
Examination of the Suitability of Available Energy Crops for Biodiesel Production as an Adaptative Measure to Climate Change in Nigeria

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ABSTRACT: *Motivated by the need to reduce the amount of CO₂ and other Green House Gases (GHGs) in the atmosphere as a means of climate change adaptation, this study was carried out to identify and examine the suitability of available energy crops in Nigeria. Secondary data sources were adopted in the identification of the energy crops and it was found that sugarcane, Soybeans, maize, wheat, oil palm and Jatropha; among others are available in Nigeria and can be utilized in the production of bio-fuel to replace the fossil-fuel presently in use in order to reduce the emission of GHGs. The suitability appraisal was conducted by interviewing professionals on which of the identified energy crops will be most suitable and why. A total of 30 professionals were purposively selected and interviewed, 10 Chemists, 10 Environmentalists and 10 from Biosciences. 28 out of the 30 supported the adoption of Jatropha Curcas considering the cost of production, benefits attached and effects on food availability and food security, since it is not edible. The study therefore recommended that Jatropha Curcas Seeds be harnessed for bio-diesel production in Nigeria. A policy design to improve the production and processing of the Jatropha Curcas was proposed while a thorough research into the economics and cost benefit analyses is deemed necessary.*

KEYWORDS: energy crops; bio-diesel; climate change; sustainable energy.

INTRODUCTION

Developing nations like Nigeria are feeling the impacts of climate change more severely than developed countries. Nigeria should aim to implement mitigation and adaptation measures now. Scientific literature on the impact of greenhouse gas mitigation suggests that a range of broader health and economic benefits arise from mitigation. In fact, global studies indicate that the potential health savings made by cutting greenhouse emissions are more than the costs of abatement in most countries (West *et al*, 2013) and the cost of obtaining a license to emit pollution is not high enough to provide polluters with an incentive for abatement. Nigeria and many other nations in Africa are facing the challenge of achieving an affordable clean energy in accordance to the sustainable development goal (SDG 7), hence the need for alternative energy sourcing.

Statement of the Problem

Biodiesel development in Nigeria over the years has been given little attention because of the myriads of economic strain and stress facing the country like any other third world country. Biodiesel is a renewable source of energy that has not been fully tapped. Biodiesel can facilitate clean air, readily usable in existing engines and transport facilities, capable of generating employment and income for citizens and country at large (Samuel, Zalliat and Ismaila, 2013). Most of the currently used energy strategies are either not sustainable or poorly maintained. Nigeria is a major exporter of fossil fuel but currently faced with serious energy crisis, which necessitates the search for a sustainable renewable form of energy as alternative to fossil fuel in order to meet the SDG 7.

The brunt of climate change is already being experienced in our urban areas, and the next few years are critical for determining how effectively we will rise to the challenge of protecting our cities. A study of this sort will not just help to save our environment for today but will also improve it for tomorrow hence will contribute immensely to building a sustainable environment.

Aim and Objectives

The aim of this study is to identify and examine the suitability of available energy crops in Nigeria, with a view to recommending the more suitable one for biodiesel production.

To achieve this aim, the following objectives were pursued:

1. to justify the need for biodiesel in the midst of fossil fuel,
2. to identify through review, the available energy crops in Nigeria, and
3. to determine the more suitable energy crop to be adopted for biodiesel production in Nigeria and why it should be adopted.

LITERATURE REVIEW

Among the studies that supported the adoption of biofuels or biodiesels over fossil fuels include Peter (2012). In his study forecasted a future where the use of food crops for biofuels will be reduced by shifting to dedicated energy crops and agricultural residues. This was also supported by the work of Oyedepo, (2012), who opined that there is great need for energy transition to more eco-friendly, renewable, affordable and sustainable energy sources to foster sustainable development in Nigeria.

Parawira,(2010) in his study recommended *Jatropha Curcas* as very suitable for Biodiesel production. According to him, the availability and sustainability of sufficient supplies of less expensive feed stock in the form of vegetable oils, particularly *Jatropha Curcas* and efficient processing technology to bodies will be crucial determinants of delivering a competitive biodiesel. These findings were supported by the works of Alfredo, Hennecke, and Omar (2018); and Baral, and Bradley (2019) who backed up their opinion from the economic standpoint and environmental footprints of biodiesel production from *Jatropha Curcas*.

Chung, (2013) studied the Potentials of Biomass as a Solution for Future Energy Needs in the U.S.A. He asserted that Greenhouse effects and global climate change are controversial and critical issues that impact on the energy industry with serious economic undertone. Holdren (2001); Wilk (2002); Kalicki and Goldwyn (2005); all supported that long-term economic sustainability of the energy, transportation and manufacturing sectors would require the adoption of a range of renewable and sustainable fuels with high energy content but minimal emission of greenhouse gases. Omoruyi and Idiata (2015), studied the environmental and economic implication of fossil fuel generators in Benin city, Nigeria using questionnaires survey method and they found that it has grave environmental implications which needs to be addressed to avert future consequences. Chinielewski (2005) examined Environmental Effects of Fossil Fuel combustion in U.S., finding the major constituents of fuel to include carbon, hydrogen, oxygen, metal, Sulphur, and Nitrogen compounds which emits several pollutants like fly ash, sulfur oxides (SO_2 and SO_3) Nitrogen oxides ($\text{NO}_x = \text{NO}_2 + \text{NO}$) and volatile organic compounds during combustion. Similar studies were carried out by Loaigiga (2011); and Grossman (2016) who studied how the use of fossil fuel affects the health of kids in New York city and their findings agree.

Ojukwu (2020), investigated the strategies and policies to save Nigeria in the energy transition process, he posited that serious studies needs to be done to commence address the issue of drying-up investment in fossil fuel energy to enable the shift. In his recommendation, the clamor for energy transition to cleaner technologies and better alternatives, require development or new technologies and other earth-friendly energy sources.

Adawuiyi, Kiptoo, Afolay and Amara (2020) in their study on challenges and prospects of Nigerian sustainable energy transition with lesson from other countries experiences, noted that several countries have made a remarkable effort towards achieving this all-important objective in compliance with modern `energy needs and supply. According to them, to realize the sustainable development goals (SDGs) come the year 2030 as projected by the united nations in Nigeria and the entire sub-Saharan Africa (SSA), there is need for an equitable right to sustainable energy adoption in Nigeria and other countries in Africa for this United Nations SDGs deadline to be met. Ijeoma (2015), discussed the pros and cons of adopting biofuel than fossil fuel. In the outcome of this review, it was discovered that Biofuels are environmentally much cleaner than fossil fuels, producing less air pollution and consuming materials that would otherwise be considered garbage. They are renewable; the supply of biofuels is less likely to run out, while the supply of fossil fuels probably will. They can be made locally using local materials. They can be flexible, easily mixed with other fuels. They can be cheaper than fossil fuels and will certainly become less expensive as the price of fossil fuel rises. In fact, Ethanol and biodiesel are better for car engines than fossil fuels. They can be used as additives to improve performance even if they are not the main fuel source. On the other hand, Biofuels would require cultivating more land than is currently farmed. This is already considered a major problem. Some kinds of biofuels require modifications to vehicle engines. Biofuels are not widely available. Some biofuels still require the use of fossil fuels; for example, most vehicles must have some gasoline mixed into ethanol to work and cannot run on ethanol alone.

Samuel, Zalliat and Ismaila (2013), studied Biodiesel Development in Nigeria: Prospects and Challenges. The major biomass world-wide is *Jatropha* plant which is currently generating interest in every economy of the world. The major means of converting the biomass into viable fuel is trans-esterification. The major problems facing the full exploit of this modern fuel is surmountable including the fear of taking-up arable agricultural land. Various generations of biofuel feed-stocks can be made use of in place of agricultural crops. The benefits and prospects of biodiesel production is huge and numerous.

Biofuels may be a contributor of formaldehyde to urban air. Biodiesel fuels are potentially high emitters of nitrogen oxides, which are a major component of smog. People with respiratory illnesses and small children are most affected by these air pollutants. Biofuels require large amounts of land to be cultivated and harvested. This can cause major environmental problems, such as habitat destruction and fertilizer runoff. Farmers use large amounts of fossil fuels to grow crops such as corn, which decreases the value of the energy made from those crops. In some cases, producing biofuels such as ethanol actually uses more energy than the ethanol yields.

Most people still know little about biofuels and so do not seek them out. Biofuels are not readily available in many places, so it is difficult for people to use them. Few people want to go to the trouble of making their own biodiesel or modifying their car engines to run on vegetable oil. As biofuels become more commercially available and user-friendly, consumers are likely to adopt them in increasing numbers

Study Area

For proximity to the researcher, the study was conducted in Awka, Anambra State and the staff of Nnamdi Azikiwe University were utilized for the suitability appraisal interview.

METHODOLOGY

The Critical Appraisal Skills Programme (CASP, 2004) was adopted for the assessment of the methodological quality of the selected literature from the search results for literature review material. The quality of each literature material was assessed with respect to the research design, sample techniques, measurement tools, analyses, findings and applicability of findings. Each of the criteria listed was graded on a three-point scale of 2, 1 and 0. Where 2 stands for yes, 1 stands for partial and 0 stand for no. Thus each of the literature reviewed scored a maximum of 12, which was finally converted to percentage to determine the percentage quality for a critical and objective comparison of the specific literature among others.

A total of 30 professionals were purposively selected and interviewed, 10 Chemists, 10 Environmentalists and 10 from Biosciences. The Convenience sampling method was adopted in selecting the staff for the interview

DISCUSSION OF RESULTS / FINDINGS

From the findings of earlier researchers like Parawira,(2010); Alfredo, Hennecke, and Omar (2018); Baral, and Bradley (2019); Peter (2012); Kalicki and Goldwyn (2005); Samuel *et al* (2013), the following energy crops were identified: sugarcane, Soybeans, maize, wheat, oil palm and *Jatropha*; among others are available in Nigeria and can be utilized in the production of bio-fuel to replace the fossil-fuel presently in use in other to reduce the emission of GHGs.

The suitability appraisal was conducted by interviewing professionals on which of the identified energy crops will be most suitable and why. A total of 30 professionals were purposively selected and interviewed, 10 Chemists, 10 Environmentalists and 10 from Biosciences. 28 out of the 30 supported the adoption of *Jatropha Curcas* considering the cost of production, benefits attached and effects on food availability and food security, since it is not edible. This is in line with the opinion and findings of many authors like Ijeoma (2015), Samuel *et al* (2013), Adawuiyi *et al* (2020) among others.

The following summarizes the facts found about the energy crops and biofuels and their merits over fossil fuel:

- Environmentally, biofuels are to a great extent cleaner than fossil fuels, as they produce less air pollution and consume materials that would be regarded as garbage.
- Biofuels are renewable that means their supply is not liable to run out easily unlike the supply of fossil fuels.
- Biodiesels can be prepared locally using local resources, they are flexible and can be easily blended with other fuels.
- Biodiesels can be cheaper than fossil fuels and will definitely become less expensive as the price of fossil fuel rises.
- Biodiesel and ethanol are better for car engines than fossil fuels and can also serve as additives to improve fuel performance.

On the contrary biodiesels/biofuels have some major issues posing a threat to their being totally adopted unlike fossil fuels. Biofuels are not widely available and would require the cultivation of more land than is utilized presently for farming. Some types of biofuels necessitate modification of vehicle engines while others still involve the use of fossil fuels; for instance, most vehicles need some gasoline mixed into ethanol for them to work and cannot run only on ethanol.

It was also found that sugarcane, Soybeans, maize, wheat, oil palm and *Jatropha Curcas*; among others are available in Nigeria and can be utilized in the production of bio-fuel to replace the fossil-fuel presently in use in other to reduce the emission of GHGs.

28 out of the 30 supported the adoption of *Jatropha Curcas* considering the cost of production, benefits attached and effects on food availability and food security, since it is not edible.

CONCLUSION

The study therefore concluded that of all the available energy crops identified to be available in Nigeria, *Jatropha Curcas* is the most suitable for the production of more eco-friendly bio-fuel which is economically affordable, available and renewable, at no cost to food security and availability. Thus can be referred to as a sustainable energy source.

RECOMMENDATIONS

The study therefore recommends as follows:

1. That *Jatropha Curcas* Seeds be harnessed for bio-diesel production in Nigeria and the production should be enlarged to commercial quantities.
2. A policy idea to improve the production and processing of the *Jatropha Curcas* was proposed while
3. There is need for a thorough research into the economics and cost benefit analyses of the commercialization of *Jatropha Curcas* oil production.
4. There is also need to compare the level of greenhouse gases emission from an engine powered with the conventional fossil fuel or diesel and the one blended with this biofuel.
5. Deliberate efforts should be made by the government in terms of massive capital investment, training of man-power in the field of biofuel or biodiesel development.
6. Granting tax holidays to would-be investors (companies and individuals) will go a long way to encourage them.
7. If adequate policy frame-work is put in place and necessary political will is expressed and applied to the development and production of biodiesel in the country the economy would be better for it.

REFERENCES

- Chung, J. (2013). Grand Challenges in Bioenergy and Biofuel Research: Engineering and Technology Development, Environmental Impact, and Sustainability. *Frontiers in Energy Research*.1. 10.3389/fenrg.2013.00004.
- Grossman, E. (2016). How fossil fuel use threatens kid's health. *Science News for Students*. Available at <https://www.sciencenewsforstudents.org/article/how-fossil-fuel-use-threatens-kids-health>
- Holderen, J. (2001). The Energy: Climate Change. *Environmental Journal* (28) 87–97. <https://www.sciencenewsforstudents.org/article/how-fossil-fuel-use-threatens-kids-health>.
- Ijeoma, S. (2015). 'How Nigeria Could Adapt to Climate Change in a Big Way' *Ecosystem Marketplace*.<https://www.ecosystemmarketplace.com/articles/first-person-how-nigeria-could-adapt-to-climate-change-in-a-big-way/>
- Kalicki, J. & Goldwyn, D. (2005). Energy and security: Toward a New foreign policy strategy, Baltimore, MD: The Johns Hopkins University press.
- Loaiciga, H. (2011). Climate Change and Ground Water. *Annals of the Association of American Geographers*. 93. 30 - 41. 10.1111/1467-8306.93103

- Omoruyi, S., & Idiata, D. (2015). The Environmental and cost implication of fossil fuel generators: New Benin market, Benin City, Nigeria. *International journal of Emerging Technology and Advanced Engineering*. 5(2) 2250 – 2459.
- Oyedepo, S. (2012) Energy and sustainable development in Nigeria: the way forward. *Energy, sustainability and society*.2 (15).
- Parawira, W. (2010).Mshandete, A.M and Parawira W (2010). Biogas: sustainable renewable energy of today and the future for Africa. *Annals of Arid Zone* 49 (3&4):217-239.
- Perrera, F. (2017).Pollution from fossil fuel combustion is the leading Environmental threat to Global pediatric health and Equity: solutions Exist. *Int J Environ Res Public Health*. 15(1).
- Rahaman, B. (2018) *The Need for Renewable and Alternative Energy to Ensure Stable Power Supply in Nigeria*.
- West, J., Smith, S., Silva, R. Naik, V., Zhang, Y., Adelman, Z., Fry, M. M. Anenberg, S., Horowitz, L., Lamarque, J., (2013). Co-benefits of mitigating global greenhouse gas emissions for future air quality and human health. *Nature Climate Change*, 3: 885-89.
- Wilk, R. (2002). Consumption, human needs, and global environmental change.Global Environmental Change. 12. 5-13. 10.1016/S0959-3780(01)00028-0.