

Bio-ethanol Derivation from Energy Crop in Nigeria: A Path to Food Scarcity or Bio-fuel Advancement

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Abstract— Nigeria's commitment to bio fuel development under the Kyoto Treaty has put an upward pressure on agricultural prices in the past decade. The government effort to blend bio-ethanol (E20) with the petroleum product for transportation sector failed in 2008, resulting into mass car engine damage. Recently the government reduced its target of 20% ethanol blend (E20) to 10% percent ethanol blend (E10). This paper examines the feasibility of bio-ethanol derivation from staple crops like cassava, sugarcane and sorghum without creating food crises in the country. The paper finds that while there is a target of 1.27 billion litres of ethanol per year to be blended with petroleum, the government and its investors are doing little to prevent food scarcity. The current price hikes of agricultural produce especially; sugarcane, cassava and sweet sorghum (cassava and sorghum being major food for the masses) indicates a threaten to food security at the expense of a technology that is not ripe for use in a country like Nigeria. The fossil fuel price fluctuation serves as a good reason to divert to biomass energy sources but, caution is needed to avoid food scarcity that can be at the detriment of a sustainable life. The paper finds that sugarcane, cassava and sorghum based ethanol could make an important contribution to substituting (or blend) for a portion of petroleum but at a risk of food scarcity.

Keywords- cassava, sugarcane, sorghum, Nigeria, bio-ethanol, food crises

I. INTRODUCTION

The world's attention is gradually shifting from the conventional sources of energy to the renewables. The consequences of climate change, the unstable price of fossil fuel and the recent global recession are key drivers of renewable energy. The growing policy and increased research into renewable forms of energy is the first steps in the various advances to come on board if renewable energy is going to be the energy of the future. Bio-ethanol among other forms

of renewable energy is, growing exponentially in research and testing all over the world. It is seen by many to be the future energy in transportation and, decision makers are making efforts to establish a frame-work for its production, its use and any other outcome that may emanate from it. Although in many countries, especially the African countries, uncertainty exists on utilization of bio-ethanol due to the possible risks of food scarcity. The use of bio-ethanol blend in Nigeria transportation fuel (E10) has triggered sharply polarized views among agricultural scientists, food engineers, policy-makers and the general public. Nigeria in her response to minimise carbon emission is investing in the bio-ethanol technology in partnership with Brazil. One major view shared by many on Nigeria ethanol blend is her capacity to prevent food crises while achieving energy security. The bio-ethanol policy in Nigeria adopts the use of cassava, sweet sorghum and sugarcane for the production of the bio-ethanol knowing that these staple crops are the major food crops in Nigeria. Nigeria is the largest producer of cassava in the world, but more than 90% of cassava production in Nigeria is used for domestic food consumption, whilst Thailand is the largest cassava exporter. The government road map for achieving the bio-ethanol target of 5.14 billion litres/year distances itself from how this will not lead to food shortage in Nigeria. Farming in Nigeria is majorly for food production, the agricultural sector in the country suffered from the oil boom of 1960s when Nigeria discovered oil in its Niger delta region. Export earnings from Agricultural produce like cocoa, kernel and groundnuts gave way to crude oil which currently represents about 90% of government revenue. The agricultural sector has been malnourished and underfunded since the early 1960s. The country can boast of a few large or commercial farms. Farming is dominant in the rural areas due to the un-availability of white collar jobs. Government and private financial institutions have repeatedly denied soft loans to small scale farmers through unreasonable demands for suitable collateral. It is very obvious that farmers in Nigeria need additional income which bio-ethanol has potential for but, this would be at the detriment of the food crops meant for food consumption. Nigeria's size and land usage are presented in Table 1.

There is huge potential for bio-ethanol in Nigeria as can be seen from Table 1. Nigeria's total area is 92.4 million hectares out of which 79.4 million and 13.0 million hectares are occupied by land and water bodies respectively. Agricultural land occupies 71.9 million hectares ranking are occupied by land and water bodies respectively.

Manuscript received March 10, 2011; revised April 14, 2011

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TABLE 1: NIGERIA'S SIZE AND LAND USE PARAMETERS [1]

Nigeria	Percentage (%)	Quantity (Million ha)
A. SIZE		
Total Area	100	92.4
Land area	85.9	79.4
Water bodies	14.1	13.0
B. LAND USE		
Agricultural land	77.8	71.9
Arable cropland	30.5	28.2
Permanent cropland	2.7	2.5
Pasture land	30.6	28.3
Forest and woodland	11.6	10.9
Fadama	2.2	2
Other land	8.1	7.5

Agricultural land occupies 71.9 million hectares ranking Nigeria one of the top bio-fuel potential countries in the world. In Nigeria 94% of households engage in crop farming while about 68% of households engage in livestock farming [2]. These domestic subsistent farming is to augment the family income and to engage women who are unemployed. This work will attempt to reievu government's effort to advance bio-ethanol in Nigeria, assess the risk of using food crop for ethanol production and recommend policy to help in safe-guarding food security in the country.

II. EFFORT TO DEVELOP BIO-ETHANOL IN NIGERIA

In most developed countries 5% to 30% ethanol is blended to reduce the carbon imprints associated with using pure gasoline, increased octane rating (ethanol is converted to ethyl tertiary-butyl either to raise the octane level of gasoline and promote cleaner combustion) as well as serving as anti-knocking agent. Ethanol, which is also known as ethyl alcohol ($\text{CH}_3\text{CH}_2\text{OH}$) is a volatile, flammable, colorless liquid produced from any energy crop that contains high amounts of sugar or substance that can be converted into sugar like starch or cellulose from grains. Nigeria is a major player in the energy sector in the world due to the high demand of her sweet crude oil by United States and India but despite being a major crude oil exporter, Nigeria imports refined petroleum, diesel and kerosene from countries around the world. The level of poverty and uneven distribution of the oil wealth has triggered a high level of corruption within the government and private establishments in the country. The corruption and incompetence has collapsed the four crude oil refineries in the country. None of the refineries produces up to 50% of its installed capacity for quite some time now and it is nothing of concern to the successive governments. The country currently imports all of its domestic fuel consumption. According to the Petroleum Product Pricing Regulatory Agency (PPPRA) figures, the nation consumes about 35 million litres of petrol per day amounting to 1.085 billion litres per month and 3.25 billion litres per quarter [3]. The last quarter of 2010 petrol importation has been authorized by PPPRA to a tune of 4 billion litres, Nigerian National Petroleum Corporation (state own firm) import about half of the 4 billion litres and the rest is shared by the oil marketers/importers. The policy to

blend ethanol with the petroleum for domestic is first to reduce the cost of fuel importation and to respond to strategies to reduce climate change. Elijah I. Ohimain has stated that, an investment of over \$3.86 billion are already committed into construction of 19 ethanol bio refineries, 10,000 units of mini-refineries and feedstock plantations for the production of over 2.66 billion litres of fuel grade ethanol per annum. Also, additional 14 new projects are in the offing. Of the 20 pioneer projects, 4 are at the conception phase, 8 are in the planning phase, and 7 are under construction with only 1 operational. Many have argued that Nigeria bio-fuel policy will regulate the sale and use, and guarantee off-take under contractual terms [4-5]. The fact that investment worth billion of dollars is committed to sugar-cane sourced ethanol project in the northern states of Jigawa and Benue and cassava-sourced ethanol for the southern Anambra and Ondo states is not a gurantee that the fund will be used for the said purposes. The country's eagerness to jump on bio-fuels advancement with a failed policies to meet 10 percent bioethanol (E10) content in fuel by 2010 is seen by major players in the Energy sector as a distraction. The high oil prices and current environmental concerns motivated Nigeria Global Bio-fuels Limited to invest about US\$ 21 million in the sorghum to ethanol fuel production project. The fund will cover the purchase of about 10,000 hectares of virgin land (forests and grasslands) covering seven states (Osun, Oyo, Kwara, Ondo, Ekiti, Niger and Kogi) in Nigeria and seven ethanol plants in each of the the seven states, to produce about 1 million litres of ethanol per plant on a daily basis. There is no doubt that the sorghum feedstock for the bio-fuels plants will compete with production of food crops in the proposed state, thereby exacerbating hunger in the nation. The bio-ethanol production in Nigeria targets staple food crops for its derivation, cultivated land to be used are high-value lands and cleared forest that will have a negative impact on the environment. Nigeria as a country is yet to meet the 25% forest cover stipulated by international standards.

III. RISK ASSESSMENT OF FOOD CROPS FOR BIO-ETHANOL IN NIGERIA

Increased bio-fuel production in most developed countries has contributed to the rise in food prices in the world. The concerns over fluctuating crude oil prices resulting from the crisis in Niger Delta region and the current sanctions on Iran, concerns for energy security and climate change has prompted an aggressive reseach and funding to encourage production and use of bio-fuels [4]. The European Union (EU) has targetted 5.75 % of motor fuel use from bio-fuels by this year while, United State of America has madated the use of 28.4 billion litres of bio-fuels for transportation by 2012. The leading country in Bio-fuel, Brazil, is targeting the use of 100% ethanol in transportation. Thailand, India, China and Nigeria all require a 10 percent ethanol blend to demonstrate their commitment to saving the planet. All these countries in terms of population account for more than two thirds (2/3) of the world's population. The demand for bio-fuel will mean an increased demand for bio-fuel feedstock, such as cassava, wheat, sorghum, soya beans, maize and sugarcane, increase in competition for arable cropland and the use of forest land to complement the short of cropland. The year 2004 to 2007

witnessed a sharp rise in the prices of global maize, since a large percentage of maize produced within the mentioned years went into bio-fuels production in the U.S.[6]. The major players in both energy and agriculture sectors are yet to agree that bio-fuel derivation from agriculture produce leads to food shortage. The rising agricultural crop prices mainly in the developing countries only shows that small scale farmers, will prefer to sell their farm produce to exporters than to sell for food consumption due to the attractive prices attached. The debate of potential conflict between food and fuel will continue unless the feedstock for the bio-fuel shifts from major crops to production of second generation bio-fuels, which uses waste materials and non-food crops that can be grown on marginal land as feedstocks. The grain required to fill the tank of a sports utility vehicle with ethanol could feed one person for weeks; this shows how food and fuel compete. This can be further explained in literary form; 240 kilograms of maize will generate 100 litres of ethanol which can be used for about 1000 km journey.

In Nigeria the rising prices of staple crops can cause significant welfare losses for the poor, more than half of the population lives on less than \$US 2 per day, most of whom are net buyers of staple crops. The effect of rising cost of these staple food will increase starvation, food crisis, increase the spread of diseases which may lead to death. The future bio-fuel technology will need to rely on the second-generation technologies to convert cellulose from these waste products into sugars distilled to produce ethanol.

The worry that an increase in the use of food crops such as maize, cassava and sorghum will also increase the food price of most staple foods in Nigeria depends on whether or not oil crops will be planted on arable land that could otherwise be used for growing food crops, and whether water will be diverted from food crops to irrigate the bio-fuel plantations. Already the lack of rainfall in the northern part of Nigeria is gradually affecting the price of tomatoes in the south. The Northern States supply tomatoes to the Southern States since they have arable land to support tomatoe plantations, however drought has affected tomatoe production for some years now which invariably has lead to the scarcity of tomatoes. The recent price hikes of tomatoes is blamed on the high cost associated with irrigating a small arable land coupled with the high cost of fertilizer in the country. There is a need to diversify the means to produce bio-ethanol in Nigeria, the second generation bio-ethanol production technology need to be well promoted in Nigeria.

The impact of the demand for bio-fuel feedstock on food and commodity prices can be measure by: (1) the share of the bio-fuels' impact in the increase of commodity and food prices and (2) the increase in price which can be imputed to bio-fuels. The former will always be larger than the latter if the total price increase is less than 100% and thus can give a more negative view of the impacts of bio-fuels [7]. The Nigerian government has analyzed the impact of cassava, sorghum and sugar cane demand for bio-ethanol feedstock in the light of the first approach not realizing that less than 100% increase will not present the true situation of the danger of the impending food shortage that the bio-fuel technology can cause. Nigeria presently cannot afford to convert her cassava, sorghum, sugarcane or corn to bio-fuel feedstock for reason that includes, but not limited to, vast majority of the populace are nearly feeding on less than \$US 2 per which force many into consuming these staple foods intended for feedstock for the bio-fuel. Another reason is the expensive irrigation practices and the pressure on land use that will be involved if at all the country goes into aggressive mechanized farming. One other reason is the poor and unreliable research on the feedstock for the bio-ethanol. The facts about the time frame to grow the crops has not changed, there should be extensive research as done in the US and Brazil to utilize the second generation feedstock. Another serious issue is the poor management style of Nigerian government as regards project implementation. The only hope is for the Nigeria populace to be decisive in the coming election in January 2011. Table 2 gives the current installed bio-ethanol plants in Nigeria. Table 3 shows proposed bio-ethanol plant and feedstock farms in some states in Nigeria.

IV. BIO-ETHANOL POLICY RECONMENDATIONS

Development of Bio-ethanol in Nigeria will need the policy that will be comprehensive enough to provide for all the concern raised in this paper. In lieu of that the following recommendations are given:

1. Effective and robust loan facilities: There is need for long term loan facilities to motivate farmers into practicing commercialized farming. Agriculture incentives like no interest rate on short term loans, low interest on long term loan should be made available to farmer. The recapitalization of banks in Nigeria was to allow cash flow to small business but this is not the case.

TABLE 2: BIO-ETHANOL PLANT IN NIGERIA [8]

Name of Company	Plant Location	Feed stock	Installed capacity (million litres/year)
Dura Clean	Bacita	Molasses/Cassava	4.4
AADL	Sango Ota	Cassava	10.9

TABLE 3: PROPOSED PLANTS

No	Name of Company	Project information	Budget
1	Jigawa,Benue, Anambra and Ondo State	Integrated bio-ethanol refineries and sugarcane farm	US\$ 4 Billion
2	Nasarawa State	Integrated bio-ethanol refinery and cassava farm	US\$ 27 Million
3	Casplex	Ethanol refinery and cassava farm	NA
4	Akoni	Ethanol plant	NA
5	Ekiti State	Integrated bio-ethanol refinery and cassava farm	US100.7Million

NA: not available

2. The land use act: There are so many flaws in the land use act that needs to be amended, the land use acts needs to favor land for agriculture purposes.

3. Tax exception: Tax incentives should be given to private investors willing to invest in the bio-fuel feedstock.

4. Export and import duties: The waiver of duties on imported and exported related to bio-fuel should be considered by the government to kick start her ambition in the bio-ethanol field. Since the government has a poor record in the management of bio-ethanol blend. The management of bio- ethanol blend should be private sector driven

5. Well equipped R&D: The technology of bio-ethanol in Nigeria should have indigenous perspective, the government and the private sector should jointly fund research both at home and abroad to validate their outcomes at every point. Bio-fuel industry comes with new technology. The Universities of Agriculture in conjunction with Universities of Technology available in the country should be given the responsibility of pioneering the research.

6. Bio-fuel policy and legislature: Nigeria bio-fuel policy at the moment is still sketchy and need a thorough work to establish a frame work and legislature for industry. Clean energy and techniques should be well promoted and consequences of breaking the law should be severe. The law to govern the bio-fuel should be corruption proof.

7. Promoting the use of second generation feedstocks: This will reduce the risk and treat to food security especially in Nigeria where the first generation feedstocks are the main source of food.

8. Setting up a Bio-fuel Feedstock regulatory body: A body like this will be given the responsibilities to oversee the sales, price and consumption of feedstock for domestic consumption and for the bio-fuel industry

9. Brazil and the US partnership: The government should involve the two leading countries in bio-fuel to shape its bio-fuel policy and technology.

V. CONCLUSION

This paper has reviewed efforts of the Nigerian government towards bio-ethanol blend in the country, the risk and danger involved in using the staple food like cassava, sorghum for bio-ethanol feedstock. The government ambition to advance in bio-ethanol technology in Nigeria poses a threat to its populace of about 140 million that depend on the proposed bio-ethanol feedstock. If the government wants to continue its bio-ethanol technology the paper recommends that the decision makers should carefully review the policy recommendations provided in this work. The authors are of the opinion that the country is not ready for the bio-ethanol blend technology because of the lack of adequate preparation to prevent food crises in the country.

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