Short review on the prospects of human biogas utilization in Nigeria

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Abstract. Energy challenge in Nigeria is really disturbing due to many factors that borders on the inability of the national grid to meet-up with the huge energy demands in the most populated country in Africa. About 85% industries and domestic users patronize fossil fuel generators. This development had increased the air pollution load over the country. In this research, fourteen years dataset from the Nigeria Metrological Agency (NIMET) was used to simulate the energy accruable from solar energy in Nigeria. The study is poised to enhance higher patronage of solar technology in the research site.

Keywords: energy, biogas, human waste, renewable energy

1. Introduction
In today's energy-intensive society, it is a must to probe and profit from new renewable and eco-friendly energy sources [1]. Various cellulosic biomass (cattle dung, agricultural residues, etc.) are available in rural areas of developing countries in abundance that have very good potential to meet the demand for energy, particularly in the domestic sector. In India alone, there is an estimated over 250 million bovine animals in India alone, and if 33% of the waste created yearly is accessible for biogas generation, in excess of 12 million biogas plants can be introduced [2]. Biogas technology provides a very attractive way to use certain biomass categories to meet domestic energy needs in urban and rural areas.

The high demand for fuelwood which is a big business in places like Nigeria, has monumentally grown with the rise in the population of the world, leading to the loss of trees and forests, through a process called deforestation. In any case, individuals appear to overlook that the wood radiates from the trees in the backwoods, and notwithstanding certain guidelines concerning the utilization of woods, the exercises of unlawful lumberjacks can't be totally regulated or diminished. The deforestation level is higher than the forestation endeavours, and this has brought about ecological corruption. The best obstruction to the recognition of these guidelines is the nonappearance of elective wellspring of fuel, for example, the lamp oil and other oil local fuel [3].

Biogas is a gaseous fuel containing 60% methane, 40% carbon dioxide and small amount of hydrogen sulphide, nitrogen and hydrogen. It is obtained from biomass-plant and animal materials, by the process of anaerobic (absence of oxygen) digestion or fermentation, of which the in-feed to the biogas plant includes: urban waste (garbage), urban refuse, agricultural waste, cow dung-case study. Biogas is used as biofuels that originates from biogenic material, can be used for cooking, heating, generating electricity and running a vehicle [4].
The richest forms of biogas or biofuel materials are cow waste (i.e. cow dung) due to the already digested state from the multiple stomachs of the host [5]. Cow dung is easily gotten in large quantity from rural areas. But in an area like urban settlements where cow dung is not easily gotten, the only other alternative is human waste, and this is richly available in the sewage sludge. More so, the continuous use of cow dung (or its alternative i.e. bird droppings) for biogas production would be a huge problem to local farmers who adopts the natural manure from animal waste.

This review examines the prospects of biogas generation from human waste in Nigeria. According to Worldometers [6], the population of Nigeria is approximately two hundred and one million (200 million) people (Figure 1). The distribution of the human population is displayed in Figure 2. This means that Nigeria has a huge biogas potential from human waste if it is properly explored. The conversion of human waste to biogas has taken the center stage in research with amazing results in literatures [7-10].

![Figure 1: Progression of Nigeria population [6]](image1)

![Figure 2: Distribution of Nigeria population](image2)
2. Sources of Biogas

Biogas refers to a gas created by the natural degradation/crumbling of natural issue without oxygen. Natural waste, for example, decomposing plant and creature tissue, creature fertilizer, and kitchen waste can be changed over into a vaporous fuel known as the 'Biogas'. Biogas starts from organic material (i.e. resulting from biological activities) and is a type of biofuel, which is commonly used to depict auxiliary sustainable powers that are gotten by bottle concoction handling or the bioconversion of biomass particularly carbonaceous waste materials [11].

Biogas is a vaporous fuel acquired from biomass by the procedure of anaerobic assimilation or maturation, when microscopic organisms corrupt natural material without oxygen. The in-feed or raw material to the biogas plant or bio-purification chamber for the production of biogas includes:

a. Manure (for example cow dung)
b. Urban waste (sewage sludge)
c. Green waste
d. Garbage
e. Agricultural waste.

Methane (CH2) and CO2 carbon dioxide constitute biogas and can also include hydrogen sulphide (H2S), dampness and siloxane traces. Oxygen may be used to burn the gasses methane, hydrogen and carbon monoxide (CO). This release of vitality allows biogas to be used as a fuel. For any warming reasons, for example, cooking, biogas may be used as fuel in any nation. In anaerobic digesters it can also be used where in a gas motor it is commonly used to convert power and warmth into the vitality of the gas. Like gas, biogas can also be compacted and used for control of motor vehicles. In the UK, for instance, biogas is evaluated to have the capability of supplanting around 17% of vehicle fuel. Biogas is an inexhaustible fuel, so it meets all prerequisites for practical power source assignments in specific bits of the world. Biogas can in like manner be tidied and climbed to vaporous oil models when it advances toward getting to be bio-methane [4,5]. The biogas sources and the corresponding yield is presented in Figure 3 below.

Figure 3: Biogas sources and yields [12]
In order to have an in-depth understanding of biogas, it is very vital to have a good understanding of organic waste; what they are, their examples, and their environmental impacts. A natural waste in this way is whatever originates from plants or creatures that is biodegradable, which are substances that will rot generally rapidly because of the activity of microscopic organisms and separate into components, for example, carbon that are reused normally. The types of biowaste includes: agro-food Industries waste, green waste; waste-water treatment sludge, grease etc. Organic waste has both negative and positive impacts to the environment and its entire component (biotic and abiotic). A great part of the land utilized for waste transfer can't be reused later on due to defilement. This happens when litter in landfills is packed and the air is crushed out. The garbage separates anaerobically (without oxygen), which implies that acids are delivered. The acids influence other refuse things, for example, plastic, to make a poisonous blend known as leachate. Leachate gathers at the base of landfills where it at that point saturates the ground water and from that point into the conduits [13-14].

The use of waste transforms waste into a kind of useful imperative. One ton of waste (2,000 lbs.) has as much warmth as 500 lbs of charcoal. Not all of junk is biomass; maybe half of its compelling content comes from plastics supplied through oil and petroleum gas. Power plants which wastes are essential and referred to as waste plants. On the other hand, real burnable garbage and not coal is the fuel used to fire their boilers, as do coal-ended factories. Waste power costs more than coal and other sources of vitality. The main ideal position for solid waste expenditure is that it reduces 60% to 1990% of waste dumped on sites, thus lowering sites' exchange costs. It likewise utilizes the vitality in the rubbish, as opposed to covering it in a landfill, where it stays unused [10-11].

Another source of biogas is the landfill gas. Landfill gas is an astounding blend of different gases made by the action of microorganisms inside a landfill, which is a carefully structured misery in the ground (or based over the ground, resembling a football field) into which wastes are put. The point of having this landfill is to maintain a strategic distance from any pressure driven (or water-related) association between the squanders and nature, most particularly the groundwater Bacteria and growths are not fussy eaters. They are saprophytic. An organism on a spoiling log is changing over cellulose to sugars to encourage itself. Although this procedure is obstructed in a site, the methane gas substance is still created as waste rots [16].

For safety and ecological reasons, new guidelines expect methane deposits to collect. Methane gas is boring and fragrant but is not harmless. If it saturates nearby homes and is touched off, the gas can cause flames or blasts. Methane gas can be collected, sanitized and used as fuel by waste dumps. Methane is a decent source of vitality, which is the main fixation in gas petrol. Most gas heaters and stoves use methane from services. The East Kentucky Power Cooperative began to recover methane from three waste dumps in 2003. The gas company is currently using gas at five sites to generate 16 MW power–enough for 7,500 or 8,000 homes to be controlled [16,17].

3. Human waste: future trends
The human waste is vital for biogas production. The composition of the solid human waste is made up several components as presented in Table 1.
Table 1: Component of solid human waste

| Component               | Percentage |
|-------------------------|------------|
| Nitrogenous matter or Protein | 2-25%      |
| Carbohydrate            | 25%        |
| FAT                     | 2-15%      |
| Organic humus           | 25-54%     |

Hence, the human waste has the following advantages: biogas as a fuel option in contrast to wood, oil, LPG and power; slime from the bio-gas reactor could be utilized as manure. Natural nitrogen from waste will be changed into smelling salts nitrogen, a type of nitrogen which plants can take-up effectively. The robustness of sewage sludge design determines the maximum biogas production. The water closet system have disadvantage of having excess water over the solid human excreta (Figure 4). More so, the excretal is broken down into smaller beats due to collision with the walls of the connecting pipes and sewage tank. This reduces the biogas production and quality. The other option is the latrine system that allows the excretal to be in its original form as presented in Figure 5. The advantage is that the biogas yield and quality is high compared to the water closet system.

Figure 4: Water closet system [18]
More than 80 million Nigerians live in the rural areas and 30 million of the rural dwellers adopt the latrine system. Hence, the biogas generation have huge potentials if adequate or robust sewage design systems are used.

4. Conclusion
Biogas generation from human have been discussed as a viable alternative biogas source due to availability. Domestic energy needs for cooking and mini-power generating plant is a possibility. This will greatly reduce anthropogenic emissions due to biomass burning. In other words, biogas production from human waste may likely gain potential because it's a lot cheaper than solar energy generation – both in the short and long run. Based on the human population and the current toilet system adopted by over 40 million of the populace, the kick-off cost for individuals and small businesses will be appreciably low. It is recommended that the human waste biogas can be enhanced if homes can adopt robust sewage sludge system.

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5. References

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