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Estimated Methane Gas Emissions (CH4) from the Utilization of a Biogas Technology as an Alternative Fuel Source in Ploso Ngamban Village, Kendal, Ngawi East Java

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ABSTRACT

This research aims to estimate the emission of CH4 gas from the utilization of biogas technology as a source of alternative fuels and biogas has an influence on the economic condition of the society of Ploso Ngamban Village, Kendal, Ngawi East Java who has been utilizing biogas. Ploso Ngamban Village, Kendal, Ngawi East Java is one of the villages with the most populations as cattle ranchers and has been utilizing cow dung as a biogas. In cow dung, there is a CH4 gas that contributes 3% of the total greenhouse gas emissions. There are 32 cows that have been utilized to 18 units of biogas, if used maximally, it is able to reduce the emission of CH4 gas by 1,952 kg or it helps to reduce the CO_2e gas emissions by 48,800 kg/year of emissions for the district of Kendal, Ngawi East Java. So, if the use of cow dung into biogas is done to the fullest, it will get the efficiency of lowering the cost of CO_2e gas emissions processing in Ploso Ngamban Village, Kendal, Ngawi East Java by Rp 23.424.000/year. Calculation method is based on the calculation of greenhouse gas emissions, using the formula quoted from the Ministry of Environment of the Republic of Indonesia, namely *GHG emissions = Ai x EFi*.

Keywords: biogas, CH_4 gas, greenhouse gas

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INTRODUCTION

Ploso Ngamban Village, Kendal, Ngawi East Java is one of the villages with the most populations as cattle ranchers with an intensive system (the cows are being caged). Ranchers who nurture livestock intensively should provide feed processing, health care, and livestock waste treatment is needed to increase the productivity and the quality of livestock. The processing of good livestock waste will minimize the negative impact of livestock waste on the quality of the environment, one of them is CH_4 gas issued through eructation (about 83%), respiratory (about 16%), and anus (about 1%) (Vlaming, 2008). The production of CH_4 gas that is produced by cattle varies, depending on the type of feed, temperature of the environement, and the individual types of livestock (Syarifah, 2017).

CH_4 gas is one of the greenhouse gases in the earth's atmosphere which happens to be one of the contributors to climate change, especially in the short term (10-15 years). CH_4 gas becomes the second most contributor of the total global emissions after carbon dioxide gas (CO_2). Although the amount produced is less than CO_2 gas, but the CH_4 gas causes a global warming effect of 25 times larger because of the CH_4 gas radiation is higher than the CO_2 gas. The CH_4 heating gas to the atmosphere increases by 1% annually, and especially cattle livestocks contribute to produce a CH_4 gas of 3% of the total greenhouse gas emissions (Tyler and Ensminger, 2006).

One of the efforts of good cow waste treatment is to utilize cow dung as a biogas to minimize the impact of CH_4 gas to change the quality of the environment. CH_4 gas is the main component of forming a biogas. The CH_4 gas is expected to have a large amount of value because of its high number of calorific values that can be utilized for various purposes (Bindari, 2012). In the village of Ploso Ngamban, Kendal, Ngawi East Java itself, there are about 18 units of biogas that serve as an alternative fuel replacing firewood, kerosene, and natural gas. The purpose of writing this journal is to 1) examine the estimated CH_4 gas emissions from utilizing a biogas technology as an alternative fuel source in Ploso Ngamban Village, Kendal, Ngawi East Java, 2) review biogas influence on the economic condition of the society of Ploso Ngamban Village, Kendal, Ngawi East Java who has been utilizing biogas.

RESEARCH METHOD

Place and Time of Research

The case study was conducted on 28th of December 2018 until 6th of January 2019 in the village of Ploso Ngamban, district of Kendal, Ngawi Regency, East Java Province, while the literature study was conducted at the Faculty of Science and Technology, Campus C of Airlangga University on 27th of May 2019 until 29th of May 2019.

Data Collection Method

The methods used are literature study and case study. Case study is conducted through field observation, while the literature study of secondary data related to ranchs is obtained from the Central Statistical Board (Badan Pusat Statistik) of Ngawi regency.

Data Analysis

Analysis of the potential biogas is done by multiplying the heavy of cow dung with the content of dry material contained therein and then it is converted into a volume of gas produced (M3), so that the daily results of biogas volume are obtained from the total of cow dung in Ploso Ngamban Village, Kendal District, Ngawi Regency, East Java Province, that is used as a biogas.

Environmental analysis is done by calculating the

emission of greenhouse gases using the formula quoted from the Ministry of Environment of the Republic of Indonesia, which is:

GHG emissions = Ai x Efi (1)

Description :

GHG emissions = Emissions of a greenhouse gas (CO_2, NH_4, N_2O) Ai

= Consumption of material type i or number of I EFi products

= Emission factors from material type i or product I

Processing 1 ton of CO_2e emissions according to the calculation of GHG emissions based on the standard of Kyoto protocol requires a fee of 30 euros (1 euro = Rp 16,000 (May 2019)). With the use of cow dung into a biogas, cattle ranchers in the village of Ploso Ngamban, Kendal District, Ngawi Regency, East Java Province helps to reduce greenhouse gas emissions.

RESULTS AND DISCUSSION

Estimation of CH_4 Gas Emissions from the Utilization of a Biogas Technology as an Alternative Fuel Source in Ploso Ngamban Village, Kendal, Ngawi East Java

Cattle ranchers are accounted for greenhouse gas emissions from belching, farting, and cow dung containing CH_4 gases. CH_4 gas has a hot capture power coefficient of 25 times than CO_2 (Morgavi, 2008). Total cows in the district of Kendal, Ngawi East Java, according to the Central Statistical Board of Ngawi Regency in 2014, is 5.980 cows, while the total number of cows that are used for biogas in the village of Ploso Ngamban, Kendal, Ngawi East Java is as much as 32. Mature cows with weights ranging from 400 to 450 kg produce 25 kg of feces per day (Rinialdi, 2010). With the number of cows utilized for biogas in the village of Ploso Ngamban, Kendal, Ngawi East Java is 32 cows, the production of cow dung per day is 800 kg/day.

According to the IPCC source in 2006, the CH_4 gas emission factor from the fermentation of cow's digestion is 61 kg/tail, then it can be noted that the district of Kendal, Ngawi East Java is accounted for CH_4 gas emissions of 364,780 kg or 9,119,500 kg/year of CO_2e gas emissions. If the amount of dung from 32 cows is utilized to the maximum biogas, then there is a reduction of CH_4 gas emissions by 1,952 kg or it helps to reduce the CO_2e gas emissions by 48,800 kg/year of emissions for the district of Kendal, East Java Ngawi. So, if the use of cow dung into a biogas is done to the fullest, it will get the efficiency of lowering the cost of CO_2e gas emission processing in Ploso Ngamban village, Kendal, East Java Ngawi by Rp 23.424.000/year.

Biogas Influence on the Economic Condition of the Society of Ploso Ngamban Village, Kendal, Ngawi East Java who Has Been Utilizing Biogas.

Biogas processing of cow dung with digester system provides many benefits for the owners of cattle and the surrounding communities. The main benefit is that the product of biogas can be utilized as an alternative fuel for cooking. The gas generated from the reaction that occurs in the digester, will flow and exit through the gas outlet pipeline. This gas is then accommodated in a simple gas bag made of large plastic bags. This gas bag is connected to the pipe that flows to the stove. Stove needs to be hammered with fire from matches to light the stove with biogas fuel. The resulting fire is blue, so it has a good heat for cooking.

The biogas that is produced, is not only used in the home of livestock owners (the owner of the biogas system), but can also be streamed to the homes of residents around the area with pipes. Therefore, the surrounding community also gains alternative fuel benefits for cooking stoves. The use of biogas makes public expenditure in Ploso Ngamban Village, Kendal, Ngawi East Java for fuel stove (Liquified Petroleum Gas or LPG) reduced. According to the literature, the following is the equality of biogas to liquified petroleum gas:

Table 3.1. Comparison of Biogas to Other Fuels

Description	Other Fuels
1 m^3 Biogas	LPG 0,46 kg

Source : Wahyuni, 2013

So, the number of 18 units of biogas in Ploso Ngamban Village, Kendal, Ngawi East Java is equivalent to the use of liquified petroleum gas if 1 m^3 of biogas is equivalent to 0.46 kg of LPG as follows:

Table 3.2. Estimated Potential Use of Biogas

Total of Cow Dung of 32 Tails (per year)	The Amount of Biogas Produced (per year)	Other Fuels (per year)
292.000 kg	29.200 m^3	LPG 13.432 kg

Biogas system with cow dung input such as the table above is able to produce equivalent gas to 13,432 kg of LPG per year or 1,119 kg per month. Whereas the consumption of the average household's LPG is 4 kg/month, so that the amount of biogas produced will be able to meet the needs of fuel for cooking in the village of Ploso Ngamban, Kendal, Ngawi East Java. These results apply to large biogas systems with the input of cow dung in large quantities (large cattle ranchers).

Based on the results of the field observations that were conducted in the village of Ploso Ngamban, Kendal, East Java Ngawi, a simple biogas system with a small budget and the input of dirt from 1 to 2 cows, will be able to save the expenditure of the residents to LPG by 50%. The consumption for 1 household before the presence of biogas was 2 tubes with the size of 2 kg LPG per month or 4 kg LPG per month. This amount is reduced after the residents also use biogas, namely to be 2 kg LPG/month. The LPG price with the size of 2 kg is Rp 20,000.00, meaning that the community can save Rp 20,000.00 every month. This number is large enough for villagers who the majority are farmers and ranchers. The society of Ploso Ngamban Village, Kendal, Ngawi East Java has not completely abandoned LPG with the full use of biogas yet, because of the technology of the biogas system used can only be used for a stove with one furnace. While the cooking activities usually require stove with more than one furnace, that is when people also use the LPG stove.

Side results of the biogas system is that it can be utilized again into an organic fertilizer. This side result is a mud or a sludge, commonly called bio-slurry or biogas pulp. Bio-slurry contains various elements that plants needed for their nutrients, so that it is potentially used as an organic fertilizer for organic vegetable farming around

the biogas system. Organic farming is a good business opportunity, because organic vegetable prices are more expensive than ordinary vegetables, so it can increase farmer's income. The following is a flowchart of the utilization of the main product and the side results of biogas.

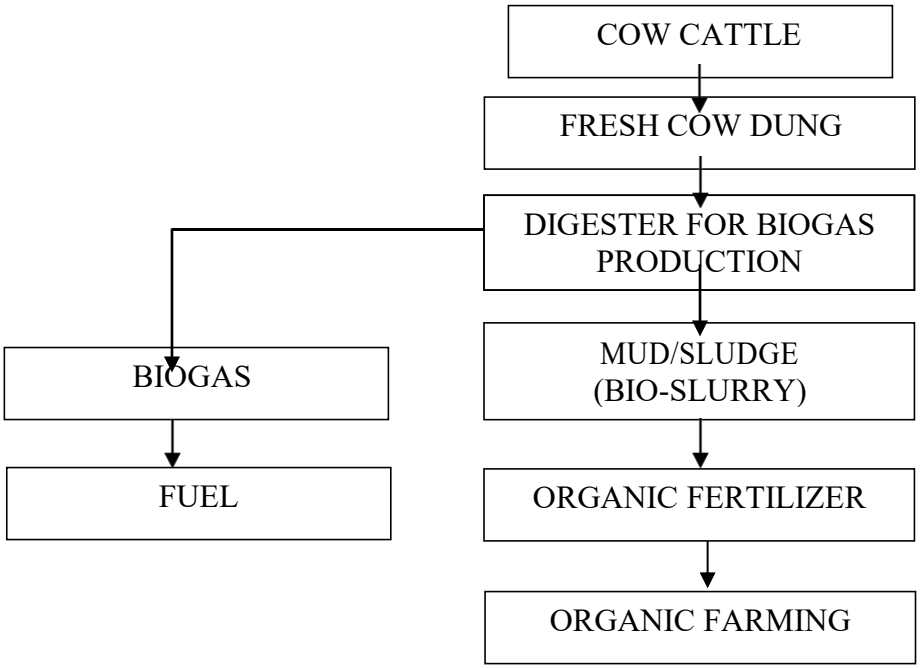

Figure 3.1 The Utilization of Cow Dung into a Biogas and an Organic Fertilizer

Other benefits that can be gained are the increasing welfare of the society of Ploso Ngamban, Kendal, Ngawi East Java if their village, with many biogas systems, can be developed into a tourism village of energy. Increased public awareness of the transition to the use of fossil energy to be more environmentally friendly energy is higher. It can be utilized to develop this village into a village for biogas energy education. The increasing welfare of the community will be aligned with the increasing number of tourists presence. Based on the results above, the use of cow dung into a biogas can increase many benefits for the community.

CONCLUSION

According to the results of the calculation, when the amount of dirt from 32 cows utilized to the maximum biogas then, it will decrease CH_4 gas emissions by 1,952 kg or it will help to reduce the CO2e gas emissions by 48,800 kg/year of emissions for the area of Kendal District, Ngawi East Java and it will get the efficiency of lowering the cost of CO2e gas emissions processing in Ploso Ngamban Village, Kendal, Ngawi East Java by Rp 23.424.000/year.

The influence of the existence of biogas for the community economy of Ploso Ngamban Village, Kendal, East Java Ngawi is that the community can reduce the cost expenditure for fuel stoves, revenues will increase with the manufacture of organic fertilizer for organic farming, and the welfare of society can be increased by making the village as an energy tourism educational village.

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