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Sustainable business model: Transforming goat manure waste combined with egg shells into economical and environmentally friendly products

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Abstract

The large number of people who keep goats in their residential areas has caused the accumulation of goat waste in Cangkring Village, Bantul, Yogyakarta. This often occurs due to a lack of understanding of effective waste management. On the other hand, eggshell waste from production activities in home industries such as cake shops in Bantul also causes similar problems. This study aims to identify an effective integrated management method for utilizing goat waste and egg shells to produce valuable products, such as organic manure enriched with calcium and nutrients for plants. With a circular economy approach, this study involved field observations and interviews with residents in Cangkring Village, Bambanglipuro, Bantul, and several cakes shop entrepreneurs in Bantul Regency. The results of this study indicate that processing goat manure and eggshell waste can significantly reduce waste volume while providing added value for the public through more efficient and high-value fertilizer production and helping to open up new business opportunities that can support the local economy. This study provides an important contribution to sustainable organic waste management; it not only emphasizes waste reduction but also transforms wasted resources into solutions that benefit the ecosystem in local communities.

Keywords

Goat waste, Egg shells, Waste transformation, Circular economy, Economical and environmentally friendly products

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Introduction

The problem of organic waste management, especially waste from livestock and home industry activities, is increasingly becoming a global concern, including in Indonesia. One of the most significant organic wastes is goat manure, which is widely produced in rural areas. Based on data from the Badan Pusat Statistik (BPS) in 2022, the goat population in Indonesia was recorded at 18,560,835 goats [1]. With an average goat manure waste production of 1.13 kg per head per day [2]. So, the amount of goat manure waste

produced in Indonesia in 2022 is estimated to reach around 20,973,743.55 kg/day. This condition shows the large potential for waste that must be managed wisely to avoid negative impacts on the environment and public health. On the other hand, Indonesia also faces the problem of managing eggshell waste. According to BPS data in 2022, chicken egg production in Indonesia reached 5,566,339.44 tons [3]. Assuming that the average weight of a chicken egg is 60 grams and eggshells make up about 10% of the total egg weight [4]. So, the eggshell waste produced in Indonesia in 2022 is estimated to reach 5,049,698,197.628 kg/day. Eggshells that should be used as raw materials for other products are often simply thrown away, adding to the burden of waste that must be managed.

One of the areas facing the problem of goat waste management is in Cangkring Village, Mulyodadi, Bambanglipuro, Bantul, Special Region of Yogyakarta. In this area, many people keep goats around their residential areas, which causes the accumulation of goat waste. This happens because of the lack of understanding and adequate facilities for effective waste management. Based on BPS data, the goat population in the Special Region of Yogyakarta Province in 2022 was recorded at 466,759 goats [1], which means that goat waste in this province reached around 527,437.67 kg/day. The impact of this waste accumulation not only affects environmental quality but also public health. In addition, home industries such as cake shops in Bantul also produce large amounts of egg shell waste. According to BPS data in 2022, chicken egg production in Bantul reached around 168,303 tons, which means that eggshell waste in this area is estimated to reach around 152,681,913 kg/year or around 418,356 kg/day. This eggshell waste is often thrown away, even though it has great potential to be utilized, both for fertilizer products and other industrial raw materials [3].

The problem of managing these two types of waste opens up opportunities to develop circular economy-based solutions that can reduce negative environmental impacts while providing added economic value. Circular Economy is a model of extending the life cycle or maximizing the repeated use of products. The circular economy is an important concern today. The linear economic model of "take-use-dispose" is no longer in accordance with environmental conditions and environmental sustainability. The linear economy has increased since the start of the Industrial Revolution. The linear economic model causes tremendous environmental damage due to waste and residual consumption waste. The amount is expected to increase in line with population growth [5, 6]. Processing goat manure and egg shells into organic manure can provide dual benefits, namely reducing the volume of waste while producing products that are useful for agriculture, as well as opening up new business opportunities in the area.

Previous studies conducted by [7, 8] have identified that goat manure and eggshells can be processed into organic fertilizers that are useful for agriculture. Goat manure has a high nutrient content, while eggshells contain calcium which can enrich organic fertilizers and support plant growth. However, although this potential has been recognized, there has been no research that integrates the two types of waste in one

effective and efficient processing process. Most previous studies have only focused on the utilization of one type of waste, without considering more complex integrated management.

Based on previous research data, it is clear that there has not been much research that integrates goat manure and eggshell waste in one efficient management process. Most previous studies have only focused on one type of waste, without considering the potential for joint utilization to produce valuable products, such as higher quality organic manure. Therefore, this study aims to develop an integrated waste management model that can process both types of waste into environmentally friendly and highly nutritious organic manure. With a circular economy approach, this study not only aims to reduce the environmental impact of the waste, but also to create new business opportunities that can support the local economy.

The circular economy approach in this study can be a solution to existing problems. In this study, researchers support the community in Cangkring village to provide knowledge related to the manufacture of economical and environmentally friendly products in the form of organic manure. As illustrated in Figure 1 regarding the problems and solutions to be achieved in this study, namely the manufacture of organic manure.

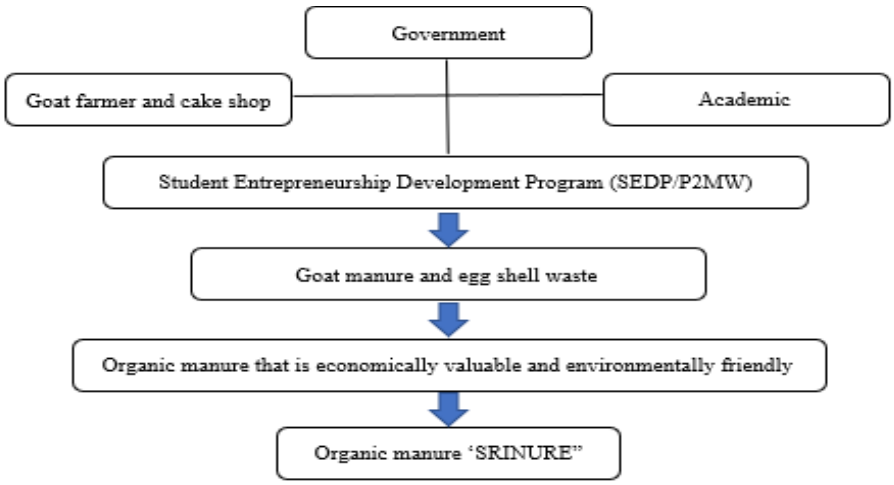

Figure 1. Research Framework

Method

The main objective of this study is to identify an effective integrated management method to utilize goat waste and egg shells to produce valuable products, such as organic manure enriched with calcium and nutrients for plants. The circular economy approach is very relevant in this study, because it not only leads to waste reduction, but also encourages the reuse of existing resources to produce products of economic value.

This study also aims to contribute to more efficient waste management, reduce negative impacts on the environment, and open up new business opportunities that can support the local economy. By exploring the application of circular economy in the management of goat waste and egg shells, the focus on these two types of waste can be processed into organic manure that is environmentally friendly and has economic

value. To achieve these goals, researchers conducted a case study method by conducting direct observations and interviews with the community in Cangkring Village, Mulyodadi, Bambanglipuro, Bantul, Special Region of Yogyakarta and several cake shops in Bantul.

With this method, in-depth and comprehensive information on the potential for managing goat waste and egg shells in the community, as well as providing useful insights on the application of circular economic principles in improving environmental sustainability and the local economy. In addition, this sustainable business model is expected to increase public awareness of the importance of wise waste management and provide social, economic, and ecological benefits in the area. With the production process of managing waste into organic manure as follows:

Figure 2. The process of egg shell washing

1. Wash the eggshells using water until clean (See Figure 2). Based on existing research, eggshells still contain important nutrients, especially calcium, even though they have gone through a washing process. The proper washing process does not remove the calcium content in eggshells. Therefore, washing eggshells before using them, for example as a source of calcium in food products or as organic fertilizer, is a good step to ensure cleanliness without reducing their nutritional content [9].

Figure 3. The process of making egg shell powder

2. After the eggshells are washed, they are dried in the sun. If there is no sunlight, the drying process can be assisted by using an oven or by roasting. Once dry, the eggshells can be ground using a chopper or blender until they become eggshell

powder as seen at Figure 3. The ground eggshell powder is then filtered/sifted with a cloth until a fine powder is obtained.

3. Clean the goat manure from foreign objects that may be mixed in such as plastic, wood, stones or other foreign objects. At the same time, loosen the clumped manure so that the decomposition process will be faster. Make sure that the goat manure is dry or almost dry, not too wet. If only wet goat manure is available, it must be dried in the sun or spread out to be air-dried.

Figure 4. The process of making fermented liquid

4. Next, Figure 4 make a fermenter solution, by preparing 5 liters of clean water in a bucket, add EM4 (yellow packaging specifically for plants/fertilizers) which functions as a starter or decomposer, to activate it must be shaken first then mixed with clean water. The dose of EM4 for 100 kg of manure requires 24-100 ml to be dissolved in 5 liters of water. Add molasses or commonly called sugar cane drops which functions as nutrition/food for the beneficial bacteria. Stir until all ingredients are evenly mixed, let stand for a while so that the bacteria start to become active. Put the solution into a watering can.

Figure 5. The process of making organic manure

5. Pour the fermenter solution on the manure while stirring it until evenly mixed, along with the eggshell powder that has been made. Once it is considered sufficient, put the manure into the fertilizer making box(Figure 5 and 6), then ferment it covered using a tarpaulin and place it in a shady place away from direct sunlight and rainwater.

Figure 6. Organic manure

6. The process of making fertilizer takes approximately 2-3 weeks. Fermented goat manure is ready to use, namely with the characteristics of cold, dry, odorless, not clumping/loose, light and has changed from its original form.

Result and Discussion

Result

Organic manure in this study has undergone three laboratory tests to determine the content of macronutrients contained therein. Referring to the SNI-19-7030-2004 standard which contains the specifications of compost from domestic organic waste such as the following quality parameters:

Table 1. Standard SNI-19-7030-2004

No	Parameters	Min	Max
1	Nitrogen (N)	0,40%	-
2	Phosphorus (P_2O_5)	0,10%	-
3	Potassium (K_2O)	0,20%	-

Based on these standards, it can be seen that the nitrogen (N) content has a minimum value of 0.40%, phosphorus (P_2O_5) has a minimum value of 0.10% and potassium (K_2O) has a minimum value of 0.20%. Based on the test results from the Laboratorium Tanah, Tanaman, Pupuk dan Air conducted by the Badan Standarisasi Instrumen Pertanian (BSIP), Sleman, Special Region of Yogyakarta in 2024 from organic manure samples, this study obtained the following results:

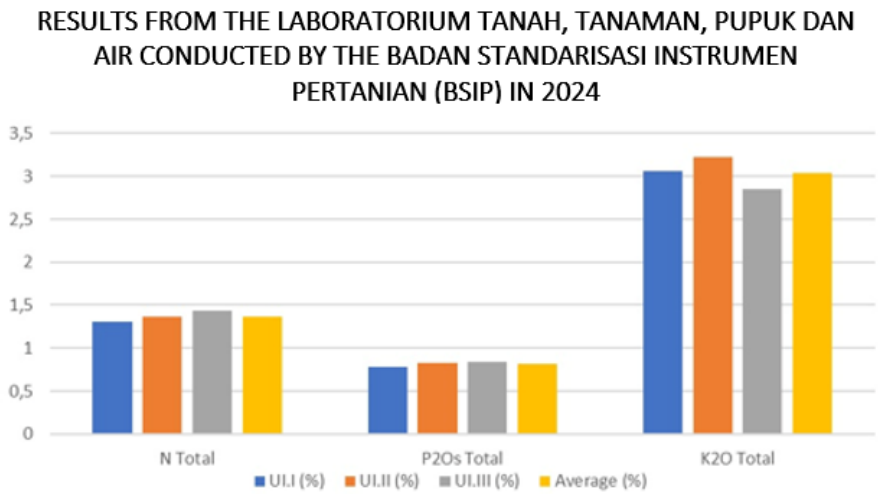

Figure 7. Results

The results showed that the organic manure in this study had exceeded all minimum values for the content of macro elements in fertilizers, namely nitrogen, phosphorus and potassium from the SNI-19-7030-2004 standard. Based on the test, the results obtained in this study showed that the first test of this organic manure contained Nitrogen (N) of 1.31%, Phosphorus (P_2O_5) of 0.78%, and Potassium (K_2O) of 3.06%. In the second test, the Nitrogen (N) content increased to 1.37%, Phosphorus (P_2O_5) to 0.83%, and Potassium (K_2O) to 3.22%. While in the third test, the Nitrogen (N) content reached 1.44%, Phosphorus (P_2O_5) of 0.84%, and Potassium (K_2O) of 2.85%. Thus, based on the average of the three laboratory test results, the fertilizer content is as follows: Nitrogen (N) 1.37%, Phosphorus (P_2O_5) 0.82%, and Potassium (K_2O) 3.04%.

Discussion

These results indicate that organic manure from goat manure and egg shells has a fairly good nutrient content to support plant growth. According to [10], good manure contains macronutrients such as Nitrogen, Phosphorus, and Potassium which play an important role in increasing soil fertility and plant growth. Nitrogen functions in the formation of plant tissue and photosynthesis [11], Phosphorus helps in the process of cell division and root development [12], while Potassium plays a role in metabolism and increasing plant resistance to environmental stress [13].

One of the problems faced in Cangkring Village, Bantul is the low knowledge of farmers in managing their goat manure waste properly. Many farmers are not yet aware of the economic potential of this waste, so it is often just thrown away without processing. On the other hand, many cake shops throw away egg shells carelessly, without further utilization. This not only pollutes the environment, but also wastes resources that have the potential to be processed into more useful products. This study aims to help reduce organic waste by processing goat manure and egg shells into organic manure that has economic value. By utilizing this waste, it is hoped that it can open up new business opportunities for the community, increase farmers' awareness of the importance of waste management, and support sustainable agricultural practices in the area.

Goat manure as a basic ingredient for organic manure has advantages because of its higher Nitrogen content compared to several other types of manure [14]. Meanwhile, egg shells which are rich in Calcium can improve the quality of fertilizer by adding micronutrients that are beneficial for plants [15]. Therefore, organic manure in this study can be an innovative solution for waste management while providing economic impacts for the local community. Organic manure in this study was named "SRINURE" which comes from the abbreviation Srintil or goat manure which is small or small grains (Javanese) and Manure which means fertilizer (English).

Conclusion

The management of goat manure and egg shell waste into economical and environmentally friendly products is an innovative approach in supporting sustainable development. This process aims to significantly reduce the volume of waste while creating opportunities for community empowerment in Cangkring Village, Mulyodadi, Bambanglipuro, Bantul, Special Region of Yogyakarta through economic development. The successful implementation of this model that combines technology, entrepreneurship, and sustainability can build an effective and relevant circular economy-based business model for the future.

In this study, there are limitations in the content of egg shells which are still small, if the portion of egg shells is increased, the results of the organic manure made will also be better, containing many nutrients for plants. This research can be developed into an organic fertilizer product that is combined with the composition of egg shells and commonly used household waste such as food waste/leaves and others as soil nutrient enhancers.

The practical implication of this research is the creation of economical and environmentally friendly products in the form of organic fertilizer from the management of goat waste and egg shells. Thus, the community (academics and the general public) benefits from the circular economy approach of a sustainable business model.

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