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THE BIOGAS POTENTIAL ESTIMATION TOWARDS SIMANTRI PROGRAM IN BALI

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Keywords:

Biogas;
Simantri;
Zero Waste;
Livestock Waste;
Renewable Energy.

Abstract

The utilization of livestock waste became a biogas was part of implementing the Simantri (Integrated Farming System) in Bali. Moreover, the Simantri targets in Bali was to produce 4F (Food, Feed, Fuel, and Fertilizer). The word *Fuel* defined was the biogas energy. The biogas availability would be an energy source for farmers in fulfilling the energy needs for cooking. The livestock processing and utilization, especially, the cattle as a part of the zero waste concept. It was an effort to minimize the occurrence of soil, water, and air pollution that could potentially interfere the animal and humans health itself. In one Simantri group, it usually has at least 21 cattle. If a cow produces a waste, about 10 kg per day, therefore, the manure potential in one day reaches 210 kg. If it was 1 kg of waste cattle produced a biogas energy potential of 0,023 m3, then, in a day the Simantri could produce a biogas about 4.83 m^3. Using the equality value that 1 m^3 of biogas was equal to 0,46 kg of LPG, so that, for 21 cows in one group, the Simantri could produce LPG about 2,222 kg/day. The Simantri program still having some issues. The farmers and breeders were lazy in utilizing the biogas due to a houses distance. The biogas could not be distributed to more distant places because of limited capacity. It as well led not all Simantri participants' involving the livestock waste to be a biogas. The next issue was a limited capacity in abiogas digester. Due to thelimited capacity digester and retention time caused the farmers and breeders tend to accumulate a waste. In fact, accumulating a waste will be an effect to environments like a soil, water, and air pollution.

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1. Introduction

The Biogas has been defined as gas mixture that was produced by methanogenic bacteria that occurs toward materials that can naturally decompose under anaerobic conditions (Kaharudin and Sukmawati, 2010). It can also be defined as a process of bio-gas production from organic materials of bacteria in low oxygen conditions (Deptan, 2009). The Biogas technology is the right choice to recycle the organic farm waste to be an energy and fertilizer so that, it was obtained profits in terms of socio-economic and

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environmental (Haryati, 2006).

The Biogas in Indonesia began to be familiar since 1970. The high use and dependence on kerosene fuel and the firewood availability cause the biogas is used in developing less. The desire at adapting the biogas technology began squirming back since 2006 when the scarcity energy became a major topic in Indonesia (Wahyuni, 2011). It has a good prospect as an alternative energy to non-renewable in Indonesia. It is much cheaper than the fossil fuel energy sources (Saputri et al., 2014). The same opinion also stated by Ana et al. (2015).

In developing the Simantri program in Bali, the utilization of livestock waste become Biogas is the important thing. The Simantri targets are to produce 4F (Food, Feed, Fuel, and Fertilizer), which essentially is a step in maintaining the resilience and food and energy availability. The word *Fuel* defined was the biogas energy. The biogas availability would be an energy source for farmers in fulfilling the energy needs for cooking (The Department of Agriculture Bali Province, 2016). In recycling, the livestock waste (cattle) is expected the farmers have a valuable thing in fulfilling the need of energy. It is as well as an effort to prevent environmental pollution.

The problem that occurs is how potential the livestock waste that can be utilized by the Simantri farmers become a Biogas. In fact, not all the livestock waste able to be processed into Biogas by the Simantri members. The Biogas is distributed not for all members due to the distance between the farmer's houses are very far. It is needed the calculation or estimation of the biogas potential in the Simantri group.

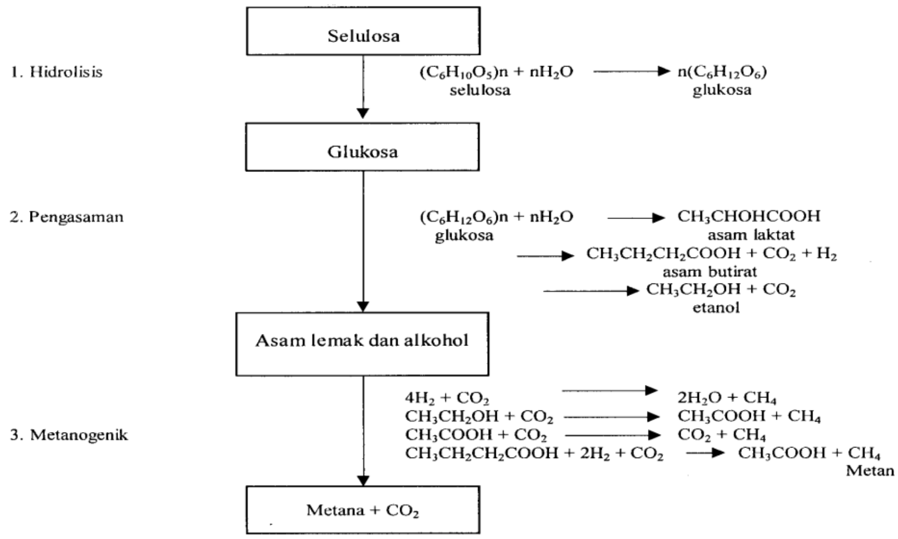
2. Research Method

The observation method is applied in this research. It is a method of data collection by direct observation in the field. The process is conducted by observing, recording, and note taking. It was also conducted a data collection by interviewing the Chairman of the Simantri SawoKabeh Dawan Klod Group and the Simantri Madani Desa Sampalan Klod Klungkung-Bali. The interviews were conducted to determine the livestock waste utilization become Biogas and the distortion in the Biogas developing. The data collection is also done by asking the data and interviewed the Simantri staff program at the Department of Agriculture and Foodstuffs Bali Province. The data related to standards and procedures for processing of Biogas Simantri, the number of Simantri in Bali, and the Biogas Simantri processing issues. The other data collection is done by the library studies i.e. to collect a research related to Biogas energy development, especially, that is directly related to the development of Biogas Simantri in Bali.

3. Results and Analysis

Biogas is produced by the breakdown of organic waste material that involves the anaerobic bacteria activities under anaerobic conditions in a digester. An anaerobic digestion processing over the three stages: hydrolysis, acidification, and methanogenic. The fermentation process requires certain conditions such as the C: N ratio, temperature, acidity is also the digester type that is used. The optimum conditions at a temperature are about 32-35 °C or 50 - 55 °C and pH between 6,8 - 8 (Haryati, 2006).

Figure 1. The diagram of anaerobic fermentation processes procedures



Source: Haryati (2006)

The cattle waste is one effective raw material for the biogas production. The cumulative biogas produced from the cattle waste that produces a gas which has a stable performance (Abubakar and Ismail, 2012). The biogas production from cattle waste, if it is done on a commercial scale, not only provide an alternative energy source but also will become a tool for waste recycling (Onwuliri et al., 2013). It is a potential and an efficient effort to cost-effective production. The biogas production will also be important in contributing the provision of environmentally save energy and to address climate change (Ozor et al., (2014).

Table 1. The Biogas production of different types of livestock waste

Livestock Waste Type	Gas Production
Cows and Buffaloes	0,023 - 0,040 m^3/Kg
Pig	0,040 - 0,059 m^3/Kg
Chicken (Poultry)	0,065 - 0,116 m^3/Kg

Source: Ministry of Agriculture (2009)

The Biogas typically consist of methane (CH_4) about 60-70% that is burned will produce a heat energy about 1000 British Thermal Unit/ft^3 or 252 Kkal/0,028 m^3 (Haryati, 2006). In addition, it consists of several other gases, like carbon dioxide, carbon monoxide, and nitrogen.

Table 2. The gas composition of biogas in cattle waste

Gas Type	Content
Methane (CH_4)	65,7 %
Carbon dioxide (CO_2)	27,0 %
Nitrogen (N_2)	2,3 %
Carbon monoxide (CO)	0,0 %
Oxygen (O_2)	0,1 %
Propane (C_3H_8)	0,7 %
Hydrogen Sulfide (H_2S)	Not measurable
Calorific value	6513 kcal/m^3

Source: Harahap et al. (1978; Haryati, 2006)

According to Sanjaya (2013), the implementation of the waste processing business of cattle by the farmer average Simantri members is moderate in Bali. It is proved to be the most dominant variable influence on the Simantri effectiveness. Zalizar1 et al. (2013) argue the cattle breeders with holdings at least 2-3 cows should be constantly motivated to make a biogas digester in its house, as a form of responsibility to maintain the health of humans, animals, and the environment. Ozor et al. (2014) argued the biogas use will not only serve as a source of fuel but will also help in waste recycling. According to Imam et al. (2013), the biogas technology can be aviable choice for developing countries on an energy production and substitution, if it properly managed and marketed.

According to Adijaya and Yasa (2012) the waste amount that is produced by the cows throughout proportional to feed consumption and a feed given quality. The average solid waste and urine produced the fresh cows reached 14.87 kg and 5.94 liters with an average feed and water consumption about 17.91 kg and 7.39 liters per day. Unlike Kaharudin and Sukmawati, (2010) that stated the adult cows in Bali produced about 6 to 8 kg/day. Kasworo et al. (2013) found a cow that everyday has a waste ranges 8-10 kg per day or 2.6 to 3.6 tons per year.

The colony house existence is part a development package Simantri in Bali. In one unit Simantri group, it contained one-colony house upon 21 cows. It will be equipped with biogas installations building capacity about 7 or 11 m^3. It will be targeted until 2018 in Bali there will be 1000 Simantri, it means that in 2018 in Bali there will be 1000 biogas installations. (The Department of Agriculture Bali Province, 2016).

Table 3. The Number of Simantri Group in 2009-2015

No.	Regency/City	Simantri Total
1	Badung	39
2	Buleleng	107
3	Bangli	73
4	Denpasar	8
5	Gianyar	69
6	Jembrana	55
7	Karangasem	67
8	Klungkung	54
9	Tabanan	74
	Total	547

Source: The Department of Agriculture Bali Province, 2016

If oneday, a cow produces waste about 10 kg, therefore, in one group of Simantri has manure material about 210 kg per/day. The Ministry of Agriculture (2009) data stated that was in one kilogram of cow waste can produce a minimum of 0,023 m^3 biogas, then, the biogas amount can be produced reached 4,83 m^3.

Economically, the biogas energy is cheaper than the other energy sources, therefore, the breeders are better to invest in building digesters independently than buying LPG. The government could provide subsidies to the breeders to reduce a dependence on LPG (Dianawati and Mulijanti, 2015). The biogas is used for ahousehold in scale the livestock 2-4 cows or supplies a waste about 25 kg/day. It is sufficient to use a tube reactor with 2500-5000 liters capacities to produce a biogas is equal 2 liters of kerosene/day and able to fulfilling the energy needs for cooking at six members in a family (Kaharudin and Sukmawati, 2010).

The benefit economically of biogas technology use can be seen from the application at thehousehold level, assuming an average having cattle to each house about 2-3 cows. A cow can produce an average of 23.59 kg waste per/day. In spending of IDR. 1.5 million, to buy a unit of biogas equipment, can make savings in the first year about IDR. 552.960. Whereas, the next year made profits about IDR. 1.037.540 million subtracted the care total cost per/year (Hastuti, 2009). The biogas energy amount economically can also be synchronized with other fuels, such as LPG, kerosene, diesel, gasoline and fuel wood.

Table. 4. The equality values of various energy types are compared by biogas

Energy Type	Equity Value Compared to 1 m^3 of Biogas
LPG	0,46 kg
Kerosene	0,62 liter
Solar	0,52 liter
Premium	0,80 liter
Firewood	3,50 kg

Source: Ministry of Agriculture (2009)

By using the equality value, that 1 m^3 of biogas is equal to 0, 46 kg of LPG, then, for 21 cows in one group of Simantri at one day can produce LPG about 2,222 kg/day. If it is then synchronized with kerosene, therefore, obtained about 2,995 liters/day. According to Saputri et al. (2014), that the energy that consists of one cubic meter of biogas can also be synchronized with the electric energy of 4.7 kWh or can be used, unlike a lighting 60-100 watt for 6 hours.

Biogas produced from animal waste (the waste of cattle and pig) to produce an energy source that can be purified and stored in gas cylinders and used efficiently for direct heat conversion (Aremu and Agarry, 2012). Biogas purification is done to increase the combustion calorific value and prevent corrosion. The biogas is completed in 95% CH_4 composition (is equal pipeline quality natural gas), will be economically viable if the minimum waste capacity about 100 tons/day. This is a cheaper method that uses a water scrubber (Wahyu et al. 2012). The biogas purification can be done by the absorption method. The absorption method process can use an alkaline solution of $Ca\ (OH)_2$ (dissolved limestone) as the absorbent biogas (Nadliriyah dan Triwikantoro, 2013). The iron chips can be also used as an effective material to purify biogas of impurities H2S gas. An iron chips are changed to iron oxide or metal hydroxide is reacting with oxygen at heating or burned it is smoldering iron looks red and cool be slowly allowed in the furnace (Sunaryo, 2014).

In developing the biogas energy, through household digester must be started due to being very beneficial to the farmers and rural communities at fulfilling their energy needs. It helps in reducing a waste, and the other side is to provide energy for the farmers (Rajendran et al., 2012). Although in processing the livestock waste become biogas, several factors must be considered to obtain a high biogas production volume. It was included the temperature variations, pH, and the total of solids concentration (Imam et al., 2013).

The main reason why the Simantri members did not utilize a livestock waste become biogas due to the distance between their houses to the processing place. The biogas can not be distributed to more distant places because the capacity is limited and there is no safe and cheap technology to its distribution (Sartono, 2007). Unlike, this condition also occurred in the Simantri group in Bali, wherein, the biogas was produced, could only be consumed by the near place members. Therefore, not all Simantri members involved in the livestock waste processing become biogas. The result is fewer workers in processing livestock waste become biogas, then, not the whole cow waste is processed.

The challenge in developing the biogas i.e. the capacity is limited for biogas digester. Due to thelimited capacity digester and retention time, cause the farmers and breeders tend to accumulate a cattle waste. Though, it will have an effect on the environment unlike the soil, air, and water pollution, that could potentially interfere the cattle and human health (Kasworo et al., 2013). In addition, to accumulate livestock waste, some of them also throw the waste elsewhere, there is even a farmer who let the waste in several days so that, the Simantri house sanitation becomes ugly that can influence the cattle health (Budiyanto, 2011). The biogas utilization contributes the reduction in firewood use. The reduction in the use of firewood contributes to greenhouse gas (GHG) emissions. GHG reduction and conservation of trees contribute for mitigating a climate change (Chad et al., 2012).

4. Conclusion

The processing and utilization the livestock waste as a biogas in the Simatri program in Bali is one of the environmentally go green. The biogas utilization is also part an effort to save energy in fulfilling the farmer family energy needs. Biogas utilization in terms of the environment is an attempt to minimize environmental pollution from the livestock sector. It was an effort to minimize the occurrence of soil, water, and air pollution that could potentially interfere the animal and humans health itself. In one Simantri group, it usually has at least 21 cattle. If a cow produces a waste, about 10 kg per day, therefore, the manure potential in one day reaches 210 kg. If it was 1 kg of waste cattle produced a biogas energy potential of 0,023 m3, then, in a day the Simantri could produce a biogas about 4.83 m^3. Using the equality value that 1 m^3 of biogas was equal to 0,46 kg of LPG, so that, for 21 cows in one group, the Simantri could produce LPG about 2,222 kg/day.

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