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CORN COMMODITY DIVERSIFICATION POLICY AND IMPLEMENTATION OF A CIRCULAR ECONOMY: STEPS TOWARDS SUSTAINABLE AGRICULTURE IN BONE BOLANGO DISTRICT

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Abstract: This research is motivated by the importance of conserving corn plants by implementing the concept of sustainable agriculture using organic fertilizer. Researchers emphasize that the formulation of the problem of corn commodity diversification is the right step in overcoming economic challenges, especially in the context of a very comprehensive circular economy, a circular economy can maximize added value from each stage of production. This process supports the circular economy concept which focuses on the efficient and sustainable use of natural resources. By harnessing the full potential of corn, from seeds to waste, the circular economy can create a more sustainable value circle. The aim of this research is to analyze and present the implementation of a circular economy in corn crops by: 1) organic fertilizer can replace chemical fertilizer subsidies; 2) corn milk products can prevent and reduce the prevalence of stunting; 3) Corn cob waste can be used by farmers to make briquettes which have sales value. The research method used is a mixed method approach or a combination of qualitative and quantitative methods through: 1) direct observation carried out for four months on corn production activities; 2) interviews with key informants; 3) looking at literature. The research results show that: 1) liquid organic fertilizer from banana peel waste is effectively implemented because it can reduce production costs and is able to provide soil nutrition; 2) providing nutrition in corn milk has a positive impact as protein helps form muscle tissue, improves cell performance, and strengthens the immune system so that it can reduce stunting rates; 3) utilization of corn cob waste into effective briquettes in providing long-term solutions to agricultural sustainability.

Keywords: Organic fertilizer; Corn; Stunting Prevalence Policy

Introduction

Sustainable agriculture is increasingly receiving attention in Indonesia. Many farmers are turning to organic systems to meet the increasing demand for organic products. In terms of improving soil fertility and maintaining the balance of the soil ecosystem, Dadi, D. (2021) explains that the use of compost and manure in organic farming adds organic matter to the soil, which increases the soil's capacity to hold air and nutrients. Additionally organic practices support healthy populations of microorganisms, which aid in the decomposition of organic matter and provide plant nutrition. Meanwhile, Arif, A. (2015) added that organic products do not use synthetic pesticides which can leave residue on food. Consuming foods that are free from sensitivity residues reduces the risk of exposure to chemicals that are potentially harmful to human health.

The implementation of sustainable agriculture is driven by the desire to protect the environment, reduce industrial waste, and utilize natural resources responsibly. This not only contributes to environmental health, but also meets the needs of a society that is increasingly concerned about the nutritional value and manufacturing standards of food and beverages. The use of liquid organic fertilizer is an effective alternative to overcome the policy of reducing rationed fertilizer subsidies, increasing soil fertility and supporting plant growth. Corn in Indonesia is not only the second food ingredient after rice, but also an alternative substitute for rice and animal feed. From corn oil, flour, milk and cereal can be produced. The waste can also be utilized, creating additional economic value. Nainggolan, (2023).

As the economy and animal feed industry grow, demand for corn increases. Gorontalo Province has high corn production, with production reaching 715,781 tons in 2014 and reaching 643,513 tons in 2017 (Gorontalo Province Central Statistics Agency), especially in Bone Bolango Regency which is the largest corn producer in Gorontalo Province with a harvest reaching 14,430 tons. in 2017 (Bone Bolango Central Statistics Agency, 2018). However, processing corn also causes ecological problems, such as burning corn cob waste. By converting corn cobs into briquettes you can reduce waste and support local economic development (Zulkarnaini, Khasman, & Ulhaq, C.D. 2023).

This research focuses on the problems of sustainable agriculture in Bone Bolango Regency related to corn farming activities which cause various ecological impacts, including: (1) farmers' dependence on chemical fertilizers which causes soil degradation and high fertilizer prices, as well as the lack of preservation of liquid organic fertilizers which more environmentally friendly; (2) burning corn cob waste which can still be used as a basic material for the production of charcoal briquettes, thereby reducing waste and providing an alternative energy source; (3) there is no use of corn food products as additional nutrition for farmer children in efforts to prevent stunting; and (4) agricultural practices that are not optimal in managing available natural resources, which have an impact on the loss of the environment and the welfare of farmers. Widarti (2016) stated that charcoal briquettes from corn cobs can be used as an alternative fuel that is environmentally friendly and cheaper than fossil fuels.

Diversifying corn commodities not only affects food and energy security, but can also be a solution to reduce stunting rates in Bone Bolango Regency. Hawi, (2020) stated that in 2017 22.2% or around 150.8 million children under five in the world experienced stunting. Data on stunting sufferers as stated (Ministry of Health, 2018) shows that the average number of toddlers suffering from stunting in 2005-2017 was 36.4%. Currently, 9 million or more of the total number of children under five (37.2%) in Indonesia suffer from stunting. The 2017 Nutritional Status Monitoring (PSG) shows that the prevalence of stunted toddlers in Indonesia is still high, namely 29.6%. According to Efendi (2015), corn-derived food products have health benefits, such as fighting cancer, preventing anemia, and supporting the immune system. Corn milk as a source of vegetable protein can help overcome the problem of stunting by providing nutrition to toddlers (Setiyono, et. al 2020). With the abundant benefits of corn and the vast area of corn plantations, processing corn into corn milk can be a positive step to overcome the stunting problem in Bone Bolango Regency.

Farmers in Bone Bolango Regency face the problem of reducing subsidies for fertilizer rations, which has an impact on agricultural yields and expenditure costs. Liquid organic fertilizer solutions have emerged as an affordable alternative and are easy to find in the surrounding environment. Corn milk innovation can be the right step in preventing stunting in toddlers in Bone Bolango Regency, with ingredients that are easy to process. Corn cob waste, which is usually thrown away, can be processed into briquettes with high selling value, providing great opportunities in a market that is still rarely found. Based on the urgency of the problem above, this research aims to: 1) analyze the potential for using liquid organic fertilizer as a substitute for subsidized chemical fertilizer with the aim of reducing negative impacts on soil and the environment; 2) develop and evaluate the use of processed corn products to make corn milk in an effort to prevent stunting among farmer children; 3) promote the processing of corn cob waste into charcoal briquettes to reduce agricultural waste, and provide an alternative source that is environmentally friendly, and provides added economic value for farmers; 4) identify and formulate strategies for sustainable agricultural practices in Bone Bolango Regency

Methodology

This article uses a mixed method approach or a combination of quantitative and qualitative methods as follows; 1) Direct observations were carried out for four months on corn production activities and waste utilization in Bone Bolango Regency, Gorontalo Province; 2) Interviews with 76 respondents conducted from January – March 2024, including government officials, farmers and communities in the Bone Bolango Regency area; 3) Literature review of corn production results using secondary data for research to obtain information that supports the topic.

Data analysis used in qualitative research is an interactive model analysis consisting of three components of analysis namely: 1) Data reduction; 2) Data Presentation; 3) Data Verification and Conclusion Drawing. Miles, M. B, Huberman, A. M, Dan Saldana (2014).

Result and Discussion

In the results and discussion of this article, researchers explore various aspects related to the research objective, namely to see the effectiveness of liquid organic fertilizer as a more environmentally friendly and economical alternative compared to subsidized chemical fertilizers. The results show significant potential in increasing soil fertility as well as reducing farmers' dependence on expensive chemical fertilizers(Alori, 2017; Carvalho, 2017; Hartmann, 2015). Furthermore, researchers will also explain the benefits of corn milk as a processed product that is rich in nutrients for farmer children. The findings show that corn milk can play an important role in increasing nutritional intake and preventing stunting, providing an innovative health solution for farming communities. Apart from that, researchers are also evaluating the process of processing corn cob waste into charcoal briquettes as an effort to reduce agricultural waste and provide an alternative energy source. The results show that charcoal briquettes from corn cobs can be a sustainable and economical solution to overcome waste problems and energy needs. To discuss it in more depth, describe it in the following sub-chapter:

1. Potential use of organic fertilizer as a substitute for subsidized chemical fertilizer

Sustainable agriculture aims to increase farmers' income and sustain production by paying attention to the ecosystem. The benefits include preserving land, protecting the environment, ensuring farmers' income, energy conservation, increasing productivity, and food security. Organic farming systems are a clear example of sustainable agricultural practices with a primary focus on environmental protection. By not using chemicals, organic farming creates an optimal agroecosystem socially, ecologically, economically and ethically, Recanati, F., & Guariso, G. (2018).

Sustainable agriculture in Bone Bolango Regency can be realized through making organic fertilizer from fruit, vegetable waste, banana peels, market waste, household waste and other organic materials. Liquid organic fertilizer (POC) is a superior choice with easier application, efficient nutrient absorption, and high microorganism content. Banana peel waste is the main focus, because it is abundantly available and easy to get by asking people who sell fried foods or taking it from trash in the market. Apart from that, banana peels are also rich in nutrients such as N, P, K, Ca, Mg, Na, and Za are essential for corn plants. The use of liquid organic fertilizer from banana peels has proven to be effective in increasing the growth of corn plants, so it is a solution to improve production quality with proper application, Serna-Jiménez, (2021).

Based on the SWOT analysis of the IFAS and EFAS matrices, it shows that liquid organic fertilizer from banana peel waste has the main strength in terms of cost. affordable production and the ability to provide soil nutrition. A big opportunity comes from the READSI program from the Ministry of Agriculture which supports organic farming, while the threat is a decline in interest in farming. With the right strategy, liquid organic fertilizer products from banana peel waste can have a positive impact on farmers by reducing capital costs, utilizing banana peel waste around them.

Based on researchers' experiments in the field, the stages of using liquid organic fertilizer can be carried out using the steps presented in the following picture:

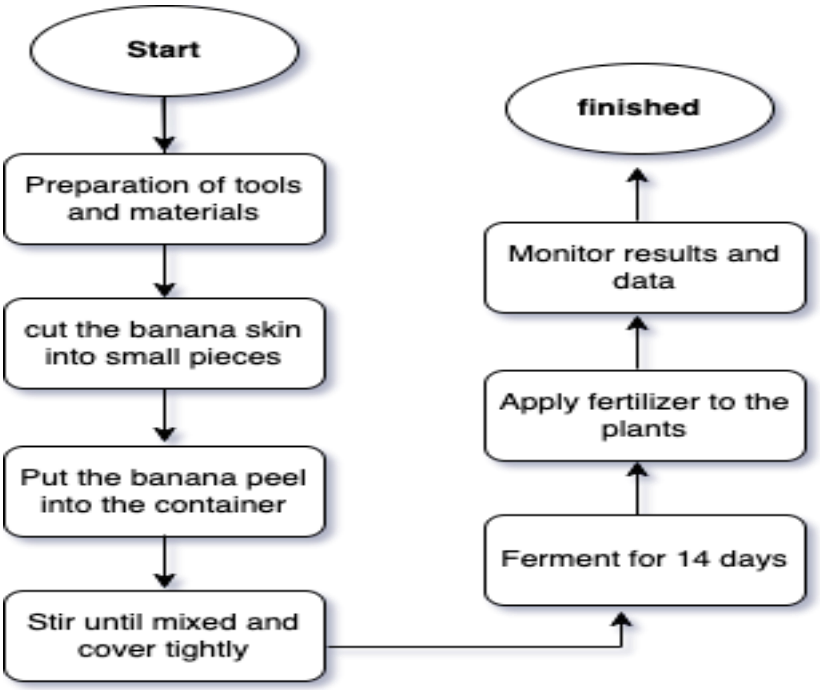

Figure 1: Stages of Making Banana Peel Liquid Organic Fertilizer

Based on the research results, the following researchers describe the stages in making liquid organic fertilizer from banana peel waste, including: 1) Preparing tools such as knives, cutting boards, jerry cans, measuring cups and filters. as well as ingredients such as water, banana peels, and sugar that will be used; 2) Cut 1 kilogram of banana peel into small pieces using a knife; 3) Put the banana peel that has been cut into small pieces into the jerry can. 4. Add 1 liter of water; 4) and 100 grams of sugar into a jerry can filled with banana peel pieces; 5) Stir the banana peel pieces, water and sugar until completely mixed, then close the jerry can tightly; 6) Ferment for 14 days and open the lid of the jerry can periodically to remove gas from the fermentation and re-close the lid of the jerry can; 7) After 14 days of fermentation, liquid organic fertilizer from banana peel waste is ready to be applied to plants.

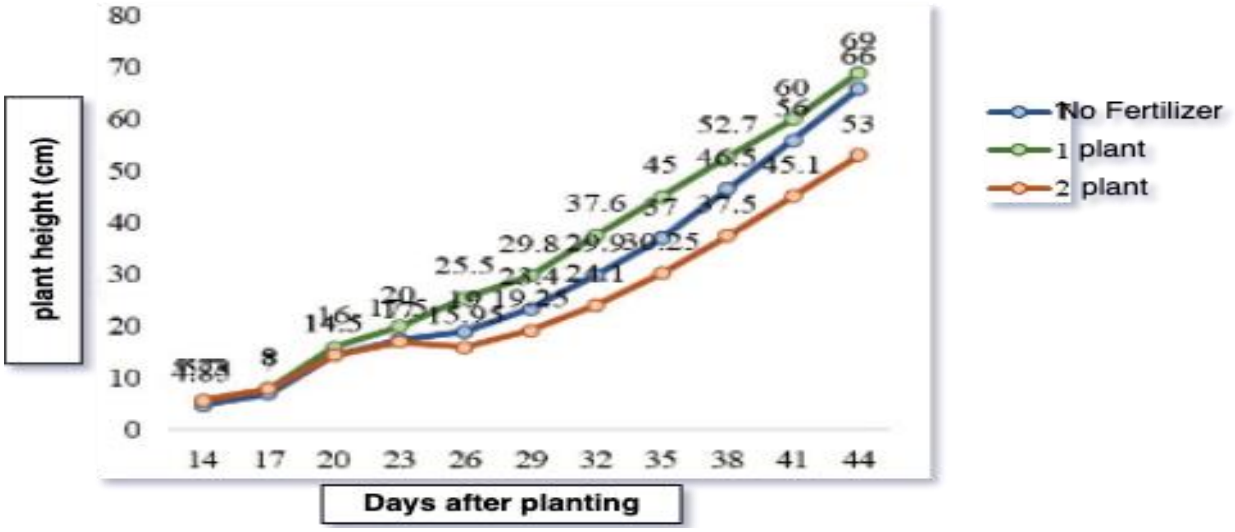

Figure 2 graph of corn plant growth

Based on the picture above, the research results show that banana peels contain many substances that are beneficial for plants when processed into liquid organic fertilizer. One of the main components is potassium, which reaches 42% of the total content. Potassium plays an important role in regulating the photosynthesis process, which has an impact on strengthening plant stems, increasing resistance to disease, and accelerating growth and fruit ripening. Liquid organic fertilizer from banana peels can be an effective and economical alternative to replacing chemical fertilizers. The use of this fertilizer not only helps reduce production costs for farmers, but also supports more environmentally friendly agricultural practices. Santiago (2022) revealed that using banana peels as liquid organic fertilizer reduces organic waste, thereby providing multiple benefits for the environment and the agricultural sector. With a potassium content of 42%, this fertilizer plays an important role in regulating the photosynthesis process, strengthening plant stems, increasing resistance to disease, and accelerating fruit growth and ripening. The use of banana peel waste will reduce the use of subsidized chemical fertilizers. The presence of liquid organic fertilizer from banana peel waste has a real influence on farmers' results and is able to increase crop yields so that liquid organic fertilizer from banana peel waste can indirectly improve the farmers' economy. Utilizing banana peel waste which is processed into organic fertilizer is an effective solution to deal with the main problem faced by the majority of corn farmers, namely the reduction in subsidized fertilizer quotas. If a solution is presented, the level of productivity of corn farming can be maintained and the cost of non-subsidized fertilizer can be reduced.

Through this research, the Bone Bolango Regency government is advised to encourage the use of liquid organic fertilizer from banana peels as an effective and economical alternative to replacing chemical fertilizers. Several policy steps that can be taken include: 1) Holding training and outreach for farmers on how to make and use liquid organic fertilizer from banana peels. This will increase farmers' knowledge and skills in utilizing organic waste efficiently; 2) Support further research and development regarding the effectiveness and benefits of liquid organic fertilizer from banana peels, as well as optimal production techniques; 3) Providing subsidies or incentives to farmers who switch to using liquid organic fertilizer, to encourage wider adoption; and 4) Launch an environmental awareness campaign to educate the public about the benefits of using liquid organic fertilizer from banana peels, as well as the importance of sustainable agricultural practices.

2. Utilization of processed corn products to make corn milk in an effort to prevent stunting

Corn in Tilongkabila District, Bone Bolango Regency is usually only sold raw or used as animal feed. Unfortunately, corn plants have not been utilized optimally to become processed products with high marketability. Even though corn is rich in nutrients, traditional processing such as boiling or frying has reduced people's interest. The potential of corn can be increased by processing it into corn milk, providing added value and a different impression that suits consumer tastes. Trials for making corn milk have been

carried out, but cooperation between the government, community and writers is needed to provide literacy regarding the processing of corn into economically high-value products. From the SWOT analysis of the IFAS and EFAS matrices, the development of practical and hygienic corn milk products as well as collaboration with local MSMEs, has a positive impact on the community's economy. The use of social media and the internet helps maintain the availability of raw materials and marketing. Corn milk products not only increase economic value but also provide health benefits with good nutritional content, contributing to the prevention of stunting in Bone Bolango Regency. The basic ingredients for making corn milk are also very abundant in all areas of Bone Bolango Regency.

Elvinawati (2023) explains that corn milk contains vitamins A, B and E, as well as minerals such as potassium, magnesium and phosphorus. These nutrients are important for the growth and development of children, as well as maintaining healthy bones and teeth. The fiber content in corn milk helps digestion and prevents digestive problems such as constipation. Fiber also helps in regulating blood sugar and cholesterol levels. Meanwhile, Arifan (2022) added that corn milk contains antioxidants which help fight free radicals in the body, reducing the risk of chronic diseases such as heart disease and cancer. The carbohydrates in corn milk provide the energy needed for daily activities, helping children stay active and healthy.

Based on researchers' experiments in the field, the processing stages of corn milk can be carried out using the steps presented in the following image:

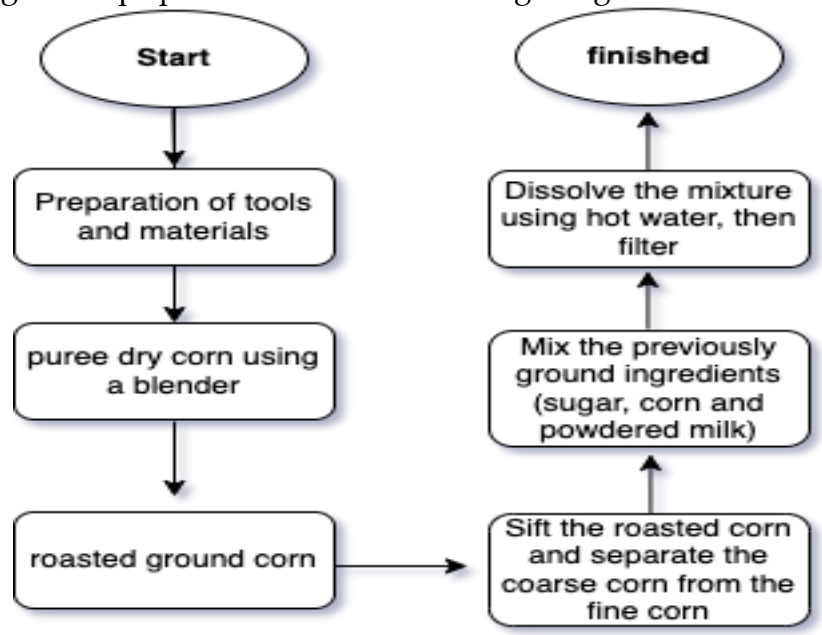

Figure 2: stages of making corn milk

Based on the research results, the following researchers describe the stages in making corn milk including: 1) preparing the tools and materials that will be used in making corn milk; 2) grind the dried corn using a blender until smooth. Setiyono (2020) emphasized that by grinding dried corn, more nutrients and flavor from the corn can be extracted into the water during the milk making process. This produces corn milk that is richer in taste and

nutrients; 3) Roast the corn that has been blended using a frying pan over low heat. Katili (2023) revealed that the roasting process can develop and deepen the taste of corn, giving a more distinctive and delicious aroma to the corn milk produced. Roasting corn helps reduce remaining water content, thereby increasing shelf life and preventing the growth of microorganisms that can spoil corn milk; 4) Sift the corn that has been in the sangria then separate the fine corn from the coarse corn. Sifting corn helps ensure that only truly fine particles are used to make milk, resulting in a product with a uniform, smooth consistency. Burhan (2023) revealed that fine corn particles dissolve more easily in water and release their nutrients, so the corn milk produced will be richer in nutrition; 5) Mix the ground corn, powdered milk, powdered sugar and desired flavoring according to the measurements until evenly mixed. Munawaroh, (2022) added that mixing the ingredients according to the measurements ensures that each component contributes flavor proportionally, so that corn milk has a balanced and delicious taste. Besides that, the added flavors provide the desired aroma and taste to corn milk. Even mixing ensures consistent flavor throughout the product; 6) Pack the corn milk using a bottle and label it as attractively as possible. Packaging in bottles can protect corn milk from contamination, air and light, which can damage the quality and safety of the product. This helps maintain the freshness and taste of the corn milk longer. Besides that, attractive labels can attract consumers' attention, increasing interest in buying. Creative and informative label designs can make products look more professional and appetizing; and 7) Corn milk is ready to be enjoyed and marketed.

Helmyati (2020) emphasized that stunting is a condition where children experience stunted growth due to chronic malnutrition. Corn milk can be part of the solution to preventing stunting by providing an affordable and easily accessible source of nutrition. Regular consumption of corn milk can ensure that children get adequate nutritional intake for optimal growth and development. The following researchers describe the amount of nutritional content of corn in 100 grams:

The benefits of corn milk can provide a source of vegetable protein, help form muscle tissue, improve cell function, and strengthen the immune system. The nutritional content such as carbohydrates, fiber, vitamins, potassium, linoleic acid, folic acid, beta carotene, minerals and protein in corn makes it useful for preventing several diseases. In Setiyono (2020) revealed that corn milk is a plant-based food ingredient which is a source of protein. Protein can help form new muscle tissue and improve cell function in the body. Apart from that, protein can also improve the immune system and increase insulin release. The ingredients contained in corn milk products can help prevent or reduce stunting rates through nutritional requirements. Therefore, corn milk can play a role in preventing and reducing stunting rates in toddlers. This benefit is very relevant in Bone Bolango Regency which has large areas of corn land. Utilizing corn-based processing into corn milk can be a solution to reduce stunting rates.

Through this research, the Bone Bolango Regency government is advised to 1) Educate the public about the health benefits of corn milk and how to process it, through health campaigns and nutritional literacy programs; 2) Holding training for farmers and small businesses to produce corn milk with good quality standards; 3) Regional governments can

provide support in the form of subsidies for raw materials, production facilities and marketing assistance to encourage the production and consumption of corn milk; 4) Building partnerships with food and beverage companies to produce and market corn milk on a larger scale. Because by developing corn milk products, we not only increase the economic value of corn but also contribute to public health, especially in efforts to prevent stunting.

3. Processing corn cob waste into charcoal briquettes

Corn cob waste in Bone Bolango Regency is often thrown away or burned after harvest, of course this causes pollution and environmental losses. Even though this waste is abundant, farmers have not utilized it optimally. In an effort to overcome this problem, corn cob waste can be used as a high-value alternative fuel. Trials on the use of corn cob waste to make briquettes were carried out to increase people's income and reduce environmental pollution. IIIUsing corn cob waste into briquettes not only improves the community's economy, but also supports environmental quality. High-quality briquettes have a fine texture, hardness, and safety for both humans and the environment. Its good ignition characteristics, such as easy ignition, low smoke production, and high heating value, make it an efficient solution. By using briquettes made from corncob waste, production waste can be minimized, and reductions in kerosene or LPG gas costs can be achieved.

From the SWOT analysis of the IFAS and EFAS matrices, the cost of producing corn briquettes is quite affordable and of course does not require a large amount of capital to start a corn cob briquette business. The strategy used to convert corn cob waste into briquettes involves technical and social approaches. From a technical perspective, the focus is on developing production processes that are not only efficient but also environmentally friendly. Meanwhile, in the social aspect, involving active community participation in the entire value chain is a very important step. By providing training related to waste processing, briquette production and marketing. By involving many parties, the use of corn cob waste into briquettes not only provides a short-term solution to the waste problem, but also creates the potential for sustainable solutions for the future. Solid support from various parties will help create a cleaner environment, a more sustainable economy, and a society that is more aware of the importance of maintaining a balance between development and environmental preservation.

From the test results of burning cob briquettes with two different textures, namely small particles and large particles, we get a comparison of the ignition time and burning time until the briquettes are finished. The results show that coarse particle briquettes have an ignition time of 44 minutes, while fine particle briquettes have an ignition time of 36 minutes. For the overall burning time, coarse particle briquettes require 1095 seconds, while fine particle briquettes require 1434 seconds. Kasim, E., & Aminah, S. (2021) said that using corn cobs as raw material for briquettes helps reduce the amount of agricultural waste that needs to be managed or disposed of. Briquettes from organic raw materials such as corn cobs tend to produce fewer emissions than fossil fuels, helping to reduce the impact of climate change. Meanwhile, Wijaya (2023) added that the production and sale of briquettes can be a source

of additional income for farmers and rural communities. Briquettes can be a cheaper fuel alternative to conventional fuel, helping to reduce energy costs for households and small industries.

From the results of this test, it can be seen that particle size has an influence on the ignition time and burning time of the briquettes. This is in accordance with research by Priyanto et al. (2018) that the size of the briquette particles has a significant effect on the burning rate of the briquettes, where it is said that the smaller the particle size of the briquettes, the longer the burning rate of the briquettes. From burning test data, coarse texture briquettes burn more easily because they have more open areas for contact with fire. The rough texture creates more gaps and space, allowing air and heat to penetrate efficiently, so that the briquettes can reach optimal burning temperatures quickly (Kurniawan et al, 2019). On the other hand, fine texture briquettes take longer to ignite because their dense surface can inhibit air and heat penetration. Even though the ignition time is longer, fine texture briquettes can maintain stable combustion after reaching the optimal temperature, increasing usage efficiency in the long term. Thus, differences in briquette texture affect the burning performance and ignition time with respective advantages in the combustion process.

Conclusion

Based on the research results and discussion on each research focus above, the conclusions in this article include: 1) That the use of banana peel waste as a basic ingredient for liquid organic fertilizer has a positive and significant effect on the implementation of a circular economy among farmers. Because banana peels contain many substances that are beneficial for plants when processed into liquid organic fertilizer. One of the main components is potassium, which reaches 42% of the total content. Potassium plays an important role in regulating the photosynthesis process, which has an impact on strengthening plant stems, increasing resistance to disease, and accelerating growth and fruit ripening. Liquid organic fertilizer from banana peels can be an effective and economical alternative to chemical fertilizers; 2) That corn milk production is effective in preventing and reducing stunting rates in toddlers. This benefit is very relevant in Bone Bolango Regency which has large areas of corn land. Utilizing corn-based processing into corn milk can be a solution to reduce stunting rates; 3) That the use of corn cobs as raw material for briquettes helps reduce the amount of agricultural waste that needs to be managed or disposed of. Briquettes from organic raw materials such as corn cobs tend to produce fewer emissions than fossil fuels, helping to reduce the impact of climate change and encouraging sustainable agriculture in Bone Bolango District.

Meanwhile, through this article, researchers provide recommendations to the Bone Bolango Regency Government, including: 1) Carrying out education to consumers with a focus on consumers, especially Bone Bolango Regency, which aims to foster trust and understand the benefits and differences between organic and non-organic food; 2) Holding training in making various diversified corn commodity products, such as corn milk and corn cob waste briquettes, for the community or for farmers so that they can be sustainable

and develop; 3) Regional governments can organize business empowerment programs by providing special production cost assistance to diversified corn producers in order to foster the entrepreneurial spirit of business actors in institutions to support sustainable production businesses.

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