Assessing The Potential of Biogas Production from Cattle Markets: A Case Study of Geidam, Yobe State

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Abstract

The depleting and costly nature of fossil fuels have necessitated the need to look for alternative energy sources which are generally regarded to be readily available and sustainable. Biogas is one of those renewable energy sources that offers great opportunities for the generation of environmental friendly energy. This research focused on assessing the potential of producing biogas from cattle market in Geidam using cow dung the feedstock. Field observation and surveys were the methods employed during the research. The result of the sturdy revealed that there are about 10000 cattle are gathered every week in the market with the capacity of producing an estimated 100000kg of dung per week, which can be converted to approximately 4000m^3 of biogas. The research concluded that Geidam cattle market holds a huge potential for producing biogas from cow dung which can be used as a means of both waste management and promoting economic activities.

Keywords: *Biogas, Renewable energy, Anaerobic digestion, Cow dung, Fossil fuel*.

Introduction

There is currently worldwide quest to achieve renewable and sustainable energy. This is particularly necessary because of the depleting nature of the conventional energy resources such as fossil fuels. As such, there are various attempts to explore the use of alternative energy sources like biogas.

Biogas is the gas produced by the anaerobic degradation of organic matter (Manesh et al. 2020). Biogas energy is one out of the many sources of renewable energy. It is produced from many raw materials such as sewage, liquid manure of hens, animal dung, organic wastes and other forms of biodegradable wastes most especially from the food industry (Adelekan and Bambgoye, 2009). The main application for biogas is electricity generation, thermal applications like cooking, heating, and lighting, and production of biofuels (Kabeyi & Olanrewaju, 2022).

Cattle markets which served as centre of commerce for trading livestocks for decades in northern Nigeria, holds a large quantity of cow dung that can be properly harnessed for the production biogas. This can go a long way in mitigating environmental and health issues occurring as a result of poor management of cow dung wastes in the cattle markets.

Geidam local government area of yobe state can offer an exceptional opportunity in this regard due to its active cattle market coupled with enormous agricultural activities in the area.

This research aims to evaluate the feasibility of utilizing cow dung obtained from cattle market in Geidam to produce a biogas, a renewable and environmentally friendly source of energy. This can significantly promote effective waste management practices because the waste that would otherwise litter the environment can now be utilized to produce sustainable energy. The research can also pave the way for addressing issue of deforestation arising from over utilization of firewood for cooking purposes because the biogas can serve as a partial replacement of the firewood which can in turn counter the effects of deforestation in our environment. The move can also serve as an employment generation opportunity in the community by providing young men the opportunity to exploit the underutilized resources that litter the cattle markets.

THEORY

What is a Biogas

Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen (Bhatia, 2014).

Biogas is produced by anaerobic digestion or fermentation of biodegradable materials such as biomass, manure, sewage, municipal waste, green waste, plant material and energy crops (Bhatia, 2014).

Biogas produced from anaerobic digesters is usually a mixture of CH4 (50%–75%) and CO2 (50%–25%). Unwanted CO2 will reduce the quality of biogas, and expensive upgrading processes are required to purify it (Sangeeta et al., 2020).

Biogas production process is dependent on many factors such time and temperature. According to Kristoferson & Bokalders (1986), The more the time that is allowed for the degradation process to take place, the more complete the generation will be and the more biogas will be produced. Also, the higher the temperature, the faster is digestion and biogas production (Kristoferson & Bokalders, 1986).

Biogas Production Potential in Nigeria

Nigeria generates about 542.5 million tons of the above selected organic waste per annum. This in turn has the potential of yielding about 25.53 billion m^3 of biogas (about 169 541.66 MWh) and 88.19 million tons of bio fertilizer per annum. Both have a combined estimated value of about N 4.54 trillion ($ 29.29 billion). This potential biogas yield will be able to completely displace the use of kerosene and coal for domestic cooking, and reduce the consumption of wood fuel by 66%. An effective biogas program in Nigeria will also remarkably reduce environmental and public health concerns, deforestation, and greenhouse gas (GHG) emissions (Ngumah et al., 2013).

Benefits of Using Biogas

Biogas technology offers environmental advantages that are frequently seen as a viable and strong option for hydrocarbon deposits (Cecchi & Cavinato, 2015). Along with the depletion of greenhouse gas (GHG) emissions, biogas will improve energy protection, especially, due to its impressive high energy potential. Biogas is viable source of renewable energy, it enables the extraction of agricultural by-products and industrial waste with a depleting energy potential. Biogas is a non-toxic, colorless combustible gas, that is created by decomposition of organic matter.

MATERIALS AND METHODS

Field Observation

In this research, weekly visits were carried out to Geidam cattle market for a period of one month. Various factors such as dung generation pattern, number of cattles in the market and waste management practices were ascertained during the visits.

Surveys

Comprehensive survey was conducted among cattle traders and important information regarding dung management practices, willingness to participate in biogas generation activities was gathered.

Biogas Potential Assessment

The estimated amount of dung generated within the cattle market per day was estimated using equation (1):

$$Quantity\ of\ Dung\ Produced\ Per\ Day\ (kg) = Number\ of\ Cattle\ in\ the\ Market \times Average\ Amount\ of\ Dung\ Produced\ by\ One\ Cattle \quad ------(1)$$

Number of Cattle in the Market = 10000, Average Amount of Dung Produced by One Cattle = 10kg (Akpan et al 2022.)

$$Quantity\ of\ Dung\ Produced\ Per\ Day\ (kg) = 10000 \times 10$$

$$Quantity\ of\ Dung\ Produced\ Per\ Day\ (kg) = 100000kg$$

The estimated amount of biogas that can be produced in the market per day was calculated using equation (2):

$$Amount\ of\ Biogas\ Per\ Day\ (m^3) = Quantity\ of\ Dung\ Produced\ per\ day\ (kg) \times Amount\ of\ Biogas\ Produced\ by\ 1kg\ of\ Dung \quad -------(2)$$

Quantity of Dung Produced Per Day = 100000kg, Amount of Biogas Produced by 1kg of Dung = $0.04m^3$ (Akpan et al 2022.)

$$Amount\ of\ Biogas\ Per\ Day\ (m^3) = 100000 \times 0.04$$

$$Amount\ of\ Biogas\ Per\ Day\ (m^3) = 4000m^3$$

Results and Discussions

Results

Field Observations

Visits to Geidam cattle market indicated that, on average, there are about 10000 cattle present each week in the market.

The visits also showed that the dung production followed a similar pattern each week. Large quantity of dung is usually observed in the evening time during the closing hours of the market.

It was observed that dung management practices in the market was very poor. The dung is usually littering on the ground causing environmental and health hazards.

Surveys

The result of the survey among cattle traders and other stakeholders in the market revealed that most of the traders and the stakeholders are unaware of the processes and the benefits of producing biogas from cow dung. However, they express their keen interest of participating in the program.

Biogas Potential Assessment

According to the estimated 10000 cattle every week in the market and an average daily dung output of 10kg per cow, the market can produce an estimated 100000kg of dung per week. Regarding the biogas potential, with a conversion rate of 0.04m^3 per kg of dung, the markets daily biogas production potential is estimated to be approximately 4000m^3.

Discussion of Result

The result of the study revealed that significant number of cattle are gathered every week in the market, which are generating a large amount of dung that are managed poorly. This causes severe environmental and health challenges that needs to be addressed urgently. The result also indicated that there is lack of awareness among the traders and the stakeholders alike on the dangers associated with poor management of waste such as cow dung in market places. Innovative ways of managing the waste for producing valuable materials like the biogas are also not known for the traders. The result also indicated that significant amount of biogas can be produced from the market weekly which can be used to do many activities such as cooking in households.

Conclusion

In summary, it can be said that Geidam cattle market harbours large number of cattle every week, which are generating significant amount dung that can be converted in some innovative ways to valuable materials like the biogas. The research, if implemented, cannot only serve as a waste management activity, but also as an employment generation and wealth creation activity because biogas generating plant in cattle markets can employ many unemployed youths in the community, thereby reducing poverty among them.

Recommendations

Considering the findings of the research, the following recommendations are suggested:

Effective awareness on the possibility of producing biogas from dung should be provided to the cattle traders, local population and other relevant stakeholders. This will facilitate easy adoption of the scheme.

The cow dung obtained from Geidam cattle market should be analysed in order to know its chemical composition. This will help to accurately predict the quantity of biogas that can be obtained from the dung.

Government at all levels should come in to the scheme and play important role in many areas such as provision of public awareness about the program, construction of biogas plant, enforcement of rules and regulations etc.

There should be a comprehensive feasibility studies on the suitable location where the biogas plant should have situated.

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