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Implementation Of Green Economy System In Sugarcane Waste Management From Sugar Production

Aisyah Eka Yurianingsih
Accounting, Maulana Malik Ibrahim Malang State Islamic University, Indonesia

Sheryn Alivia Auril
Accounting, Maulana Malik Ibrahim Malang State Islamic University, Indonesia

Tsalitsatul Mahdiyyah
Accounting, Maulana Malik Ibrahim Malang State Islamic University, Indonesia

Kurniawati Meylianingrum
Faculty Of Economics, Maulana Malik Ibrahim Malang State Islamic University, Indonesia

Corresponding Author
Aisyah Eka Yurianingsih
aisyahyuria@gmail.com

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ABSTRACT

The green economy system is a positive economic activity that can improve people's welfare by reducing the risk of environmental pollution. Sugarcane is one of the big incomes in one of the Lamongan areas and in the area, there is the largest sugar production factory in Asia, this has the potential for a lot of waste generated from the factory activities. This research aims to find out how sugar cane waste management is in accordance with the green economy and what impact the establishment of a sugar production factory has on the green economy system and community activities. This research uses a qualitative method that focuses on interviews with parties concerned with the factory and a descriptive approach. The results showed that the factory had successfully treated waste by implementing a green economy system so that the waste flowing into the community did not interfere with community activities and pollute the environment. This research underscores the importance of implementing a green economy system in waste management.

Keywords: Green Economy; Waste Management; Sugar Factory, Sugarcane

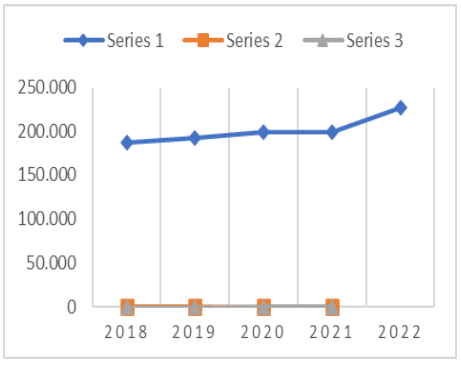
INTRODUCTION

In Indonesia, companies play an important role in the national economy. Based on available information, companies in Indonesia have a very precise role in bridging trade interests, finding the shape of the Indonesian economy, and driving industries/production that utilize natural resources, such as the agricultural sector and tourism services. Private companies also have a role in the country's economy, including directing, supervising, and being a figure in the country's economy to increase people's desires and welfare (Djukardi, 2023).

Data from the Ministry of Environment and Forestry (KLHK) in 2021 shows that in 2020, as many as 2,897 manufacturing sector industries produced hazardous waste. Companies have an important role in waste management such as providing services to treat various wastes, such as hazardous waste or industrial waste. To anticipate the increasing B3 waste, the business world government is implementing a green economy with a program that includes economic development, environmental sustainability and resource efficiency, with a focus on sustainable energy and infrastructure.

According to the Lamongan Food Security and Agriculture Office in 2021, the sugarcane crop area in Lamongan Regency reached 3,259 hectares, with a production of 198,637 tons. Productivity reached 600 quintals per hectare with a milled sugarcane yield of 7.5%. Meanwhile, in 2022, the crop area increased to around 3,601 hectares, producing 226,994 tons. Productivity also increases to 613 quintals per hectare, with a fixed yield of 7.5%. Based on this data, sugarcane companies can provide employment for the people of Lamongan, especially in the Ngimbang sub-district. The job is not the main livelihood but rather a seasonal job because the main livelihood of the Ngimbang sub-district community is the agricultural sector that produces rice crops. But the presence of sugarcane companies can increase the per capita income of the area.

Graph of sugarcane production in Lamongan (tonnes).



Indonesia is one of the countries with the largest waste producer in the world (Ahdiat, 2023). Hanifiyah & Subari (2020) analysed that the production process of PT KTM can increase air waste produced by the factory in the form of unpleasant odours and smoke. Smoke from the production process spreads to tobacco farms and to residential

areas around the factory. the above causes the community and farmers who live around the factory to experience losses due to production activities from PT KTM. The odour comes from liquid waste that is stored behind the factory.

Based on the findings of previous research related to the production process of PT KTM which can increase air waste in Ngimbang District, Lamongan Regency motivates the author to conduct research on how to process sugarcane waste in order to reduce the increase in waste in Lamongan. Sugarcane waste that is usually directly disposed of can be reused with the correct recycling process so as not to pollute the surrounding environment. Therefore, it will be safer or more appropriate if sugarcane waste is properly processed by implementing a green economy system so as not to pollute the environment. Therefore, the purpose of this research is to find out how sugarcane waste is managed by applying a green economic system.

THEORETICAL FRAMEWORK AND EMPIRICAL STUDIES

1) Theory A

Green Economy is an economic behaviour that pays attention to economic growth by preventing damage or pollution of the natural environment which then results in human welfare and social welfare (Saidah et al., 2023).

2) Theory B

Waste is waste material or residual material that is no longer used for production in human activities both in households, industry, and mining (Sunarsih, 2014).

3) Relationship between Theory A and Theory B

Theory A and Theory B are interconnected because the green economy will have a good impact on the environment by reducing the negative impact of waste.

RESEARCH METHODS

The method, type of research approach and data collection techniques used are using qualitative methods and descriptive approaches where the data collected comes from direct interviews with respondents and observations. The location for conducting this research is in the place or around PT Kebun Tebu Mas Jl. Babat-Jombang No.KM 25, RW.5, Pule, Lamongrejo, Kec. Ngimbang, Kab. Lamongan, East Java 62273. In this case we have three target respondents namely the company manager, the community around the factory location, and local government representatives or village heads.

The types of data used in this study are primary and secondary data sources for primary data are the results of the interviews presented and observations while secondary data are documentation during the data collection process. Primary and secondary data are often used as data collection targets, because in general primary data is said to be better

than secondary data, but it cannot only rely on primary data because primary data alone is not necessarily valid for that, secondary data is also needed.

RESULTS AND DISCUSSIONS

1) Description of the Object

To support the research conducted, we chose PT Kebun Tebu Mas or commonly referred to as PT KTM. The company was built in 2011 and started operations in 2018. Informants 1 and 2 mentioned that this PT has such a big influence on the area where this PT can provide many jobs where jobs are now difficult to find besides that it also helps farmers to increase income for farmers who have sugar cane plantations, they also don't need to bring it far from the lamongan area itself because there is already this PT KTM. Besides providing the influence of employment, this PT also provides knowledge of how important it is to maintain ecosystems and environmentally friendly activities. PT KTM only operates during the Onn season which is usually for 3 months a year besides that PT KTM also has production targets and yields every year. Yield is the percentage resulting from comparing the initial weight with the final weight and this yield uses units of percent (%) where the higher the yield value, the more extract value obtained (Masruroh, 2018). In 2023 the factory produces 953,000 tons of production which has a yield of 7.5% to calculate how much sugar is produced is the total production multiplied by the yield, namely 953,000 x 7.5% = 71,475 tons of sugar produced multiplied by the price of sugar in that year is Rp.13,500 / Kg = Rp.13,500,000, so the calculation is Rp.13,500,000 x 71,475 = Rp. 964,912,500,000 so the turnover obtained in 2023 is Rp. 964,912,500,000. .500,000 x 71,475 = Rp. 964,912,500,000 so the turnover obtained in 2023 is Rp. 964,912,500,000 and this year the factory has a production target of 1,200,000 tons with a yield target of 8.2% if the sugar production is calculated then 1,200,000 x 8.2% = 98. 400 tons of sugar means that the turnover obtained is 13,500,000 x 98,400 =Rp. 1,328,400,000,000 where if production is on target and the price of sugar is in accordance with 2023, it could be that the turnover generated in 2024 is Rp. 1,328,400,000,000.

2) Sugarcane Cultivation Concept with Green Economy System Implementation

Sugar cane is a plant that belongs to the Gramineae family, which is a type of grass, but this plant contains sugar raw materials. sugar cane is also a seasonal plantation where sugar cane experiences two periods of farmers call it the ‘off season (maintenance period) and on season (harvest period)’, the factory manager said that:

‘To know the calculation of the harvest period is divided into three stages, namely: a). Early sugarcane is 10 to 12 months or enough rain or no water for 30 days or 1 month. b). Middle period sugarcane, namely 10 to 12 months or no water for 60 days or 2 months. c). Late sugarcane is above 12 months or up to 14 months or can also not get water for 90 days or 3 months. In using the green economy system in addition to paying attention to waste, the factory also pays attention to good cultivation standards and factories that also

pay attention to the application of the green economy, this is also stated by the factory manager as follows:

a. ‘In the past, sugar cane residue and dry leaves were burned by farmers even though it was relatively easy to manage but it had a bad impact on global warming, the potential to add good material to the soil or organic material that could function as a soil improvement material tool could not be achieved, caused air pollution, and there was no application of green economy, so the factory followed up on this by socializing giving an understanding that this was not right and suggesting to the community that the remaining sugar cane and dry leaves should be chopped or crushed and put into the soil to be used as fertilizer and improve the physical chemical and biological properties of the soil so that in the coming year it will reduce the attitude of using chemical fertilizers.
b. In addition, the factory also conducts socialization on how to fertilize properly, this can reduce lusis or loss of fertilizer power both through run off (surface flow), blecing and evaporation. The fertilizer used is of three types, namely using single fertilizer or usually using urea fertilizer which is one type of single fertilizer and compound fertilizer two ordinary mixtures used are ammonium sulfate fertilizer which contains nitrogen and a small sulfur component and compound fertilizer three mixtures consisting of 3 compositions in one sack and the dose depends on the price and consumer needs. And the factory anticipates it by mixing several fertilizers to get the desired composition. Techniques used for laying fertilizer are traditional and modern. The traditional way is done by laying fertilizer on the edge of the plant for the possibility that in the event of rain it will cause 3 impacts, namely the first impact of fertilizer evaporating so that it pollutes the air, but this technique is not very influential or has a big impact, the second impact of rainwater on fertilizer will enter the soil and pollute groundwater, and the third impact of fertilizer water exposed to rain will pollute the river. Secondly, the more modern fertilizer applied by farmers now is by burying the fertilizer 15 cm deep and covering it when the fertilizer is placed above the possibility of run off and bleaching will occur while if it is not covered, evaporation will occur and be used by weeds. The effectiveness of previously applied fertilizer that is not buried or covered is as much as 30%, after applying a modern fertilizer system with a little overhaul of the previous concept the effectiveness can increase by 70% to 80%, what happens is that productivity increases, does not contribute to soil, water and air pollutants, makes efficiency which will reduce production costs, and increase yields.
c. The use of fuels that are not fossil fuels or non-renewable so sugarcane material in the form of bagasse is used as fuel to power this boiler is a renewable organic material so that the factory does not use non-renewable fossil materials.’
d. In providing green economy practices, the sugarcane factory not only pays attention to where the waste will be used but also to the cultivation standards

carried out by farmers to make it better, which used to be burned sugarcane residue, now it is buried which also has a positive impact on the soil and reduces the use of chemical fertilizers that can pollute the soil. In addition, the factory also provides lessons to sugarcane farmers on the correct technique of fertilization, which is 15 cm deep, which has the impact of reducing pollution, increasing effectiveness by 70% to 80%, as well as increasing productivity levels compared to previous techniques. The mill also uses bagasse as boiler fuel to replace non-renewable fossil fuels which is more environmentally friendly. From this research, it is proven that by making slight improvements in cultivation techniques and basic materials, the factory contributes from green agronomy to green economy.

3) *Sugarcane Processing with Green Economy System Implementation*

Based on our research, we obtained information about the processing of good quality sugarcane from the factory manager. The factory manager said that:

'Sugarcane that wants to be processed into sugar must have good quality, therefore the factory has a standardization aimed at sugarcane farmers. The way to ensure the quality of sugarcane that enters the factory is to control its cultivation from tillage to planting. Sugar factory field officers who will ensure the quality of the sugar cane by implementing good cultivation. One of them is good tillage, the use of appropriate spacing, the use of balanced fertilizers, the right dose, and on time. After that, they cut down according to the level of maturity. One of the indicators is using a measuring tool called handbrix with the minimum limit of sweetness of sugar cane is at 17 on the reading of the handbrix tool. Quality sugarcane is sugarcane with MBS standards (Sweet, Clean and Fresh). Sweet means the level of maturity is just right. Clean means that not too many leaves are involved, the feeling does not reach the top so that not much soil is involved. Fresh means that the sugarcane is not too long between the time of cutting and arriving at the factory.'

After the sugarcane is declared suitable and of good quality to become sugar-making material, then the sugarcane will be sent to the factory and will undergo the sugar production process. The processing stage of sugar cane into sugar is explained by the factory manager that

'Sugarcane brought to the factory will undergo a milling process. In this milling process, there are 3 stages carried out by the factory. The first stage is done by chopping the sugarcane stalks. After chopping the sugarcane, it will be ground. During the last stage is the sugar cane stems will be squeezed until it releases water called nira water.

The juice produced from squeezing sugarcane stalks will be flown into a container and mixed with certain materials to adjust the acid-base standard. The mixing of the material is also useful for binding impurities that are still mixed in the nira water. So that the stage of filtering impurities in the nira water will be carried out and will produce clear nira water. The clear nira will undergo a thickening stage, namely by evaporation. Evaporation is done to produce thick syrup from the clear nira and the syrup will be crystallized which will

then be put into centrifuges to go through the filtering stage. So, it can be seen that this filtering produces sugar granules.'

This sugar production will certainly cause new problems such as waste, even though the product will be useful for the community. But it will still cause waste after the production process. Waste from sugar production will also have good and bad impacts on society. In yesterday's interview, the factory manager also explained about the impact caused by the production of sugar, there is no doubt that the impact is waste. The factory manager said that

'There are two kinds of waste generated from this factory, namely solid waste and liquid waste. Solid waste consists of wet solid waste and liquid solid waste. For wet solid waste, the factory has processed itself by piling them together, then drying them to go through the process of becoming organic fertiliser. This fertiliser will minimise production expenditure because the factory uses materials from production that are no longer used. Meanwhile, dry solid waste is generated from burning residue during sugarcane harvesting. This waste is only processed by certain vendors in the field.'

'On liquid waste, it is done through a definite process, namely with IPAL (Wastewater Treatment Installation). The factory builds holding ponds for the treatment of bad bacteria in composters and fermenters both aerobic and anaerobic. To be discharged into the sewer outside the factory, it must meet the minimum standards of the applicable regulations. Meanwhile, the factory does not know the limits because it is outside its scientific discipline.'

The factory will continue to minimize the negative impact of waste generated in the sugar production process. Because before the establishment of the sugar cane factory, the environment was very clean and safe from sugar cane waste. Based on the results of yesterday's interview, the community around the factory is disturbed by the existence of the factory, because the wastewater pollutes the river. Nadya as the community around the factory stated that

"When the factory was discharging waste, many people protested because of the pungent smell and the waste polluting the river. But now the factory has minimized the smell and the liquid waste."

By minimizing the negative impact of waste, the factory will also not be exposed to problems due to protests from the surrounding community regarding its waste.

"People often experience water shortages because a lot of water is used by the factory. Therefore, the factory provides free water to the community directly from the factory, although the water from the factory is also often jammed or does not come out smoothly." said Nadya as a community member around the factory.

The following is an example of the disposal of liquid waste from sugar production through IPAL (Wastewater Disposal Installation) based on information from the Journal of Precipitation: Media for Communication and Development of Environmental Engineering by Paramitadevi et.al, 2017:

a. Wastewater generated from sugar production will be flown to pass through the oil separator pond which serves to reduce oil content. Furthermore, it will flow to the buffer pond which functions as an equalizing parameter such as pH and waste temperature.
b. Waste that has passed the buffer pond stage will flow into the anaerobic pond. Previously, the waste was inoculated with activated growth bacteria (AGB) to accelerate the decomposition of pollutants. In the anaerobic pond, degradation occurs by AGB bacteria. After that, foam can be seen on the surface of the pond.
c. Next, it flows into facultative pond I which was previously given super growth bacteria (SGB) which is aerobics. The total number of facultative ponds is five pounds. Facultative ponds I-III are assisted by an aerator unit. While in facultative pond IV the waste is allowed to stand with the aim of TTS (Total Suspended Solid). In facultative pond V, the waste is made to fall to increase oxygen supply and reduce COD (Chemical Oxygen Demand).
d. Then the wastewater is put into an aeration pond I which is assisted by three aerator units and a fountain on a pipe with a diameter of 10 cm, to help supply oxygen to the pond. Furthermore, the waste will flow into the aeration pond II with the help of two aerator units, besides that there is also the application of water hyacinth which is used to reduce pollutant levels.
e. After a long process, the effluent will flow back to the stabilization pond without any other treatment. The last pond of the WWTP series is the monitor pond which contains tilapia bioindicators for monitoring wastewater quality.

4) The Impact of the Establishment of Factories on the Implementation of the Green Economy System and the Economy of Neighboring Residents

The establishment of the KTM factory can have several impacts, both positive and negative impacts, these impacts affect local residents and can contribute to the green economy.

a. Positive impact
    1. Reducing global warming, “by applying the concept of a green economic system to sugarcane cultivation, one of which is by destroying the leaves and remaining taboos that have been cut down by applying this concept, it can reduce pollution or air pollution so that it does not cause global warming,” said Mr. Agus. Global warming usually occurs due to the burning of forests, gardens and land.
    2. Increased productivity, “by inserting fertilizer into the soil 15 cm deep, the effectiveness of fertilizer previously inserted 30% will increase by 70-80%, this can reduce production costs and increase factory productivity,” said Mr. Agus.
    3. Increasing employment opportunities, “the establishment of the KTM factory can create new jobs for local residents, especially for teenagers”

said the village head. The creation of new jobs can increase the economic growth of the area and can overcome unemployment.

4. Improving soil biology, “by destroying the leaves and the remaining sugar cane that has been cut down, the content that is in the leaves and the remaining sugar cane that has been cut down will absorb into the soil,” said Mr. Agus.

b. Negative impact

1. Air pollution, “the establishment of the KTM factory can cause air pollution, such as unpleasant odors caused by waste that usually occurs after rain,” said Nadya. Even though they have implemented a green economy system, it cannot eliminate air pollution but only reduce it.
2. Water pollution with the KTM factory can cause river water to become cloudy caused by sugar cane waste and can hamper the waters of local residents. “The solution provided by the factory is to filter sugar cane waste before it is released into the river so that the dirt in the waste does not enter the river and provide free water to affected residents, the water comes from the factory which is channeled to each house,” said Mr. Agus.

CONCLUSION, SUGGESTION, AND LIMITATION

Based on the results of the research and interviews we have conducted; it can be concluded that the KTM factory has successfully implemented a green economy system both in the management of sugarcane production waste and in the cultivation of sugarcane plants. This factory also has standards set for farmers before sugarcane enters the factory. The establishment of this factory can also have positive and negative impacts on the surrounding community and on nature, but these negative impacts can be overcome by the application of the green economy that has been implemented by the KTM factory.

Based on the results of this study, it is hoped that the KTM factory will be able to maintain the application of the green economy system that has been implemented by focusing more on the disposal of sugar cane waste so that the sugar cane waste does not cause air pollution that can disturb the surrounding community. In addition, for researchers who will continue this study, it is hoped that they can examine in detail how the application of the green economy system will be studied and also expand the scope of researchers regarding the process of managing sugar cane waste comprehensively.

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