

ECONOMIC POTENTIALS OF ANIMAL DUNG AS A VIABLE SOURCE OF BIOMASS ENERGY

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ABSTRACT

The increased dependence on Hydrocarbon products as main source of energy in Nigeria has created a scenario of both human, technological and socio-economic lapses and setback in the country. Rampant use of diesel generators as means of alternative energy yields unrelenting greenhouse gas emission in the atmosphere thereby endangering human lives. However, efficient and renewable energy sources have been explored and have been adjudged to be viable, reliable and sustainable alternative. Unfortunately, some of the harnessed and most popular renewable energy sources like solar energy, geothermal, hydroelectricity, tidal power, wave and wind power are very expensive and consequently out of the reach of an average individual. Biomass energy is a cheap renewable energy that is locally sourced. Biogas is a type of biomass energy that can be produced from waste materials. This paper explored the use of animal dung as one of the sources of biogas as well as identifies its economic potential. Noting that small scale biogas production is fully capable of replacing rural energy requirement for lighting and cooking, harnessing it will alleviate the present energy problem. The large scale production is capable of generating and feeding electricity into the mainstream power grid. Since animal dung constitutes environmental pollution and yields pathogens and parasites that are harmful to health, it therefore becomes necessary to harness it for better use.

Keywords: *Alternative energy, Biomass, Biogas, Animal dung, Sustainable, Power grid*

INTRODUCTION

Importance of Energy can never be overemphasized in view of human, technological and socio-economic development of a country. Every sector of a nation requires reliable and viable sources of energy for its operation. Energy is so essential that in industrial sector, every production and manufacturing activities revolve around it. In the domestic sector, energy is used for household keeping. It is equally required in agricultural production, material processing, communication and other sectors.

Petroleum products have been the major source of energy in our country. The increased dependence on petroleum products in Nigeria has no doubt created an unfortunate scenario of lapses and setback to national development. Even the burning of fossil fuel harms the environment by releasing green house gas in the atmosphere which causes global warming^[2]. Adding to this, the process of refining crude oil is quite expensive and requires a lot of capital investment. It is often the case that resources for other sectors of the economy are digressed into the petroleum industry^[9]. This obviously affects the economy of the country. However, the alternative would have been providing energy by Power

Holding Company of Nigeria (PHCN). Unfortunately, the condition of the supply is quite disheartening. Worst case is in the rural communities, where they hardly enjoy electricity supply despite government's substantial investment and budgetary allocations to rural electrification projects by successive administrations in Nigeria. People who are buoyant resort to diesel-propelled generators. These are otherwise expensive and environmentally unfriendly. The use of the generators does nothing to detract from Nigeria's image of being one of the world's largest producers of carbon emissions, closely associated with global warming^[5]. It therefore becomes a challenge devising alternative energy source that is sustainable, cheaper and more environmental friendly.

Promoting renewable energy efficiency in Nigeria will address this challenge. Renewable energy is energy which comes from natural resources such as solar energy, geothermal, hydroelectricity, tidal power, wave and wind power, and biomass^[6]. These resources are constantly replenished. Renewable energy replaces conventional fuel in four distinct areas: power generation, heating (both water and space), transport fuels and rural energy services like cooking, and others^[7].

Although most of these renewable energy sources have been criticized to be so capital intensive, Biomass however posed a different view. Biomass raw materials are cheap and locally sourced. There are different forms of fuels derived from biomass which could be solid (such as wood), liquid (such as alcohol) and gas (such as methane); these are all referred to as biofuels. Among all other biofuels, biogas is of much interest because of its greater advantage. Technologically, the production of biogas is cheaper and much simpler than those for other biofuels. As fuel, the most valuable component of biogas is methane with accrued qualities of:

- i. high calorific value,
- ii. clean fuel,
- iii. reduction of greenhouse gas emission,
- iv. no residue produced,
- v. no smoke produced,
- vi. non polluting,
- vii. economically, can be supplied through pipe lines, and burns readily with a convenient ignition temperature^[17].

JUSTIFICATION FOR BIOMASS ENERGY GENERATION FROM ANIMAL DUNG

Animal dung is one of the livestock materials for the production of methane. This yields pathogens, microorganism and parasites. In other words, animal dung, if not harnessed, has very high possibility of causing water pollution. Over 1.6 million people die every year due to health and respiratory effect from air and water pollution^[3]. The air pollution in this context could be attributed to the gases released in the atmosphere during burning of fossil fuel. It therefore becomes necessary to harness the dung for better use and device alternative for fossil fuel. The use of methane proffers this solution. Adding to its other advantages, methane is produced by the process of anaerobic digestion. Anaerobic digestion inactivates pathogens and parasites, and is quite effective in reducing the incidence of water pollution. Producing and using biogas will reduce the frequent burning of fossil fuel thereby reducing air pollution since it is environmental friendly.

Insinuatingly, utilization of biogas will not only alleviate energy crisis but will equally extend its effect to health and economic issues. Majority of people in rural area sustain their livelihood by access to energy. Almost on daily bases, women and children undergo the stress of fetching firewood for use at home. Worst during the fuel scarcity period, some families would withdraw their children from school for the purpose of having enough hand to fetch firewood. This does not only constitute child labour but also hinders educational development of the children. In addition, the over-reliance and unsustainable use of firewood poses a great threat to climatic equilibrium and therefore, high levels of deforestation and biodiversity loss becomes inevitable. Solution to these issues can be provided by deploying methane as a viable energy source.

Conclusively, the use of methane presents many advantages. Methane would generate enough electricity to meet up to three percent (3%) of a continent's electricity requirement^[14]. Methane usage could potentially reduce global climate change. By converting animal dung into Methane, the millions of animals in Nigeria would be able to produce one hundred kilowatts hour of electricity enough to power many home across the country. One cow can produce enough manure in one day to generate three kilowatt hour of electricity, only 2.4 kilowatt hours of electricity is needed to power a single one hundred watt light bulb for one day^[6]. Imagine the quantity of energy that would be saved in the country by using methane. In addition, any rural households in Nigeria with methane digesters would enjoy the following benefits: saving fossil fuels, saving time collecting firewood, protecting forests, using crop residues for animal fodder instead of fuel, saving money, saving cooking time, improve hygienic conditions, producing high- quality fertilizer (residue from methane production), enabling local mechanization and electricity production, improve the rural standard of living, and reducing air and water pollution. This however justifies the need to explore and encourage the use of animal dung as a viable energy source with regards to its economic potentials.

Conversion of animal dung to useful energy

The conversion of Biomass into useful energy can produce heat and electricity moreover it can also be converted to bio fuels (e.g. biogas). There are three ways of converting waste into useful biomass energy and bio fuels. These methods include thermal conversion, chemical conversion and biochemical conversion. Thermal conversion is the process in which various bio organisms are converted to chemical formations using heat. There are many ways to perform this conversion like combustion, torrefaction, gasification, prolysis, hydro processing and hydrothermal upgrading. A typical thermal biomass plant is 20% to 30% efficient. Chemical conversion is the process of converting various waste materials and liquid slurring into fuels by using chemical reactions. The natural materials like biomass are made up of molecules. In order to break these molecules, living enzymes like bacteria and other micro organisms are used. These micro organisms are helpful in performing processes like fermentation, compositing and digestion.

Methane Production using Animal Dung ; Projects and Observations

Anaerobic digestion is a proven process to reduce offensive manure odors while potentially generating some income. Methane can be produce by anaerobic digestion of animal dung. This is the process of converting animal dung into useful products by micro-organisms in the absence of air. The slurry (mixture of animal dung and water) is put inside sealed tanks and naturally occurring micro-organisms digest it, releasing methane. This sealed thank is referred to as digester. The material left over at the end of the process is rich in nutrients so it can be used as fertilizer.

The Gobar Gas Research Station being managed by Ram Bux Singh is situated in India and was founded in 1960. This Station concentrated on studying the production of methane from cow dung. Ram Bux Singh and his colleagues have biogas plants in operation ranging in size from about 8 cubic metres per day to 500 cubic metres per day. They have plants using heating coils, filters and mechanical agitators to test the change in efficiency, and have also tried various mixes of manure and vegetable waste. Ram Bux Singh however noted that methane production is not just a dream, but a practical application and use of a waste product and pointed out that India already has around 3000 biogas plants of varying sizes^[12].

Rural families in Nepal often use animal dung as the feedstock for a biogas plant^[13]. The dung from two to four cows (or five to ten pigs) can produce enough gas for all cooking and sometimes lighting too. The family needs to feed the plant once each day with a mixture of dung and water. A reference was made to Mrs Mitha Koirala who uses her biogas plant for cooking and lighting in Sarangot near Pokhara. Ashden Award winner Biogas Sector Partnership has however coordinates a programme which has sold over 170,000 biogas plants throughout rural Nepal. Literature showed that biogas plants has replaced nearly all the use of fuelwood, and make cooking easier, cleaner and safer in Nepal. It also provides safer lighting in about 20% of houses as well^[13].

Researchers have revealed that the use of cattle dung to generate biogas is well known in the Indian subcontinent, but in no other place has it been used with such success as in Nepal. The scale of the programme is remarkable. Biogas already serves about one million people (4% of the population of Nepal), and the biogas sector provides about 11,000 permanent jobs in the country. If anyone needed to be convinced that 'small scale can be big' then they need look no further!

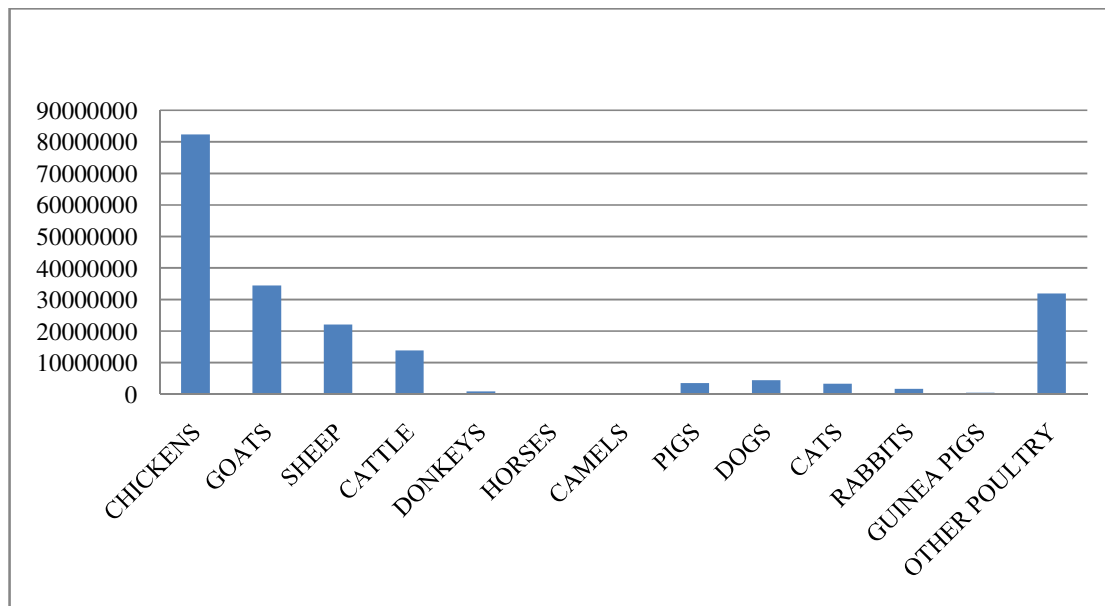
The above discussed projects are only but few among numerous biogas plants across the world. In fact, the number of biogas plants currently in use is difficult to estimate. Nepal, with about 170,000 biogas plants in 2008 has the largest per capita use. India had an estimated 2 million plants in use in 2000. Biogas programmes are growing in many other parts of the world, such as Vietnam, Brazil and Tanzania etc. ^[13]

Conclusively, biogas plants can work well for many years, provided that they are constructed well and checked regularly. Nigeria can do better in methane production project. There are enough animal herds in the country and these animals can produce enough dung for methane production. Many more rural areas can go by dung-based methane production especially for household need. This will not only serve the individuals, but will save the nation a lot in both power generation, and socio economic issues.

THE AVAILABILITY OF BIOMASS RAW MATERIAL IN NIGERIA AND ITS IMPLICATION

Nigeria is blessed with a lot of livestock. A project carried out by Federal Government of Nigeria and the World Bank, gave the most reliable estimate of Nigerian total livestock population ^[18]. The estimate was based on standardised, systematic methods of sampling and combined estimates from both the 1990 traditional sector survey and the 1992 survey of commercial livestock enterprises thus;

Fig 1.



Source; ^[2].

Fig. 1 above shows that Nigeria has great number of animal which will enable immense deployment of methane production. Although population of cow is much less than that of chicken, the energy yield is higher as will be shown in the table 1 below.

RANKING RATE OF METHANE YIELD OF SOME ANIMAL DUNG**Table 1.**

Animal Dung	Qty of methane yield(m3/kg)	of Qty of Dung produce by one (million kg/day)	Qty of methane yield (million m3/day)	Power Equivalent (kwh)
Cow	0.025	108.9	3.27	3
Pig	0.045	5.20	0.26	0.24
Chicken	0.075	6.40	0.51	0.47

Source ^[4]

As depicted by fig 1, there is an average of 13,900 000 million cows in Nigeria. Table 1 on the other hand shows that one cow can produce dung that generates average of 3kwh power a day. If a cow yields dung worth of 3kwh a day, then 13,900 000 cows will generate 417,000 Megawatt hour energy. This is too good to be real. Having this to be real calls for immediate attention. Animal dung should be harnesses as an alleviation measure to the energy crises in the country.

ENERGY UTILIZATION ISSUES IN NIGERIA

Presently, energy utilization in Nigeria is far from being sufficient. There are three most energy consuming sectors where the effect of Nigerian insufficient energy issues is felt most. These sectors include; the domestic sector, industrial and transport sector ^[4].

Domestic sector

Firewood was observed to be the most common source of energy in the domestic sector with about 70 - 80% of households depending on it as their cooking fuel in both the remote villages and the towns ^[9]. This has serious consequence on the environment. The incessant felling of trees for provision of the wood fuel does not do any good to the environment than exacerbating desert encroachment, soil erosion and loss of soil fertility problems. Although the used of wood fuel is more laborious, time consuming and less safe than methane, people still stick to the use because majority are not yet aware of methane production technology. Adoption of efficient methane stoves will go far in proffering solution to this.

Industrial sector

Mains electricity from PHCN dominates the energy supply for the industrial sector. This is supplemented by electricity generating sets that are fueled with fossil. The foregoing is for large industries which are mostly located in the big cities and towns. For the rural areas, the bulk of the small - scale industries are operated on diesel generators. Power from PHCN would have saved some issues these rural areas, but the condition of the service is epileptic that production totally depends on running of generators which is expensive. As a result of this, the producers escalate the cost of their products in order to recover the cost of production. The effect of this bounces back on the general economy of the nation. Investing in biogas plant can provide sufficient alternative power thereby reducing production cost.

Transport sector

In the transport sector, fossil fuel is the major fuel in use. Not discussing much in this sector, it is obvious that this sector entirely depends on fossil fuel in Nigeria. This has drastically affected the economy in general. In the developed countries, technology has so improved that some vehicles now uses methane. This can equally be adopted in Nigeria as means of reducing the total dependency on fossil fuel in transportation sector.

SUMMARY

Methane gas has become an alternative for fossils fuel for quite some time although; Nigeria has not fully deployed the mechanism. The usage of methane can be promoted by Nigerian legislation on the promotion of energy produced from renewable energy resources. Agricultural sector (animal production) is a significant source of methane production. Unfortunately, generating energy from animal dung is not common in Nigeria, most especially, in rural areas. As to increase the number of biogas facilities, public awareness should be created and the advantages of biogas to beneficiaries should be explained. People should be trained concerning biogas production. Biogas facilities are an additional source of income on many farms. The production of methane will decrease energy costs of many sectors added to its lot of advantages in both environmental and economic aspect.

RECOMMENDATION

With the availability of the resources in all parts of the country and the existing level of development of systems and devices in the nation, there is the urgent need for all of us to adopt practical measures that will systematically introduce biogas technologies into the economy. Policy issues are very vital if this should be achieved. The thrust of the policy here should be the incorporation of biomass facts into as many spheres of the economy as possible. The strategy for this includes:

- Incorporation of biogas energy production for domestic use into the Youth empowerment scheme (YES) for youth empowerment and poverty alleviation.
- Consistent support of research and development activities to cater for biogas production projects for all parts of the country.
- Support of demonstration and pilot projects to ensure that the general public becomes aware of the potentials of animal dung as an alternative energy resources as well assist in creation of markets for methane usage systems.
- The provision of financial incentives to encourage the building of biogas plants especially in the rural areas where the greatest potential exists.

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