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***Journal of Scientific and Engineering Research*, 2016, 3(6):75-80**

Review Article

ISSN: 2394-2630
CODEN(USA): JSERBR

An Overview of the Potentials of Cassava as a Feedstock for Bioethanol Production in Nigeria: Problems, Constraints, Challenges and Oppurtunities (b)

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Abstract The motives behind Nigeria's interest in biofuel production, includes to decrease the huge capital it spend on procuring refine petrol from abroad, to enable the country reduce its harmful emission into the environment and also the expectation that the bioethanol project would serve as an avenue for stimulating sustainable socioeconomic development especially in the rural areas of the country. But In the developing countries cassava is an important source of carbohydrate for nearly 500 million people more especially in Nigeria where about 90 percent of the 40 million metric tonnes of cassava output is used as food by the vast majority of the poor people living in both rural and urban centres. Moreover there are other industrial demand for the cassava as raw materials for producing other products such as glue, pharmaceuticals, starch, confectionaries etc. Therefore the study conclude that the production of bioethanol from cassava feedstock is unsustainable and may pose threat to food security in Nigeria.

Keywords Cassava, Bioethanol

Introduction

Today among other key issues on global agenda are matters concerning environmental pollution and energy security, this has generated a global commitment in redefining an alternative source of energy supply which would serve as most realistic solution to the problems posed by fossil fuel consumption. However the world is now focused on utilizing raw materials from agricultural products, as the best alternative source for biofuels production. Because of their environmental and economic promises. However the productions of biofuels from agricultural raw materials (biomass) are important because of its role in reducing greenhouse gas emission [1]. Biofuels are produced in three forms i.e. solid, liquid (biodiesel and bioethanol) or gaseous form (biogas, biosyngas and biohydrogen). These fuels are usually made from plants, animals and micro-organisms, as well as from organic waste. However bioethanol is sourced from the fermentation of plant starches, Therefore variation in oxygen content is the main difference between biofuels and petroleum feedstocks. Bioethanol and biodiesel are the most favourable substitute to petroleum sourced from fossil fuels [2].

The objective of this study is to examine the prospects of bioethanol production from cassava feedstock in Nigeria.

Global Bioethanol Production

There are fears over energy security, increasing oil prices and global warming, these matters are the main drivers behind the use of renewable energy sources for some decades now, but this new source of energy share only a small percentage of the global energy production (Wenjie et al, 2012).

In 2006 there was ten percent increase in the prices of agricultural produce such as wheat, soybean and corn. This was as a result of the demand of these crops for fuel energy, on the other hand the race for biofuel

production from plant biomass is still growing, about almost sixteen billion gallons of biofuel was produced in 2007 which is three times the production rate of 4.8 billion gallons in 2000 (see Fig. 1 below).

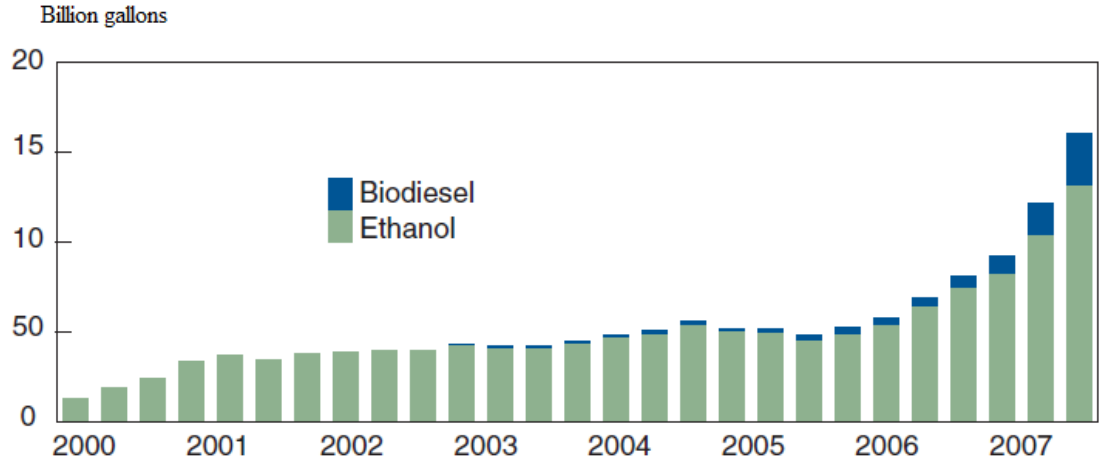

Figure 1: World biofuel 2000-2007 [3]

Currently the largest biofuel producing countries are the United States of America, Brazil and the European Union virtually producing ninety (90%) percent of global output (see Fig. 2 below). This development has kindled the hope of a new alternative source of fuel from renewable resources, (corn, sugar cane, vegetable oils etc). But the wide fear expressed on the use of these raw materials for the production of biofuel makes some governments such as China to undertake radical change in the use of feedstocks for biofuel production to raw materials such as cassava, sweet sorghum, and jatropha which have little or no concern over their use [3].

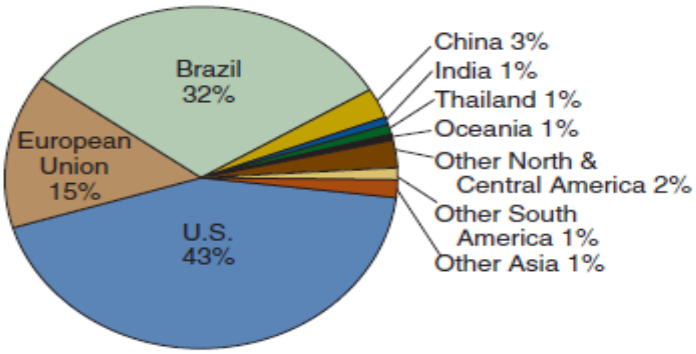

Fig. 2 World largest biofuel producers US, Brazil and Europe

Source: William 2007

Figure 2: World largest biofuel producers UD, Brazil and Europe

The Challenges, Constraints and Opportunities of Using Cassava as Potential Biofuel Feedstock Crop in Nigeria

According to Fargione et al, (2008) the belief over lowering of CO_2 as a result of the use of alternative fuels such as biofuels is not real, because there is too much released of CO_2 from the destruction many ecosystems such as the rainforest and savannahs [4]. However the demand of large land for growing biofuel feedstocks has caused the destruction of biota ecosystems, for the reason that vast forests are converted into farm lands [5-6]. Such activities affects many different types of lower and higher animals e.g. butterflies, spiders and birds inhabiting both uncultivated and cultivated lands that have rich and diverse wild plants or crops growing on

them, when compared to mono plantation farm lands. Lands that houses various species of plants, provides habitat to many different life forms. And these organisms carry out various independent biological functions in the biome such as pollination, biological control of pest that can be threat to other plants etc than land that has single type of crop growing on it [7].

Moreover comparing the life-cycle of bioethanol production and that of fossil fuels, ethanol may have the potentials of reducing the amount of atmospheric greenhouse gasses, because the different stages involved in producing the two fuels starting from cultivation, growing of the feedstock or the extraction of the fossil fuel to the final stage which is the utilisation of these fuels in automobiles. Yet enormous amounts of greenhouse gasses are released from the land during the cultivation of this feedstock, because plants and soil capture and store carbon that is released from decayed plants and animals materials or organic matters burned by fire. Therefore use of these land cause the discharged of these carbon [8].

According to Ohimain (2010) some of the constraints the Nigerian government has to overcome are the issue of small scale farmers still practicing the traditional method of agriculture, some of these farmers prefer to use the local varieties of cassava instead of the improved ones [9]. The farmers cannot afford to supply their farms with all the essentials farm requirements, in addition they barely receive the knowledge, guidance and techniques of modern systems of farming from the extension workers, these issues may pose constraints in achieving the target of both the cassakero and automotive bioethanol production. The cost of energy for bioethanol production is quite higher than that of petrol [10-11]. Some developing countries face problems in producing bioethanol from cassava, for example inadequate power supply, high prices of enzymes and inaccessibility, absence of appropriate technology for bioethanol production in the rural areas etc these tend to make the bioethanol production inefficient. Therefore sourcing bioethanol from cassava feedstock may be economical and attractive if the techniques employed for production is improved, and ease of access to cheap and efficient enzymes [10]. Nigeria spends large amount of capital in procuring refined crude oil from outside the country, thus the biofuel project is expected to provide relief by reducing the huge capital costs incurred by the country, as well as it may also help Nigeria to mitigate its environmental emissions [12-13]. The scheme is likely to create more jobs especially in the rural areas, other prospective opportunities may include, enabling the country to generate more revenue from the trades and industrial operations that will be taking place in various parts of the country. Likewise the farmers may benefit more in improving their methods of cultivation through regular interactions with the extension services department [13-14].

The Technical Improvements of Cassava- Bioethanol Production

It is obvious that different feedstock may present different types of technical challenges during the bioconversion process. According to Reddy et al, (2009) bioethanol produced from starch feedstocks is derived through uneconomical and arduous procedure when the three stages of bioethanol production are taken into account. However two possible factors are responsible for these difficulties [15]. This is because the microorganisms (*S. cerevisiea*) find it almost impossible to directly act on starch, and therefore the fermentation exercise consumed much more enzymes. Secondly in order to achieve a large quantity of ethanol, efficient fermentation has to be carried out by the microbes, for this reason about 60-120 °C of high temperature is utilised so that a complete breakdown of the starch bond is obtained during the cooking process. But enzymes such as α-amylase can only act on the starch under temperatures of 90-110 °C. Thus the use of such high energy for this reaction is seen as inefficient [16]. However the application of high temperatures such as 140-180 °C, brings about the elimination of microbes that can cause problems during later stages of the conversion. And it may also lead to a more productive saccharification [17].

On the other hand remarkable successes have been recorded, as new techniques are now employed in solving the difficulties encountered during breeding of cassava tubers. These techniques includes, the progress made in "molecular mapping sequencing of cDNA clones and expressing tags, marker-assisted breeding" and of course now the new cassava genome sequence technique that can be applied for the conventional breeding and investigations in biotechnology. Bull et al, (2011) pointed out that now biotechnology is applied to produce improve cassava varieties, for example, the techniques of Agrobacterium-mediated transformation of somatic cotyledons. Moreover the technique of micro-particle bombardment is also used in modifying regenerated transgenic plantlets from totipotent tissue called "friable embryonic callus". Now these two technologies are

generally used in producing improved varieties of cassava crop. However these technologies are considered to have problems, coupled with technical difficulties and too laborious etc [18].

The Socioeconomic Impact of utilising Cassava as a Feedstock Crop for Bioethanol Production in Nigeria

According to Sanchez and Cordona (2008) the increase in more sources of fuel energy leads to positive socioeconomic development [19]. Such as, the enhancement of agriculture activities and the improving the standard of living in the rural areas, increase revenue to the country, employment opportunities, refining atmospheric air by lowering emission of harmful gases, as well as reducing the country's dependence on procuring fossil fuel from overseas. In addition the biofuel project would also provide host communities with cost efficient and environmentally sustainable energy etc [5]. However Pimentel, (2003) point out that politicians have been misled by way of indoctrinating them with the notion that bioethanol project bring about achieving growth and development, but then the following impacts is associated with bioethanol project, the incidence of global warming and air pollution, the absence of net energy balance, moreover it is not actually considered as a renewable source of energy, because the production process involves inefficient use of energy and economy [20]. According to Onuoha (2010) there may be potentials threat to food security in the course of Nigeria's (E-10) blending 'target, because the country would essentially need 254,000 hectares of cassava or 345,000 hectares of sugar cane to realise the blending objectives. Moreover the cost of cassava cultivation is more economical and produces higher output than sugar cane. Therefore for this reason cassava may be selected as the most preferred choice of feedstock for bioethanol production in Nigeria [6].

Consequently, this may eventually lead to the demand of large quantities of cassava and may subsequently give rise to inevitable threat to food security. Besides this may also necessitate the demand for more land, and as a consequence there may be diversion of many farmlands to the production of cassava feedstock. This event may in turn lead to food crisis in the country. According to Echebiri and Edaba (2008) Nigeria is witnessing significant growth in population as well as decrease in revenue. And it is expected that there would be increased use of cassava by the poor population as the most affordable source of sustenance in the country. Currently Nigeria is estimated to have an average cassava output of only fifteen (15) tonnes per hectares [21]. This is as a result of the poor attention the sector is receiving from the government.

Besides almost ninety (90%) percent of the 40 million metric tonnes of cassava output in Nigeria is used as daily food by poor Nigerian's [21]. These demand dynamics may cause instability in prices of commodities, which also has the potentials of triggering food insecurity in the country. Additionally farmer's productiveness to supply more food in the country may be derailed. But the federal government directives of using 10% cassava flour in bakery and other related food industries. This statement is regarded as a positive policy in adding importance to cassava chain value, and a encouraging step in stimulating the cassava output in the country.

Conclusion and Recommendation

In conclusion the emergence of biofuels is expected to play an important role in alleviating socioeconomic and environmental problems. However there are challenges and constraints associated with bioethanol programme in the country. Therefore considering the current demand in biofuels globally, and the growing international market of bioethanol creates an opportunities for developing countries such Nigeria, to engage in bilateral trade agreement with some of the most prosperous biofuels producing nation over exporting the cassava by-products or the bitter varieties as feedstock for biofuels production.

On the other hand the government can direct the use of sweet variety of cassava for food and bitter varieties for bioethanol project. In view of the socioeconomic and environmental issues arising from the bioethanol programme, such as the possible threat to food security as a result of diverting farmlands for growing feedstock in the country, coupled with the capital intensive nature of the project as well as the environmental impact on biodiversity and greenhouse gas emission etc, makes the Nigeria bioethanol programme unattractive.

Therefore the study concludes that from the socioeconomic and environmental perspectives the Nigerian bioethanol programme from cassava feedstock is uneconomical and unsustainable, and may cause food crisis in the country. Because about 90% of the cassava produced in Nigeria is consumed as food, similarly this study agrees with the findings of Onuoha (2010) on biofuels development in Nigeria [6].

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