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New Fuel Frontiers: The Rise of a Nigerian Biofuel Economy

Nigeria, one of the largest nations in Africa, utilizes abundant petroleum supplies, yet it is classified among the top twenty poorest nations in the world. It just so happens that the petroleum sales constitute the majority of government income, but corruption leads to the handling of this money by politicians for personal use. Since the 1990's, Nigeria has had a rapid degradation in its standard of living. Seventy percent of the population is classified as poor, earning less than or equal to US$1 a day. In the rural areas where the poor are more numerous most people are subsistence farmers and produce 90% of the country's food. Despite this, a large percentage the poor are malnourished. Conditions are expected to worsen in the north where more and more degraded farmland is disappearing due to desertification (Rural Poverty in Nigeria). The trouble does not end there. Nigeria, like much of the world, is suffering from water scarcity issues. All these factors pose a formidable challenge to reducing poverty and industrializing the nation, but the Nigerian government is taking steps to combat the issue of poverty. While the rest of the world searches for new sources of energy as petroleum supplies diminish, the Western world has turned to the production of biofuels as an answer for the time being. Looking at the steps the Nigerian government is taking, one must ask whether Nigeria can become a leader in the emerging biofuels economy.

In order to determine what can be most beneficial to the Nigerian biofuel economy, one must have a basic understanding of the existing economy. For most of the modern era, the industrialized world has been dependent on fossil fuels for energy needs. In recent years, research has shown that petroleum reserves are being depleted. Brazil was the first country to realize that excess sugarcane crops could be used to make renewable fuels. After Brazil's prolific success, other nations began to explore biofuel possibilities in their own economies. At present, the United States and Brazil are leading in biofuel production with the use of corn and sugarcane respectively. Although the world's powers are capitalizing on biofuels that does not mean there is not a market for developing nations. In fact, biofuels account for only 3% of the fuel consumed in the United States (Jarrell and Rekas Biofuels Coming Online: International Biofuel Use Expands). This means that the industry is open to anyone and that it is in the best interest of the third world countries to capitalize on this market.

At this time, Nigeria is establishing an ethanol industry, using Cassava and sugarcane as biomass. The introduction of the Jatropha plant for biodiesel and the adoption of modern techniques could increase biomass and food yields. As well, they could also reclaim land lost to desertification and improve the standard of living. While petroleum prices are increasing exponentially across the world, it is the African people who are being impacted the most, with prices reaching $5.30/gal in some nations. This is the case in Senegal, where high gas prices have caused daily blackouts because their electric companies can not afford fuel. There is a similar story in Nigeria. Despite its vast petroleum supplies and per capita income of less than $1,500, there are long lines at gas stations ("Senegal Sees Oil as" A14). With oil prices rising, the cost to produce and transport crops increases. In an impoverished nation, this can have huge consequences on the well being of the population. The integration of a biofuel economy would help alleviate the inflated fuel prices in Nigeria by providing a steady income to their people so that the purchasing of these expensive fossil fuels becomes bearable. It is of the utmost importance that Nigeria and other countries in Africa start implementing biofuels into their economy before this opportunity to industrialize passes.

Cassava is a tree like plant that is the staple food for Nigeria and much of the surrounding region. Nigeria is the world's largest producer of Cassava, with 30 million tons produced annually (Osterkorn). Recent research has shown that Cassava can be refined to create ethanol. This discovery has already been well received by China and Thailand where Cassava is already being used to make ethanol; coincidentally the Cassava being used in these nations is being imported from Nigeria. The Nigerian government has already made an agreement with the Brazilian fuel company, Petrobras, in which Brazil will supply the Nigerian national oil company with the technology to build and sustain an ethanol industry in exchange for a Nigerian market for Brazilian ethanol (The New Scramble for Africa). This is a tremendous step in the right direction because the Nigerian people will be creating their own industry instead of selling their resources and labor to foreign companies. This was initially what happened with the oil resources. Nigeria did not have the technological resources to develop a petroleum industry nor did they have the capital to start such an endeavor. With poverty on the rise and no solution on the horizon, the Nigerian government was forced to allow foreign companies to start and monopolize the petroleum industry. The result is that Nigerian oil is not making its way to the Nigerian people and none of the money from the profits is beneficial to the people. With this new deal with Brazil, the average farmer will personally profit from the sales of his crops. According to figures taken from the *A cassava industrial revolution in Nigeria The potential for a new industrial crop*, these profits could be a minimum of N2000. This will, in turn, benefit the proletariat because they will be working in the ethanol refineries and distilleries.

We must not forget about the hunger issues in Nigeria. Cassava is the main staple of this region. If Cassava is being diverted for ethanol production, then more people will starve. Fortunately this disaster is easily avoidable. In fact, the Nigerian National Petroleum Corporation (NNPC) has proposed agreements with the International Institute of Tropical Agriculture that will focus on the low yield problems with Cassava. Once the agreements are made, researchers will study various Cassava varieties that could create higher yields (Osterkorn). These higher yields will nullify the negative effect that ethanol production would have on the food supply. Of course, this will not be enough. The Nigerian government will have to make sure that land is not sold in mass quantities to fuel companies. The best path for Nigeria is one in which the expansion of land dedicated to industrial Cassava farming is limited, while coupled with a set percentage of land dedicated to industrial and consumer use. The duty of a government is to provide for its people. If the land is sold to fuel companies, then the people can not grow enough food to eat. This is why research into higher yield Cassava is so important.

Fortunately for the Nigerian people, there is another great untapped resource in the Niger Delta that can be used to produce ethanol. The Nypa Palm or Mangrove tree was first brought to Nigeria in the early twentieth century by European settlers. Since that time, it has seen prolific growth now covering 504,000 hectares in the Niger Delta alone (Nypa Ethanol in the Niger Delta). It is considered an invasive species because it suppresses other plants. There have been efforts to stop its expansion, but all efforts have failed. For the most part, the people of Nigeria have come to accept that the plant is there to stay. Recent studies in Southeast Asia show that the tree can be tapped to obtain enough sap to make the production of ethanol feasible. Furthermore, the Nypa Palm can be tapped as early as four years old and will continue to produce sap for another fifty years (Dalibard). Researches have learned that ethanol can be cheaply produced from the sap using a fermentation process. This process can make 6,480 to 15,600 liters of ethanol from one hectare of land, in contrast to the 5,000 to 8,000 liters that can be produced by sugarcane and 2,000 liters that can be produced by corn on the same amount of land (Dalibard; Nypa Ethanol…).

If the use of the Nypa Palm for ethanol production is adopted by Nigeria then it will bring many needed jobs to the area. Although the Niger Delta is the home to the Nigerian oil industry, it is considered the poorest part of the country. For the people of the area, growing the tree will be a very painless process, as it does not require special care. Harvesting the sap is easy to learn and when perfected, can procure even more sap. The growth of this industry will bring many jobs to the area. These jobs are

estimated to pay well above the local minimum wage. The benefits do not end there; the Nypa Palm can reach yields of twenty tons of sugar per hectare (Dalibard). This is more than enough sugar to meet the ethanol needs. FAO projects in Cambodia have shown that palm sap can be used as animal feed. In a country like Nigeria, where increasing livestock populations are depleting and degrading the available grazing land into desert, this can be quite a revolutionary find.

The key to the success of both the Cassava and Mangrove industries lies with the farmers and laborers. The oil industry failed to bring Nigeria into the industrial age because large foreign companies took over. The local people were not involved in what happened to their resources or in setting the price at which their labor and resources would be sold. The same injustice cannot occur with the emerging ethanol industry. Production of the biomass must remain in the hands of the local farmers. As long as they own the Cassava and the Mangrove trees, they will have a steady income. Furthermore, the ethanol refineries and distilleries must be locally owned. It is of the utmost importance that Nigeria remains in control of this last resource that will bring it into the modern era. The point must be made that the ethanol industry will not bring a new affordable fuel to the people of Nigeria. The technology used in the area is not suited for ethanol use. Ethanol burns at a much higher temperature than gasoline and can damage the low quality engines used in the country. The biofuel most suitable for integration into the Nigerian fuel market is biodiesel. Biodiesel can be used in all the engines currently in use in Nigeria without alteration. Conveniently for the Nigerian fuel economy, there is an excellent plant that can accommodate these needs and many others.

This plant is Jatropha, more specifically *Jatropha Curcas L*, a small tree that was brought to Africa by the Portuguese from the Caribbean. There is no part of the Jatropha plant that is edible. What makes Jatropha so unique is the fact that it can grow on marginal lands, does not require more than 400 to 500mm of rainfall per year, and it can endure long periods of drought. Jatropha has been used in rural Africa for hedges, to prevent wind damage and water and soil erosion. Surprisingly, the local people have been using Jatropha oil for their various needs over the past several decades (United Nations Commission on Sustainable Development 9). The conditions are ideal to take Jatropha use to the next stage. The foundation has already been laid and all that needs to be done is implement an oil industry centered on Jatropha.

Jatropha seeds have an oil content ranging from 25 to 37 percent. With ample yields, a harvest can produce up to 8.8 tons of seed or an equivalent of 2,200 liters of oil per hectare. Current projects in Mali show that these yields are lower on marginal lands, with a harvest ranging from 3.5 to 5 tons of seed. Jatropha oil can be directly used in small combustion engines, diesel engine vehicles, or diesel generators. The oil can be refined through transesterification into biodiesel, which can then be used as is or mixed with diesel (United Nations Commission on Sustainable Development 9-10). The uses of Jatropha do not end there. Once the oil has been extracted, the remaining seed can be made into seedcake. This seedcake contains high levels of nitrogen, phosphorus, and potassium, making it an excellent source of fertilizer.

The potential that Jatropha has in developing Africa is being realized to its fullest extent. All the Nigerian government must do is look to Mali as example. The United Nations and other organizations have started programs that work to introduce Jatropha and Jatropha oil into village economies. A prime example is given by the efforts of MFC Nyetaa. This organization has set up a 1,000 hectare Jatropha plantation in Garalo, Mali. The Jatropha will provide oil to a 300 kilowatts power plant that will, in turn, provide electricity to 10,000 people for the next fifteen years (United Nations Commission on Sustainable Development 15). This will revolutionize the local economy by providing electricity that can be put to productive uses in all the existing industries.

Jatropha can and should be used to create a stable biofuel economy in Nigeria. Jatropha is not a food crop, so it will not affect the food scarcity issues of the nation. The advantage to growing Jatropha is

that it can be grown on marginal lands and does not require irrigation. This will greatly benefit the farmers who are already feeling the pains of decreasing water tables. This fact, in itself, greatly improves the case for the use of Jatropha. It is necessary for local farmers to grow Jatropha on marginal lands. Secondly, the seedcake should be made as a byproduct and used to fertilize the land. It will then be necessary to have engines and power plants set up across the country so that the entire population can receive electricity. Lastly, any excess fuel will be introduced into the global market for profit. For these benefits to occur, the government must take the first step. Local farmers currently cannot afford the seed necessary to start the industry. It must be the government's job to provide the seed in the first stages of development. This is the only way that Nigeria will be able to use biofuels in order to improve the standard of living of its people. When the standard of living rises, Nigeria will witness a period of industrialization because local industries will benefit from the introduction of electricity, creating capital that can be used to industrialize. This is what a Jatropha industry will do for the economy but it can have greater benefits environmentally and socially.

Socially, Jatropha will have the potential to bring about many reforms. Jatropha is in no way labor intensive. This will create more free time for women and children because they are the ones who work the fields. With this additional time, children will be able to get an education and women will be able to enter other fields of work.

Nigeria suffers greatly from desertification. Every year, 351,000 hectare of land is lost to the desert. This is due primarily to Nigeria's rapidly growing population and its nutritional needs. The Nigerian population has increased from 30 million in 1950 to 130 million in 2004. Where as, the livestock population has increased from 6 million to 65 million (Brown Ch. 5). This increase in livestock has required the grazing land to be expanded. The result is mass desertification. Opportunely, Jatropha can be grown in these desert lands. Not only will this put the land to use, it will also restore nutrients to the depleted soil. Furthermore, the byproduct of oil production can be used to make seedcake, which can then be used as a fertilizer to reclaim these lands. Jatropha appears to be the miracle solution to Nigeria's problems if all things are handled correctly. The success of this emerging industry is dependent on the cooperative effort of both the Cassava and Jatropha industries.

For Nigeria, the implementation of the three industries discussed above is crucial in developing a stable and productive biofuels economy. It has been decided by the world powers that ethanol is the alternative fuel of the future. In order to have a presence in the global market, Nigeria will need to develop a significant ethanol industry. Being the leading producer of Cassava, Nigeria has the necessary crop base to introduce an ethanol industry. However, Cassava is the main staple food of Nigeria and the adoption of a Cassava based industry can have negative repercussions on the food supply, so research must be done on ways to improve yields. This stress on the food supply makes it of the utmost importance for Nigeria to adopt a two part ethanol industry based on Cassava and the Nypa Palm. The Nypa Palm is found throughout the impoverished Niger Delta. The Mangrove tree can produce twice the amount of ethanol as sugar cane and has an industrial lifespan of fifty years. Aside from its use as biomass, the sap from the Nypa Palm can be used to produce animal feed for the ever growing livestock population. This can aid in the on going battle against desertification, as the excessive grazing is one of the chief factors of desertification.

As mentioned, Ethanol is perfect for Nigeria's involvement in the global economy, but its domestic use is limited. Most people in Nigeria do not possess the technology in which ethanol can be utilized. However, diesel engines are common place in Nigeria and they can run on biodiesel without modification. This would make the implementation of Jatropha for biodiesel production top priority. Jatropha can be grown on marginal lands, does not require an abundance of water, and restores nutrients to the soil. As such, Jatropha is the answer to Nigeria's desertification and water problems. Furthermore, it does not require constant maintenance, making time available for children to pursue an education.

Developing a Jatropha economy could be the most important action that the Nigerian government ever takes, because oil produced by Jatropha can be used in electrical generators that will supply the Nigerian people with clean electricity. The availability of electricity will lead to the industrialization of Nigeria and an increase the overall standard of living.

None of this would be possible without active government involvement. It must be the government's responsibility to prevent the Cassava industry from falling into the hands of foreign companies, resulting in the expansion of industrial farming and a decrease in land availability for consumer use. Secondly, it must be noted that nothing can be done with aid from the western powers. No matter how much dedication the Nigerian people show, they do not have the money or the technology to begin a biofuels industry. Brazil has already taken the first step, with the pact between Petrobras and the Nigerian National Petroleum Corporation. The Nigerian people do not need another foreign run industry but, they do need aid in starting their own. It should be active policy of nations, such as the United States, to supply Nigeria with the technology necessary for biofuel production in exchange for fuel or a foreign market. With foreign aid, Nigeria could easily become a major force in the global biofuel economy.

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