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OVERVIEW OF BIOMASS ENERGY PRODUCTION IN NIGERIA: IMPLICATIONS AND CHALLENGES

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ABSTRACT

Of late, much attention is being focused on identifying suitable alternative and renewable energy sources, which can provide high-energy outputs, to replace conventional fossil fuel energy sources. The total energy stored in terrestrial biomass is not only enormous but is also highly available and renewable. Biomass if properly harnessed can form a substantial part of future energy sources which will reduce the pressures on the global energy crises. The type of biomass required is largely determined by the energy conversion process and the form in which the energy is required. This paper will give an overview of the different types of energy generation using biomass sources, focusing on the challenges and implications of each for the Nigerian society.

Keywords: bagasse, biomass, biofuel, cow to kilowatt, cow dung, cassava, sugarcane and rice husk.

INTRODUCTION

Biomass refers to the diverse materials obtained from plants and animals, which can be used as raw materials for the creation of useful energy in various forms and for diverse purposes (Sambo, 2005). Biomass comes in variety of forms, but can be classified broadly in terms of end- use into fuel biomass, feed biomass, fibre biomass, organic fertilizer biomass and chemical biomass. Furthermore, the method of biomass production depends on the type of biomass.

It has been noted that the by-products of biomass constitute urban and industrial wastes, the poor management of which represents the most serious urban and environmental public health problems in Africa. Energy (and other resources) recovery from these wastes therefore has the potential of greatly altering the situation - turning an environmental liability into a socio-economic and poverty alleviation asset (Kishamba, 2008).

In order to utilize these resources properly, biomass should be converted to energy which can meet a sizeable percentage of the country's demand. Electricity can be generated by incinerating plant residues, liquid bio fuels 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 mechanical drive for the generation of electricity. Organic matter may also be allowed to decay, producing biogas, which is then burned.

In all of these, environmental, economic and social impacts of biomass technology cannot be overlooked. Burning biomass produces many of the same emissions as burning fossil fuels. However, growing biomass captures carbon dioxide out of the air, so that the net contribution to global atmospheric carbon dioxide levels is lessened. The process of growing biomass is subject

to the same environmental concerns as any kind of agriculture. It uses a large amount of land, fertilizers and pesticides for cost – effective growth. Biomass that is produced as a by- product of agriculture shows some promises, but most such biomass is currently being used for plowing back into the soil as fertilizer. Biomass production leads to social participation as communities learn waste management, and to economic growth in that biomass production creates employment and provides income to both the government and the general average populace whose standard of life is also significantly improved.

In this paper, biomass from cassava, sugarcane, rice husk and cow dung are discussed. The paper is divided as follows: Section 1 is on fuel biomass from cassava, Section 2 is on biomass from sugarcane, Section 3 is on biomass from rice husk, and Section 4 is on biomass from cow dung, while in Section 5 the conclusion of the work is presented.

Fuel Biomass from Cassava

Fuel Biomass comprises of all chemical energy sources in solid, liquid and gaseous forms obtained by processing plant and animal materials. These fuels can be burnt singly or in combination with conventional fossil fuels for the generation of thermal energy for purposes such as cooking, drive or the generation of electricity.

One type of biomass fuel is ethanol. Ethanol is a liquid fuel that can be produced from starchy materials like cassava and sugarcane through fermentation. Other types of biomass fuel include biogas from waste and putrefying plant and animal matter in landfills or biogas digesters (Sambo, 2005). In this section, only liquid biomass fuels – mainly ethanol –are considered.

The bias towards cassava for this purpose is informed by its abundance throughout Nigeria. An effort by the government such as the policy during Obasanjo's government for flour makers to include cassava in their flour should have been encouraging farmers to produce even more of it in recent years.

Currently, most ethanol production in Nigeria is from petrochemicals, which has the undesirable effect of tasking the nation's crude reserve even more. A switch to an alternative such as cassava is therefore more than timely. This would have the desirable effect of not just reducing the dependence on petroleum fractions for the production of ethanol, but also create employment in the rural areas where cassava is grown. The financial benefit to cassava farmers need not be stressed.

Cassava is used for the production of many staple foods in Nigeria, among them "garri", "fufu" and "alibo". Using cassava for the production of ethanol will therefore compete seriously with these other uses. The potential risk is that there could be less cassava for food or cassava for food might be too costly that life for an average Nigerian may be seriously disrupted. Furthermore, as the use of cassava for the production of ethanol will no doubt increase the demand for cassava, this venture may turn cassava into a very profitable cash crop than it is at present, and farmers may abandon the cultivation of other crops in favour of it, disrupting food supply in the country. The lesson is that effort at encouraging a bio fuel enterprise of this nature need to be pursued alongside measures that ensure it does not disrupt food supply in the country. Such measures no doubt, will include engaging farmers on the need to give equal attention to the cultivation of food crops in the face of a cassava boom, subsidizing food crop production by providing farmers with seedlings, farm implements, fertilizer, finance, etc to help them grow food crops easily.

The use of biomass creates a number of the same emissions characteristic of the use of fossil fuels and in addition to this is the pressure on the land. However, re grown biomass removes carbon dioxide from the atmosphere, leaving nature balanced and by a careful balancing of priorities efficient use can be made of the land without undue stress. But perhaps the greatest benefit from ethanol production using cassava comes from relying far less on fossil fuel, for the damage done by an overdependence on fossil fuel consumption goes beyond the emissions that result from it. Fossil fuel has to be extracted from the ground or underwater before it can be processed into useful fractions, and anyone acquainted with the situation in the Niger – Delta area of the country where such explorations have been ongoing for decades need not be told of their adverse effects on the land and water. In addition to that fact, considering the processes of extracting ethanol from cassava and petrochemicals from petroleum and then to ethanol, considerable energy savings could be implied by the former which also has the added benefit of being able to extend the longevity of our crude reserve.

The creation of employment through ethanol production from cassava has already been mentioned. Now, it can be added that biomass in the form of ethanol represents stored energy that can be used both in generating electricity and exported, in either case with more funds accruing to the government in taxes on products. Furthermore, petrochemical and pharmaceutical enterprises use ethanol, and a boost in its production no doubt will boost activity in those areas of the economy, with more jobs and more money added to the economy

Biomass Energy from Sugarcane

Sugarcane (*saccharin spp*) is a perennial grass that thrives in the tropical and sub-tropical regions. It requires a frost-free climate with sufficient rainfall during the growing season. As it grows, Sugarcane converts sunlight into chemical energy which it stores inside the plant. Each of the following main plant components contain approximately one-third of its stored energy.

a. Juice – The sweet liquid inside sugarcane stalks containing sucrose used to provide sugar and ethanol.
   b. Bagasse – The dry, fibrous residues left after sugarcane is crushed. One ton of cane produces 270 kilos of bagasse.
   c. Straw – The tops and leaves of sugarcane stalks.

Most practices in Nigeria have involved burning of sugarcane straws in order to drive away snakes and potentially poisonous animals. This process leads to the total destruction of one-third of the energy content of sugarcane. It has also been discovered that vast majority of emissions come from burning the sugarcane field prior to harvesting. Experts have estimated that straw can be burned alongside bagasse in high efficiency boilers to produce bioelectricity that could reach 11500MW (Heinimo, 2009).The bagasse which constitutes major waste product especially in the dry season has the potential power generation of the range 1000 to 9000MW depending on the technology used.

The juice forms a major source of both sugar and ethanol. Ethanol is now widely used to produce a biofuel called bioethanol. The overwhelming advantage of bioethanol for the environment is its potential to be carbon neutral on a lifecycle basis – meaning that the carbon dioxide (Co_2) emitted during its use is offset by the absorption from the atmosphere during growth. This ensures reduction of air pollution and harmful emissions. Compared to gasoline, sugarcane ethanol cuts greenhouse gases by at least 60%. Bioethanol has been employed successfully as

fuel for vehicles in its pure form. It can also be used as gasoline additive to increase octane and improve vehicle emissions. Success story of the use of bioethanol abound in countries like Brazil, the U. S and many other developed countries. Ethanol can reduce Nigeria's dependence on fossil fuels. Sugarcane ethanol is one more option for diversifying energy supplies and improving energy security.

Nigeria has vast uncultivated lands in regions which suits perfectly the cultivation of sugarcane. Some of the states where sugarcane can be cultivated successfully include Sokoto, Taraba, Niger, Kogi and most other Northern states. The International Sugar Organization (ISO) has shown that it is possible to increase the amount of land under sugarcane meant for biofuel production in Nigeria and most other African countries without decreasing food production.

Bioelectricity would be particularly important in Nigeria because a large portion of the county's electricity comes from hydro dams. The sugarcane harvesting period coincides with the dry season, so when hydroelectricity power stations sometimes have to reduce output because of low water levels in their reservoirs, sugarcane bioelectricity is most abundant. Bioelectricity also has low environmental impact. Mechanized farming if employed to remove the straw can help to reduce air pollution. Setting up bioelectric plants will surely produce employment opportunities in parts of the country where these production plants are located. Inclusively, it will stem the high rate of rural to urban drift as well as contribute significantly to socio-economic development of the country.

The major problems that face the use of sugarcane as a source of energy are its usage for sugar production (which can pose a food versus energy dilemma), its seasonal nature and decrease in biodiversity. Other problems include the fact that sugarcane cultivation puts a high demand on the soil because of the use of heavy machineries. Trash and green harvesting overcomes many of these problems. Policies should also be put up to balance off the cultivation of sugarcane and other food crops in order to discourage farmers from sacrificing food crops for biofuel which will increase food prices around the world.

Sugarcane cultivation can sustainably contribute to the supply of renewable energy but improved crop husbandry and precision farming are needful to sustain and improve the resource base on which production depends.

Biomass from Rice Husk

Rice husk is a common agricultural residue. The Federal Government of Nigeria has focused on agriculture as a means of diversifying the current crude oil economy and rice is one of the agricultural product that have been earmarked for scaling up. Rice is eaten as a staple food in Nigeria, and if the local production is increased, it will result in increase in rice processing wastes such as rice straw and husk. Rice husk is produced in many parts of Nigeria such as Abakaliki, Afikpo, Ogoja, Sokoto, Birnin Kebbi, Abeokuta, Kano and Jigawa regions. Rice husk dumps are increasing in alarming proportions in these regions. Disposing and evacuating the rice dumps is urgently necessary because of the impending environmental hazards, degradation and pollution it posses to the people and the environs. In attempt to dispose rice husk, most communities set the rice husk dumps on fire, unfortunately a small heap of rice husk takes months to get burnt to ashes . Even when burnt to ashes, it is still an eyesore in the communities especially during the rainy season. Rice husk dumps on fire causes air pollution and accumulation of ash .Therefore the need for urgent evacuation of rice dumps from these communities.

Rice husk which is the main by-product of rice processing has been identified as one of the potential biomass based energy source for power generation.Rice husk has a calorific value of 3259k cal/kg (Ezeike, 1983) and therefore can be used as a renewable fuel. The use of rice husk in electricity generation can be achieved with the use of rice husk gasifier coupled with a modified internal combustion engine that drives a generator. Rice husk in gasifier can be converted into fuel gas under high temperature in an atmosphere of about 1% oxygen.

The clean gas – syngas (Eric, 2008) produced can be used directly in a gas powered plant to generate electricity which will be used in the rice mill and the local population. The benefits of energy generation from rice husk include increased diversity and security of electricity supply; serving as a more purposeful way of disposing the agricultural waste; the steam produced can also be used for paddy drying; rice husk ash, the by- product of rice husk power plants can be used in the cement and steel industries; environmental friendliness; improving employment opportunities for the local population; helping achieve the millennium Development Goal on power generation and poverty reduction; and it does not impact negatively on food production.

Biomass from Animal Waste: Cow Dung

Animal waste pollutes the environment. The stench that exhumes near farms testifies to this. The air quality is not only adversely affected; it pollutes the land and river affecting aquatic life. Converting animal waste to energy therefore will not only provide alternative and renewable energy, but will help clean up and provide healthy environment. Animal wastes include poultry droppings cow dung etc. We shall however discuss cow dung in this paper.

Employing biogas technology to convert biological waste into energy helps improve the quality of life and health. Biogas is produced either by anaerobic digestion or fermentation of biodegradable materials. It comprises mainly of methane (CH_4) and carbon dioxide (CO_2) with a small amount of hydrogen sulfide and moisture. The biogas mitigates a wide range of environmental undesirables to provide high quality organic fertilizer, provide gas for cooking or electricity generation thereby reducing demand for fuel wood and charcoal for cooking. It improves water quality and mitigates greenhouse gas emission.

Cow dung is usually concentrated in large farms in places where the cows are confined. Huge deposits of dung and other animal waste products are also available in abattoirs. These large abattoirs usually sited in the outskirts of every major town in Nigeria will guarantee the availability of large deposits of cow dung.

Success stories of biomass energy production sited in farms in India, USA and other countries abound. In Nigeria however, where in most cases our cows are not confined, the story of cow to kilowatts sited in a slaughter at Ibadan should be visited and replicated near major slaughter houses.

Cows to Kilowatts – is a unique anaerobic fixed film reactor that treats slaughter house waste on site, producing commercial quantities of organic fertilizer and captures the potent methane that can be used to generate electricity(at the rate of 1000 slaughtered per day, the plant would generate 3,600KWh of electricity) or function as cheap cooking gas. An NGO, Global Network for Environment and Economic Development Research (GNEEDER) with funding from the United Nations piloted the project at Ibadan.

The project brings together three main points of sustainable development: economic efficiency, social collaboration and protection of the environment. Economic efficiency, in the sense that it

provides cheap gas, cleans organic fertilizer and employment for community members. Social collaboration in that the community learns about waste management, healthy living and protection of the environment from green house gases and water pollution. More so provision of cheap cooking gas will reduce the use of fuel wood and charcoal for cooking hence reducing deforestation. An added advantage of biomass from cow dung is that unlike other biomass sources it is not seasonal. Also it does not diminish food supply like sugar cane and cassava; rather it enhances healthy food production by its provision of organic fertilizer.

The major hindrance to the use of biogas technology is high cost of installation. A grant from the government can help organizations set up and manage these reactors being aware of the immense benefits.

CONCLUSION

We have looked at various ways biomass energy can be generated in Nigeria to supplement the energy from fossil fuel. These include biomass energy production from cassava, sugarcane, rice husks and cow dung.

The major advantages of employing biomass from these resources include social collaboration, ease of maintenance, economic and energy security benefits as well as enhanced environmental friendliness over fossil fuel use. With increasing biomass development, farmers gain valuable new markets for their farm residues.

The major hindrance is the localization of most of this biomass in different parts of the country. This can be overcome by localizing the plants that utilize each biomass resource for energy generation.

To promote the installation and use of biomass, there is the need to advocate policies to strengthen energy institutions. In this regard, there is the need to identify organizations or offices at state and local government levels that will be charged with the responsibilities of ensuring the full implementation of these policies.

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