



Understanding the Potential of Biomass as an Alternative Renewable Energy in Nigeria

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Abstract

Energy generation and distribution in Nigeria has been epileptic as only about 60% of the nation's population have electricity. With the majority of the country's electricity needs generated from gas power and hydro-power plants, it is pertinent and of great importance for the country to look towards other alternative and renewable energy especially biomass in order to meet its electricity demands. This paper aims to show the possibilities available in biomass by collecting data of amount of waste collected daily and calculating the electricity generating capacity.

1. Introduction

Energy generation and supply have been an issue of great concern in Nigeria. Nigeria, one of most populated countries in the world with a population of about 190 million people, is enriched with diverse renewable and non-renewable energy sources like large coal base, iron ore, solar, hydropower, crude oil and natural gas. Despite this huge energy generation potential, only about 60% of her population have access to electricity [1] [2].

Nigeria is ranked 123rd out of 128 countries in the World Energy Council's Energy Trilemma Index ranking. The country has improved significantly in global energy security due to increased energy storage and system stability but poor performance in energy diversification and environmental sustainability drops its overall global energy rank [2]. 80% of the power produced in the country is from gas-fired power plants with hydro-power accounting for just 14% of electrical production. Nigeria is one of the largest oil producers in the world and the solar irradiation in this country is highly remarkable [3]. For Nigeria to solve its current power supply problem, renewable energy must be incorporated into its electricity sector on a larger and commercial scale. The renewable energy potential in Nigeria is more than enough to meet the energy demands of all sectors if properly and efficiently harnessed along with appropriate policies and implementation. Biomass is the largest renewable energy source used (actively or passively) in Nigeria. This country is very rich in biomass resources such as forage grasses and shrubs, wood, forest wastes, municipal and industrial wastes, agricultural waste and aquatic biomass [4]. While biomass and solar energy are in passive use, resources such as wind and geothermal energy are more or less redundant in the country. Nigeria's hydroelectric power generation is commendable as 13% of the country's total electricity generation is from this source [1].

Biomass renewable energy is a very reliable and efficient alternative energy source amongst other renewable energy sources. It is a renewable source of fuel to produce energy [5]. Biomass is fuel from organic materials, a renewable, sustainable and clean energy used to generate electricity. Some of the materials that make up biomass fuels are: Green crops; Agriculture/food waste; Forest debris/waste; Community or local solid waste (Refuse); Agriculture residue.

Biomass is a proven available fuel-input for power generation. To utilize these resources properly, biomass should be converted to energy which can meet a sizeable percentage of the country's demand deficit. Electricity can be generated by incinerating plant residues, liquid biofuels like ethanol can be produced by the fermenting of plant matter, and this fuel burnt singly or in combination with conventional fuels for purposes such as heat generation for cooking, provision of a mechanical drive for the generation of electricity. Organic matter may also be allowed to decay, producing biogas, which is then burned [6].

A lot of contention and passionate views on the renewability and sustainability of biomass energy source had been established, particularly where large power stations are in the process of switching a significant of their fuel to biomass. The carbon dioxide, CO₂, released in the combustion process of biomass is often more than would be released if we were burning the equivalent in coal, oil or gas. To sustain biomass, the following should be done; Source locally; this will enhance local businesses; Research more on the extraction process; Make the most of waste; The best biomass systems make use of waste that would have been sent to landfill where their decomposition releases protect greenhouse gases like methane; Support sustainable land management- show support for crops that encourage the healthy management of biodiversity and forests. Avoid crops that damage the local ecosystem.

Biomass is not a carbon-neutral fuel source as there are CO₂ equivalent emissions in biomass fuel. However, measuring the carbon footprint of biomass is so challenging due to the complex nature of earth's living systems. To calculate the precise carbon savings of a biomass energy system can be tasking but despite being difficult to quantify, biomass can provide both a cost-effective and low carbon alternative when sourced sustainably.

This paper aims to study the potentials available in biomass for electricity generation towards achieving a greater energy generation and supply in Nigeria. To achieve this, data of waste collection is taken from 6 wards in Somolu Local Government of Lagos State, Nigeria and calculating the amount of electricity that can be generated from such.

2. Methodology

2.1 Sources of Biomass

Biomass can be sourced from food, cash crops, and animals. The biomass fuel obtained from these sources is mainly ethanol. Ethanol is a liquid fuel that is extracted from starch like cassava and sugar through cane through fermentation [5]. Other types of biomass fuel include biogas (Methane), Carbon dioxide from putrefying plant and animal matter in landfills [7]. In Nigeria, the total energy supply is 105 Million Tonnes of Energy with Crude oil contributing 14%, Natural gas 7%, Biomass 78% and Hydro 1% [8]. Agriculture has provided a larger share of biomass with animals, agricultural waste and wood residue estimated to be 1.2 PJ in 1990.

2.2 Data Collection

For this paper, to uncover the potential of generating electricity through biomass in Nigeria, data of waste collection was gotten. The average daily amount of bio-waste collected per year in 6 wards

of the Somolu Local Government Area in Lagos State, Nigeria for the year 2017 was taken from the Lagos State Waste Management Authority. The data is presented in Table 1. With the heavy tonnage of local waste product as shown in Table 1 for a few wards in Somolu local government in Lagos State, then biomass is sustainable in this part of the world.

3. Results and Discussion

In this study it is assumed that the heating value of biomass waste is 15 GJ t^{-1} . The efficiency of biomass is assumed to be 24%, so that 1 t of biomass would generate one MWh of electricity [9].

Table 1: Average Quantity of Biomass and Mega-Watt generated per Year.

Ward	Average (kg) Daily	Total Per Year (Tonnes)	MWh Generated
A	24,381	8899.1	8899.1
B	23,604	8615.5	8615.5
C	25,723	9388.9	9388.9
D	22,091	8063.2	8063.2
E	25,235	9210.8	9210.8
F	25,151	9180.1	9180.1
Total	146, 185	53, 357.6	53, 357.6

It is shown in Table 1 that an approximate 53,357MWh or 0.0534TWh of electricity can be generated per year in just 6 wards in Somolu LGA of Lagos State and with more wards across all local governments, the electricity generated also increases. In [9], a massive 1,357TWh was generated in China in 2000 while Sri Lanka, Malaysia and India produced 6.8TWh, 66.7TWh and 477.2TWh respectively from biomass plantation.

In order to achieve this level of energy generation in Nigeria, the 4 major barriers as highlighted in [9], which are the technical, financial, institutional and policy barriers should be critically addressed. To harness the great potential of biomass energy especially with the huge availability of bio-waste in the Somolu area of Lagos state, it is essential that the construction and building of a biomass power plant be facilitated and implemented. This will go a long way in meeting the energy demand of the residents of the area.

4. Conclusion

The epileptic power supply in Nigeria can be improved upon by using waste generated to produce more electricity for homes and industries across the states. Based on the level of waste generated daily in Lagos using Somolu as a case study, electricity generation from biomass is sustainable because of the huge tonnes of waste generated all over the nation. It is important and encouraged that bio-waste data across the country should be obtained in order to fully understand and establish the potential in Nigeria energy production. Bio-fertilizer can also be derived from the remnant of the waste.

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