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Converting Corn Cobs into Briquettes in Braja Harjosari Village, Braja Salebah Subdistrict, East Lampung Regency

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A B S T R A K

Tongkol jagung, salah satu limbah pertanian umum di Indonesia, dapat diubah menjadi bahan bakar terbarukan berbasis kayu. Karbonisasi (pirolisis) yang dilanjutkan dengan pembuatan briket merupakan cara efektif mengolah biomassa menjadi bahan bakar padat berbasis arang. Survei di Desa Braja Harjosari menemukan bahwa limbah tongkol jagung sering dibuang, menimbulkan masalah sanitasi dan kesehatan. Pengolahan limbah ini menjadi briket arang menambah nilai ekonomi sekaligus mendukung prinsip zero-waste dalam pertanian. Dengan memanfaatkan potensi lokal serta kerja sama dengan kelompok tani, masyarakat, dan pemerintah desa, dilaksanakan proyek percontohan pengolahan tongkol jagung menjadi briket. Produktivitas ditingkatkan melalui pelatihan teknis dan pendampingan produksi, sehingga masyarakat dapat mengoptimalkan sumber daya sambil mengatasi tantangan lingkungan.

Kata kunci: Bioarang, Briket, Pirolisis, *Zero Waste System*

A B S T R A C T

Corn cobs are agricultural waste that can be processed into an alternative firewood. Carbonization (pyrolysis) followed by briquetting is one method to process biomass into solid charcoal. According to a survey conducted, the large amount of corn cob waste is due to a lack of knowledge in processing waste, which causes health and environmental problems. Converting corn cob waste into briquettes transforms it into a valuable commodity. In fact, transforming corn cob waste is essentially applying the zero-waste concept to agricultural production systems. Based on potential and agreements with farmer groups, community members, and local government, this service activity was carried out. The productivity of the briquette charcoal business made from corn waste is increased through training and assistance.

Keywords: *Biocharcoal, Briquettes, Pyrolysis, Zero Waste System*

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INTRODUCTION

As an agricultural country, Indonesia has abundant biomass energy resources. One of Indonesia's potential biomass energy sources is agricultural waste, such as rice husks, straw, sugarcane bagasse, corn stalks and cobs, and other agricultural and plantation waste. One agricultural waste that is quite promising for processing into alternative firewood is corn cobs, which are abundant but not fully utilized. Corn cobs are the part of the corn remaining after the kernels are removed. The husks and cobs contain high levels of cellulose fibre, making them suitable as raw material for the production of art paper.

Corn is a raw material for various products such as corn flour, corn starch, corn oil, and animal feed. From each corn harvest, it is estimated that approximately 65% is corn (yield), while 35% is waste in the form of stalks, leaves, husks, and corn cobs (Maqsood, et al., 2025).

According to data from the Lampung PPID (2022), corn is the second most important food commodity after rice, with a production of 3,280,952 tons in 2022. From this corn production, it is estimated that 328,095.2 tons of corn cobs will be generated annually. The high percentage of corn cobs can cause many environmental problems.

Braja Harjosari Village is situated in Braja Salebah Subdistrict, East Lampung Regency, where the majority of the area consists of agricultural land. The agricultural land in the village consists of rice fields and plantations. In addition to rice, many agricultural lands in Braja Harjosari are also planted with corn, as shown in Figure 1.

Figure 1. Corn Field in Braja Harjosari Village, Braja Salebah Subdistrict, East Lampung Regency.

One potential use of corn biomass waste is as a raw material for the production of biochar (biological charcoal). Biochar is a solid product of the pyrolysis process or heating of biomass under limited oxygen conditions (Haryanto, et al., 2021; Hidayat, et al., 2017). Biochar is an environmentally friendly, economical material that can be used for various purposes, such as soil remediation, waste management, greenhouse gas reduction, and energy production (Hidayat, et al., 2021). Therefore, corn cob conversion into biochar not only increases soil properties but also reduces carbon loss from agricultural waste (Nurida, Salma, & Jubaedah, 2023).

After corn is harvested and dried, the next processing step involves separating the corn from its cobs. This agricultural processing results in corn as a food and in corn cob waste, which is considered a byproduct. Typically, corn cob waste generated after separating corn from its cobs is regarded by Riniarti, et al. (2021) and Wijaya et al. (2022), as trash and discarded without further consideration. This waste is often disposed of around residential areas. Thus, every corn harvest will always result in piles or even mountains of corn cobs that grow taller over time.

Corn cob waste that is discarded and forms piles of garbage that grow taller if processed naturally breaks down slowly, so the waste not only disrupts the health and cleanliness of the surrounding environment but also affects human health. Residents often burn the piles of corn cobs that have been accumulated. Burning corn cobs consequently produces smoke that can disturb and pollute the environment, as seen in Figure 2.

Figure 2. Corn Harvest and Piles of Burnt Corn Cobs.

Figure 2 indicates that corn cobs are still not being utilized, so they remain a waste material that pollutes the environment. However, corn cobs are a form of biomass that has not been optimally utilized and has a relatively high calorific value.

Agricultural waste can be converted into alternative fuel through prior processing. One method of processing agricultural waste into an alternative solid fuel is through carbonization (pyrolysis) followed by briquetting. Carbonization minimizes the formation of smoke and soot components, resulting in cleaner exhaust gases. Briquetting reduces space requirements, improves combustion quality, and makes usage more practical (Agustinus, et al., 2024; Gani, et al., 2023).

Charcoal produced from sugarcane bagasse during carbonization has its carbon content influenced by the temperature during the carbonization process. When the temperature in the carbonization process is gradually increased from 320°C to 600°C, there is an increase in the carbon content of the resulting charcoal (Zandersons, et al., 1999).

Charcoal briquettes are solid fuel containing carbon, have a high calorific value, and can burn for an extended period. Charcoal briquettes are also an alternative energy source to replace kerosene and liquefied petroleum gas (LPG). Through the process of burning dry biomass without air (pyrolysis), biochar is obtained, which is then processed into briquettes. Biomass is organic material derived from living organisms. Biomass can actually be used directly as a heat energy source for solid fuel. By converting corn cobs into briquettes, the economic value of the material is increased, and environmental pollution is minimized. Corn cobs are used as briquette material because they are easily available as production waste. Additionally, using briquettes made from corn cob charcoal can save costs on purchasing kerosene or LPG. Utilizing corn cob charcoal as a briquette material enhances the utilization of agricultural waste while reducing pollution, as corn cobs are typically burned without further processing.

Based on the results of the team's visit to Braja Harjosari Subdistrict, East Lampung, a clear picture of the situation was obtained. It was found that many problems were caused by corn cob waste resulting from agricultural productivity. Until now, corn cob waste has been discarded, left to pile up, and then burned. Many residents have complained about the environment and air pollution around the pile due to this waste. The main causes of suboptimal waste management are low awareness and a lack of knowledge and skills among farmers in utilizing and processing corn cob waste into economically valuable products.

However, if properly processed, corn waste can be managed and can increase residents' income. Agricultural waste can be converted into an alternative fuel through processing. One method of processing agricultural waste into alternative fuel is through carbonization followed by briquetting. Carbonization minimizes the formation of smoke and soot components, resulting in cleaner emissions. Briquetting reduces space requirements, improves combustion quality, and makes usage more practical.

Farmers can utilize and process corn cobs into products that reduce the impact of waste. These include biochar briquettes, planting media, and organic fertilizer. They can also produce solid fuel

(bioenergy) for farmers' needs, saving fossil fuels, and potentially strengthening the farmers' economy.

Utilizing waste minimizes corn cob pollution in the environment and prevents air pollution caused by burning. The biochar briquettes produced have the advantage of being excellent as a solid fuel that burns evenly and stably. Corn cob biochar briquettes as an alternative bioenergy source are a choice for the community. Burning biochar briquettes does not produce toxic gas emissions such as NOx and SOx, which are produced when burning coal briquettes. Another advantage is the availability of biofuel for farmers' needs, fossil fuel savings, and the potential to strengthen farmers' economies.

Therefore, when the team conducted a survey, many farmers' group members expressed a strong desire to be trained and implement pyrolysis technology. It is indeed a challenge for the staff of the Department of Mathematics at FMIPA, Universitas Lampung, to provide skills to farmers in general and members of the Braja Salebah sub-district farmers' group in particular in utilizing corn cob waste as an alternative energy source (briquettes). Thus, corn cob waste can be reduced, and family income can be increased.

PROBLEM IDENTIFICATION

Corn cobs are agricultural waste commonly found in Indonesia, one example being in the village of Braja Harjosari, which causes environmental hygiene and health problems. Corn cobs can be processed into charcoal briquettes, which are an alternative solid fuel. The technology used to produce charcoal briquettes is pyrolysis. By utilizing corn cobs to produce briquettes, waste can be transformed into something of economic value.

IMPLEMENTATION METHODS

The methods used in this community service activity are lectures, selected topic presentations, question and answer sessions, demonstrations, training, and mentoring of the practices. The lecture method is combined with images and animations using displays, enabling a relatively large amount of material to be presented in a concise, fast, and easy manner. This is followed by entrepreneurship mentoring.

RESULTS AND DISCUSSION

The community service activity was conducted from August 25 to 26, 2023. The activity took place in Braja Harjosari Village, Braja Salebah Sub-district, East Lampung. The activity was held in the hall and courtyard of the Braja Harjosari Village Office, Braja Salebah Sub-district, East Lampung, and was attended by 16 participants consisting of farmers' groups, housewives, and PKK activists.

On the first day, August 25, 2023, the activity began at 8:00 AM and ended at 4:00 PM. The first day's activities consisted of lectures, slide presentations, and question-and-answer sessions on bio-briquette technology, the briquette-making process, the use of corn cobs in briquette production, entrepreneurship techniques, and how to sell products on social media.

The event began with a lecture explaining the bio-briquette technology. The explanation was delivered through slides and demonstrations. First, the process of obtaining charcoal from biomass through pyrolysis (without air) was explained. This explanation of the pyrolysis process is crucial, as improper charcoal production may result in only ash. Subsequently, the process of making briquettes from the produced charcoal was explained. After the presentation of the first session, the event continued with a presentation on making corn cob briquettes, followed by the preparation of materials and tools to be used for the corn cob briquette-making practice the next day.

The production of corn cob briquettes is done in several stages. Each stage aims to process the material into a specific piece before sending it to the next stage. The flowchart in Figure 3 shows the complete stages of this briquette production.

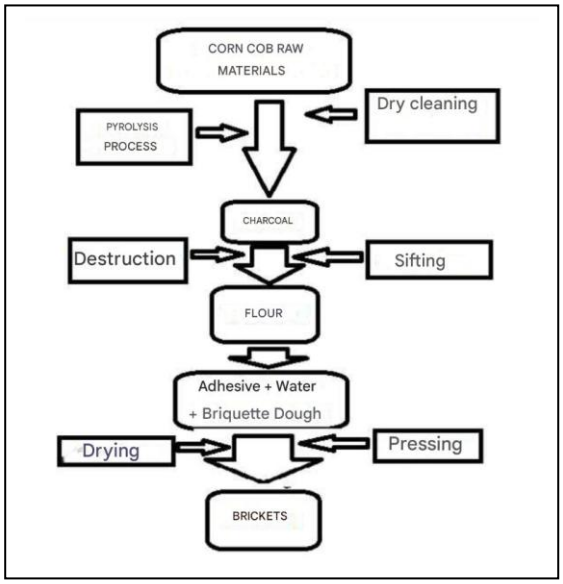

Figure 3. Flowchart of Briquette Production.

The process begins with preparing corn cobs, which can be obtained from the surrounding village area. The collected corn cobs are then cleaned and dried by sun-drying under direct sunlight or in an oven. The dried corn cobs facilitate the subsequent process of pyrolysis. Pyrolysis is performed to extract carbon from the corn cobs. Pyrolysis is carried out using a perforated iron drum as a smoke exhaust device.

The result of the pyrolysis process is corn cob charcoal. Since this charcoal is still large in size, the process continues with grinding the charcoal until it is fine. This grinding can be done using a mortar and pestle. After the charcoal is fine, it is sieved, resulting in charcoal dust.

The process continues with the production of adhesive/glue, consisting of water and sago flour. After that, the corn cob charcoal dust is blended with the adhesive and stirred until the charcoal dust is well mixed.

Once the briquette mixture is well combined, the process continues with moulding and pressing the briquettes using press equipment. The moulded briquettes are then dried in the sun or in an oven. The production process is complete.

After the briquette production is delivered to participants, the topic of Entrepreneurship Techniques and Selling Products on social media is covered. This topic introduces Entrepreneurship Techniques and Selling Products on social media. The social media platforms to be used, various applications, and how to use them are discussed. Next, the next process is downloading each application and understanding how to use it. The photo in Figure 4 is the documentation of these activities.

Figure 4. Presentation on Briquette Production (Left) and Social Media for Product Marketing (Right).

The second day of activities on August 26, 2023, began at 8:00 a.m. and ended at 4:15 p.m. The activities consist of surveying the location of corn cob waste, followed by a practical session on making corn briquettes. The practical session began with collecting corn cobs and separating the dry and wet ones. The dry corn cobs were placed into a combustion drum. The corn cobs were then processed through pyrolysis, as shown in Figure 5.

Figure 5. Production of Corn Cob Charcoal Through Pyrolysis.

After the corn cobs have been turned into charcoal, the process continues by grinding the charcoal into a fine powder. This process can be done simultaneously with the production of starch glue. Mix the starch with the charcoal powder until well combined. Then mold the mixture into the prepared molds and sun-dry the molded briquettes. If the weather is sunny, the briquettes can be sun-dried for 3 days. This practical activity is carried out together with the community and assisted by two student volunteers to ensure the smooth running of the activity. These practical activities can be seen in Figure 6.

Figure 6. Participants Making Briquettes and The Resulting Briquettes.

The community service activities were carried out smoothly and successfully. Participants were enthusiastically involved in the training throughout the event, as evidenced by their active engagement in asking questions and following the instructor's guidance. This aligns with the results of the questionnaire on training methods shown in Figure 7. Over 50% of participants responded that the training methods used were appropriate for the material and encouraged participants to be more active.

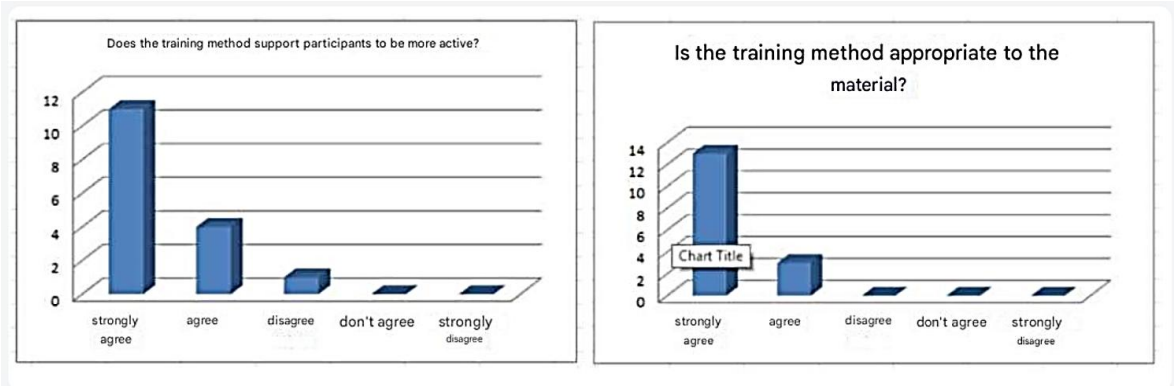

Figure 7. Results of The Training Method Satisfaction Questionnaire.

Furthermore, the participants' high enthusiasm for attending the training was due to the useful and relevant topic presented. The activity is not only keeping the environment safe and clean but also producing economically valuable items. These facts can be analyzed from the answers to the participant questionnaire in Figure 8.

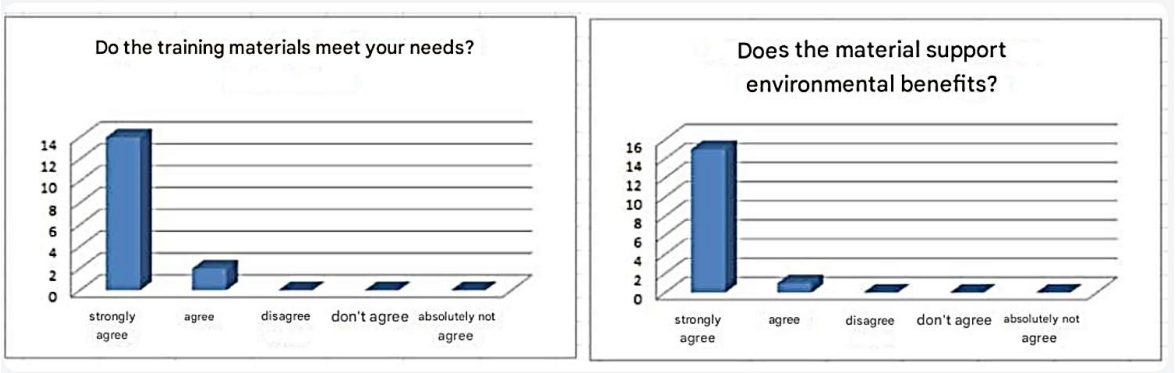

Figure 8. Results of The Training Usefulness and Relevant Material Questionnaire.

CONCLUSION

Based on the results and discussion, the community service activity in the form of training and practice in making briquettes using corn cobs as raw material was carried out successfully and was able to improve the participants' ability to utilize corn cobs into economically valuable materials. Participants responded very positively to this activity, as seen during the briquette-making practice, where participants listened attentively and participated enthusiastically. All participants felt the benefits of the training and will try to apply the results of the training and share their skills with the surrounding community.

Acknowledgments

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