. Tapioca flour is often used as an adhesive because of its high binding power (Nuwa & Prihanika, 2018) and (Permatasari IY, 2015). Other commonly used adhesive materials include sago starch and CPO liquid waste (Purnama et al., 2012); (Samrin, 2019). There have been economic analyses conducted regarding the prospects of the briquette charcoal business (Mulyati, 2016; Yuliati et al., 2021); (Rahul K & Sreenivasan, 2019).

Based on the analysis of the situation, technological developments, and business prospects, residents of the Kedung Klinter Surabaya community require training in processing dry leaf waste to produce charcoal briquettes. Training and assistance activities on the use of organic waste were initiated by the Department of Cleanliness and Green Open Space (Dinas Kebersihan dan Ruang Terbuka Hijau/ DKRTH) in collaboration with the Appropriate Technology (Teknologi Tepat Guna/ TTG) briquette team from the Faculty of Engineering at Widya Mandala Catholic University, Surabaya. The activities include educational programs, workshops, training, consultations, and community assistance, especially in the Greater Surabaya area, to manage organic waste into a new and renewable energy source, bio-briquettes (charcoal briquettes).

Socialization and education for the public on waste management and waste reduction via the 3R program (reduce, reuse, recycle) aim to promote charcoal briquettes as an alternative energy source. Kedungdoro Village in Tegalsari District is one of the villages with high commitment to be involved in this charcoal briquette initiative. The training event for making charcoal briquettes, held at RW III Kedung Klinter Hall, was attended by more than 25 residents representing every RW in Kedungdoro Village. The objectives of this activity are: (1) assist the community in managing and processing waste from residents' homes to control, reduce, utilize, and recycle it, especially for alternative energy use in the form of bio-briquettes; (2) provide community assistance in managing organic waste for renewable alternative energy use, thereby contributing to Surabaya's vision of a smart city based on a smart environment; and (3) educate the public about the business prospects of organic waste charcoal briquettes, fostering a sustainable, circular economy that supports community growth and development.

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METHOD

The training and assistance activities to use alternative energy, specifically charcoal briquettes from organic waste, were conducted on Wednesday, March 4, 2020, at Balai RW III, Jl. Kedung Klinter I/71, Kedungdoro Village, Tegalsari District, Surabaya, from 09:00 until completion. There are 25 participants from various RWs in Kedungdoro Village attended the training. The instructors were the UKWMS Briquette team, comprising multidisciplinary lecturers from the engineering faculty, supported by electrical engineering and chemical engineering students who prepared the demo/practical equipment.

The event schedules were as follows:

- Welcome speech by Mr. Ir. Joelianto MP, Head of the DKRTH Community Empowerment Subdivision.
- Greetings from UKWMS by Ir. Hadi Santosa, MM., IPM.
- Presentation of Workshop I material, "Making Charcoal Briquettes from Organic Waste," by Dr. Ir. Suratno Lourentius, MS., IPM.
- Presentation of Workshop III material, "Prospects for Charcoal Briquette Business from Organic Waste," by Ir. Yuliati, S.Si, MT, IPM.
- Questions and answers, along with a demo and practice of making charcoal briquettes from dry leaf waste, assisted by students from the Chemical Engineering and Electrical Engineering departments.

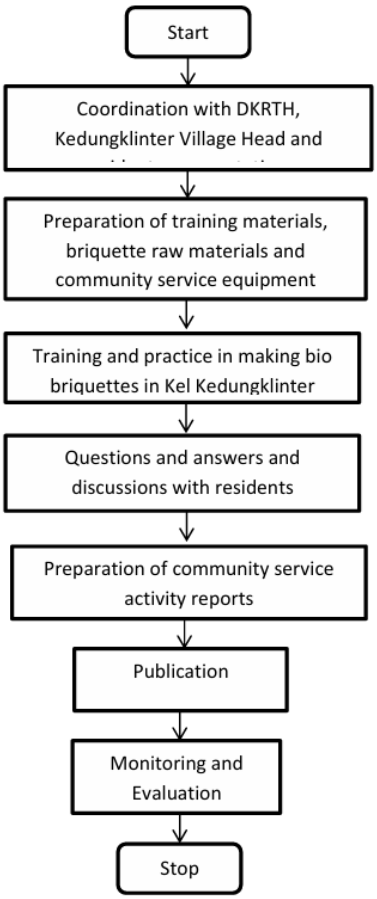

FIGURE 1. Stages of Implementing Community Service

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RESULTS AND DISCUSSION

Discussion

Educational activities in training and practice in making bio briquettes

Community service activities regarding the management and utilization of both non-organic and organic waste have been carried out (Hasan & Setiawati, 2024). Training on making briquettes from rice husk waste or agricultural waste has also been carried out (Oktafia et al., 2024) and (Setiawan et al., 2023). However, this raw material is relatively difficult to obtain in urban areas. Therefore, in this community service activity, raw materials are used from dry leaves from felling trees which are often found in urban areas in anticipation of the rainy season. This community service activity was attended by no less than 25 participants who were residents of the Kedung Klinter Surabaya community. This training was carried out at RW III Hall, facilitated by the Department of Cleanliness and Green Open Space (DKRTH) of the Municipality of Surabaya. This activity began with an opening by the Head of Kedung Klinter Village, as well as welcoming remarks from the head of the DKRTH section. This community service activity was attended by no less than 25 participants who were residents of the Kedung Klinter Surabaya community. This training was carried out at RW III Hall, facilitated by the Department of Cleanliness and Green Open Space (DKRTH) of the Municipality of Surabaya. This activity began with an opening by the Head of Kedung Klinter Village, as well as welcoming remarks from the head of the DKRTH section. In general, this activity includes educating residents in the form of providing counseling and training to residents on how to process dry leaf waste into bio briquettes. The community is also given the opportunity to practice directly making bio briquettes starting from the stage of making charcoal, mixing the tapioca flour adhesive, molding the briquettes in a press and drying them.

A. Problem Identification

Based on the background of the problem and the information survey conducted, several issues within the Kedungklinter Surabaya community can be identified as follows:

- Increasing Waste Volume and Limited Public Knowledge: The volume of waste around the Kedungklinter Surabaya residents is increasing. However, public knowledge about diversifying waste management and processing is limited. Many residents do not know how to control and process waste, particularly organic waste, in ways that are more useful and have greater business potential.
- Need for Knowledge on Making Charcoal Briquettes: Community members require knowledge about techniques for making charcoal briquettes from organic waste such as dry leaves, twigs, rice husks, reeds, and sawdust, which are commonly found in their living environment as a renewable alternative energy source.
- Desire for Cost-Effective Waste Processing: Community members are seeking ways to process waste with minimal costs.
- Need for Knowledge on Business Prospects: Community members need information on the business prospects for charcoal briquettes made from organic waste.

B. Objectives of Community Service Activities

Utilizing alternative energy bio-briquettes from organic waste is the aim of the community service and assistance. Dinas Kebersihan dan Ruang Terbuka Hijau/ DKRTH of the City of Surabaya together with a team at the Faculty of Engineering, Widya Mandala Catholic University, Surabaya conduct the following community service:

- Education and Empowerment: Educate and empower the Kedungdoro Village community through training programs and assisting residents in making charcoal briquettes from organic waste.

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- Organic Waste Management: Assist the community in managing organic waste to create a smart city based on a smart environment in Surabaya, particularly in the use of renewable alternative energy.
- Economic Education: Educate the public about the business prospects of organic waste charcoal briquettes to foster a sustainable economy (circular economy) that enables residents to grow and develop.

C. Strategy

The problem-solving strategies employed by the community service team using appropriate technology for producing charcoal briquettes from organic waste include:

- Collaboration and Cooperation: Establishing strong collaboration and cooperation between universities, specifically the Faculty of Engineering at Widya Mandala Catholic University, Surabaya (FT-UKWMS), and Space (Dinas Kebersihan dan Ruang Terbuka Hijau/ DKRTH of the City of Surabaya Government.
- Educational Materials: Creating teaching aids in the form of briquette printing tools, and preparing modules and training videos as learning media for community members to easily understand the steps and methods in making charcoal briquettes from organic waste. (https://www.youtube.com/watch?v=mKVzGmpayPs)
- Training and Mentoring: Providing training and mentoring for Kedung Klinter community members on the process of making bio-briquettes from dry leaf organic waste.

D. Execution

The FT-UKWMS team and the DKRTH team prepare plans and strategies based on the problem identification and discussion with the community to empower the urban community to manage and process organic waste into charcoal briquettes. This empowerment activities also include the business prospect of implementing the briquette production such as:

- Workshop Activities: The DKRTH Surabaya City Government organized workshop activities for assistance and development of alternative energy in the community. Resource persons from the Appropriate Technology team at the Faculty of Engineering, Widya Mandala Catholic University Surabaya (UKWMS), led the sessions. Training and assistance activities focused on using briquettes made from organic waste and were attended with great enthusiasm by environmental cadres from the Kedungdoro sub-district, Surabaya. Figure 2 shows the situation of the activities including the participants.

FIGURE 2. Implementation of Training

- The training and assistance activities for utilizing alternative energy, specifically charcoal briquettes from organic waste, took place on Wednesday, March 4, 2020, at Balai RW III, Jl.

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Kedung Klinter I/71, Kedungdoro Village, Tegalsari District, Surabaya, from 09:00 until completion. Approximately 25 participants from various RWs in Kedungdoro Village attended the training.

- Students from the Electrical Engineering and Chemical Engineering Departments also assist the team during the training. Figure 3 shows the situation.

FIGURE 3. Student involvement in Community Service

- Residents have the opportunity to practice making charcoal briquettes from dry leaf waste themselves. Figure 4 shows the activity.

FIGURE 4. Practice of making Bio-Briquettes

- The process of creating the charcoal briquettes stats with mixing the compost of the organic waste, mixing the with the tapioca glue and then press the mix into the charcoal cylinder.
- During the training process participants can ask question directly related to the presentation the practical activities to ensure that the residents thoroughly understand the process and can make good briquettes. Figure 5 shows the situation during question and answer session

FIGURE 5. Discussions and Questions and Answers

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- After the entire process comes to an end, the participant evaluate all the activities and give feedback for the entire process from the introduction, training and question/ answer session. Figure 6 shows the evaluation session.

FIGURE 6. Filling out Questionnaires Activity

The Results of Community Service Activity

The results of this Community Service activity include:

1. The community increases their knowledge and skills in making bio briquettes from dry leaf waste. This was seen during direct practical activities where they were able to make bio briquettes during independent practice sessions

2. At the end of the activity, participants were given a questionnaire regarding their responses to this training activity. In general, they thought that this activity was useful in increasing their knowledge and skills in processing organic waste into bio briquettes. Table 1 shows the comments and suggestions from the participant.

TABLE 1. The Results of The Questionnaire

Name	Descriptions
Dhendry Sinta	This training provides knowledge and skills in processing waste into briquettes
Siti Chotimah	It needs to be developed for training in processing other organic waste such as used cooking oil
Moedji Astadi	Development of briquette printing equipment that is easy to operate and cheap
Moch Rahim	Further training is needed on how to market these bio briquettes

CONCLUSION

This community service initiative is designed as a comprehensive program encompassing counseling, training, and practical sessions for residents to process dry leaf waste into bio-briquette charcoal. Community members displayed high enthusiasm and active participation throughout all stages of the activities. They significantly expanded their understanding and capabilities in managing and utilizing organic waste for charcoal briquette production.

The initiative has spurred improvements, innovations, and ongoing efforts aimed at enhancing the quality of community-produced briquettes. This includes advancements in briquette printing equipment, stove technology, and the composition of charcoal briquette materials. The increased knowledge and

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skills within the community have not only promoted environmental sustainability but also unlocked economic opportunities through the production of charcoal briquettes.

To ensure the sustainability of these activities, it is essential to continue organizing them in each sub-district, fostering strong collaboration between DKRTH services, universities, and the city government. This synergy will further support the long-term success and impact of community service initiatives focused on waste management and renewable energy.

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