

## **CHALLENGES MILITATING BODIESE SUSTAINABILITY IN WEST AFRICA AND WAY OUT- NIGERIA AS A CASE STUDY**

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**Key words :** Biodiesel, industry, technologies, perspective, renewable energy.

**Abstract.** Challenging militating biodiesel sustainability in Nigeria is examined in this paper. The key constrains facing stakeholders in biodiesel industry are identified. The establishment of conversion technologies as enumerated by some researchers is reviewed in order to spring up Nigeria's biodiesel industry and to reduce unnecessary bottleneck preventing Nigeria from joining her contemporary developing countries in proffering alternative fuel to finite fossil diesel. Future prospects of the industry and numerous benefits are highlighted. It is hoped that the afore-mentioned novel technologies will go a long way in bringing Nigeria to establish functional biodiesel industry.

### **Introduction**

Attention is being focused on developing renewable energy resources (such as hydro, bioenergy, solar, wind and thermal among others) as a way to promote sustainable development and contain the threat posed by climate change to the planet, progress at developing the abundant renewable energy resources found in Africa as a viable alternative to fossil fuel has been slow. However, the transportation and industrial sectors of many African countries rely on oil import. These countries, including Burkina Faso, Ghana, Malawi, Niger, Kenya, Tanzania, Togo and Zambia spend huge percentage of their GDP on oil import (See map of West Africa, Fig.1). This has led to huge debts being incurred with serious ramification for the performance of their economies. For example the debt incurred by Tema Oil Refinery (TOR) in Ghana made it difficult for the company to import crude oil leading to several shutdowns which affected economic activities in the country. Government of Ghana was forced to settle the arrears before TOR could lift crude into the country. These debts are linked to high global oil prices. The high prices mean that oil importing African countries will have to use their limited foreign exchange to compete with the likes of United States and China ([www.africabiofuel.com](http://www.africabiofuel.com)). In spite of opportunity that biofuel/ biodiesel can

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provide towards contributing to the seventh agenda of the Millennium Development Goal (MDGs) and preserve environment for sustainable socio-economic development. Africa is still faced with the skyrocketing price of oil and increased greenhouse gas emissions (Dufey, 2007 and Anieto, 2010). Africa countries are becoming increasingly interested in biofuel as a palliative measure. Ethiopia for instance still spends millions of dollars importing oil each year despite the fact that she and Democratic Republic of Congo possess about 61 percent of Africa's untapped hydro power potentials ([www.africabiofuel.com](http://www.africabiofuel.com)). South Africa and India are slightly ahead in this area, while Nigeria is still experimenting with feedstocks (Anieto, 2010). Over the year, Nigerian Biofuel policy and incentives have been drafted by the government. This policy aspires to achieve 100% domestic production of biofuels consumed in the country by 2020 (NNPC, 2007). Also, NNPC and Renewable Energy division have decided to promote domestic production of biofuel and encourage the use of renewable energy. At present, stakeholders seem not to have adopted any meaningful strategy for preparatory sustainable biofuel development (Youngstar, 2010). This revelation is a pointer that more efforts and strategies need be put in place for Nigeria's biofuel production to take effect. The concern of this paper, therefore, is to identify major conversion technologies through review in order to spring up Nigeria's biodiesel industry and to proffer possible solutions to the challenges that may confront proposed biofuel / biodiesel industry plant in Nigeria.



Fig.1- Map of West Africa (Source: [gifbonjourbenin.wordpress.com](http://gifbonjourbenin.wordpress.com))

Biofuels are liquid transportation fuels made from plants and animal residues used for car, trucks, airplanes and trains (Schepf, 2007). Biodiesel is a domestic renewable fuel for diesel engines derived from natural oils like soybeans, canola, palm kernel etc., which meets the specification of ASTM D 6751 (ASTM, 2004). Biodiesel has been reported as a fuel that can replace diesel fuel in engines, and has been found to produce less carbon dioxide and reduced tail emission in to the atmosphere compared to fossil diesel (Agarwal and Das, 2001; Canakci and Van Gerpen, 2001). Biodiesel is a light dark yellow liquid that is practically immiscible with water with a high boiling point of 230°C, a flash point of about 150°C and has physical and chemical characteristics that compares favorably with fossil diesel (Dairo, 2010). Biodiesel is designed as B100 by ASTM international where the “B” indicates Biodiesel and the number following represent the percentage of Biodiesel in a gallon of fuel (ASTM, 2004).

### **1. Present Perspectives of Biofuel/ Biodiesel in West Africa and Nigeria**

Biofuel is an attractive source of energy for West African states because it can protect their economies against rising crude oil prices on the world market. It is also seen as a viable source of climate-friendly energy. Santuah (2006) reported that West African countries lack the expertise needed to apply for the scheme. Also, Ghana's Minister for Lands, Forestry and Mines, Fobih indicated that West Africa lack expertise to develop proposal related to Clean Development Mechanism under the Kyoto Protocol for biodiesel production. Benin, Mali, Nigeria and Senegal, led by Ghana, have pioneered research on biofuel and *Jatropha* plantations. *Jatropha* oil's low cost and ease of cultivation make it an attractive crop for biofuel production. But biofuel production is still a relatively young technology, and more research is needed, notably to make sure it is geared towards the needs of small farmers for whom biofuel use on a local scale — for village power or agro-processing — could be highly promising.

### **2. Conceptualization and Development of Conversion Technologies**

Conversion technologies have to do with improving the process and thereby the economics of biodiesel production. Nowadays, interest lies in the development and evaluation of heterogeneous catalyst systems, the use of ethanol, in-situ transesterification, reducing NO<sub>x</sub> emissions, and adding values to the co-products (oilseed meals/ press cakes and glycerol). China and India had been reported (Frost and Sullivan, 2009) to have hastened their biofuel technology so as to ensure functional biorefinery.

The usage of heterogeneous catalyst will eliminate the need for a water wash to remove excess catalyst. This will reduce both the capital cost of a plant and the operating cost. Another potential advantage of this method is that a higher quality

glycerol may be obtained since the FFA present in feedstocks could be converted concurrently to alcohol ester rather than being separated out and used for some lower purpose (Hanna et al., 2005).

There is an interest in the use of ethanol for Biodiesel production because it is produced in large quantities from readily renewable resource. Also, it is more environmental –friendly than methanol. The only problem with ethanolysis is that it is very slow. In-situ transesterification, which has to do with direct transesterification reaction of ground seeds with alcohol and catalyst to produce biodiesel, has been proven to be technical feasible for a range of feedstocks, catalysts and alcohol. (Kazim et al., 2010). In-situ technique, it eliminates processing stages such as crushing, solvent extraction and degumming present in conventional transesterification. The simplification of the processing stages will be a useful way to reduce cost of biodiesel and optimize on a large scale production. The most important challenges have to do with reduction of volume of alcohol in the in-situ reaction.

Adding value to the co-product of biodiesel or at least maintaining their current values will enhance the economic viability of biodiesel. An opportunity for adding value includes the use of glycerin to produce chemicals and for many products.

A universally accepted standard for biodiesel and adherence to the standard by all producers will enhance the acceptability of biodiesel and its blend, both by the blenders and consumers. Two of the most accepted standards are ASTM D675L and EN 14214.

The relative simplification of the novel technique such as in-situ transesterification will make it acceptable by stakeholders in Nigeria.

Strategies for introduction of novel technique in Nigeria's biofuel industries constitute and integral part of the overall development plan. The division arm of Biofuel Research Agency should anchor and demonstrate the technical feasibility of this novel technique for proper sustainable and better application. Researchers need to study a wide range of chemical such as co-solvents in order to reduce the ratio of reactant to oil and investigate the process path itself. By this, this discovery of novel processes or unit operation might make the process more economically viable.

### **3. Biodiesel Industry and its Justification**

Global warming is one of the justifications for the development of biodiesel industry. It entails increase in the average temperature of the atmosphere, oceans and landmass of the earth (Hart, 2007).

According to UNDP 2007/2008 Human Development Report, the world temperature has increased around 0.7°C since the advent of industrialization and the rate is skyrocketing yearly.

It is argued that biodiesel is considered as a CO<sub>2</sub> neutral emissary and biodegradable (Agarwal and Das, 2001). This process reduces greenhouse gas emissions. Biodiesel industry can improve domestic and regional energy, production capacity, demonstrate tropical comparative advantage in production, enable rural job creation and food security, reduce oil imports and generate saving on foreign exchange, and enable economic diversification.

In Nigeria, Biodiesel industry would not only reduce poverty but also help in economic diversification, thus making the country less dependent on petroleum as the main stay of the economy. In addition, the market size of biofuel in Nigeria is another justification for the need to develop the industry in the country. Biodiesel demands in 2007 were 480 million liters, with a projected demand of 900 million liters in 2020 (Azih, 2007).

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#### **4. Potential for utilization of conversion Technologies and in Nigeria's Agricultural Produce Biodiesel Industry**

There are potentials for utilization of conversion technologies in Nigeria's biofuel industry. Services of skilled professional in the industry to design a formidable process, faculties of various higher institutions in several disciplines and the armies of students to work on the research ranging from engineering, biotechnology, environment issues are needed. In addition, labor forces in the rural areas can be trained and retrained to fit innovation and utilization of conversion technologies in biodiesel industry.

#### **5. Government Effort so far in Biodiesel Development**

Nigeria government has started with the establishment of Renewable Energy Division (RED) through Nigeria National Petroleum Commission (NNPC) in August, 2005. Within the period of the commission establishment to 2008, the following achievements have been made:

- public awareness campaign especially in the cultivation of crops used for the production of biofuel. Farmers were motivated to cultivate cassava, sugarcane, maize etc.

- quality assurance frame work was set up by standard organization of Nigeria (SON) for the importation and production biofuel.

- retail outlets were selected for effective distribution of the products

NNPC staff were trained on biofuel handling techniques, especially in quality assurance

- facilities in the downstream sector of the petroleum industry in Atlas cove and Mosimi were modified to handle biofuel products imported into the country (NNPC 2007).

### **6.Expected Benefits of Biodiesel Industry to Rural and Urban Community in Nigeria**

There are numerous benefits for the rural and urban communities if biodiesel industry is properly developed in Nigeria. These benefits include:

- employment Stability and Wealth Creation.
- biodiesel production links with community and agricultural produce area. It also goes with greater loans and agricultural incentive from government and the private sector. With these facilities on ground, jobs would be created for citizens. The proportion of workforce in Nigeria will increase when biodiesel industry is fully integrated into the country. Hence, great wealth will be created.
- enhancement of market.
- biofuel industry in rural and urban areas would attract services providers; this would activate multiple effects in the moment. Business would expand and the demand for agricultural produce would improve. People would have access to varieties of goods and services.
- skill Acquisition and Improvement in School Enrollment
- the establishment of biodiesel industry in Nigeria would lead to skill acquisition and improvement in school enrollment. The industry would need skilled and semi-skilled workers, and this would enhance improvement in school enrollment in both rural and urban areas.
- investment in Transport Energy Sector.
- the development of biodiesel industry would create investment in transport and energy sector. More people would be opportune to run their vehicles on bio-fuel and establishment that utilize heavy machines run by diesel would operate at a profit margin.
- stabilization in internal Revenue.
- Inclusion of biodiesel industry to the system would stabilize foreign exchange as the country would be in a better position to make use of domesticated produced fuel instead of depending on expertise from abroad.

### **7.Challenges to the Establishment of Biodiesel Industry**

*Lack of Infrastructure.* At present, basic and major equipment are lacking in both rural and urban

*Lack of Technical Skills.* Although Nigeria is endowed with enormous labor force as the biodiesel industry is new, with re-revolution technology, the need for specialized and skilled workers would arise. Specialists suited for particular technology may not readily be available for the smooth running of Biodiesel industry.

*Fears of Competition with Food.* There are fears that the biodiesel industry would threaten food security in Nigeria over the proposed establishment of the industry. This might retard proper development of biodiesel industry.

*Inadequate Fund Provision.* Loan and incentives by the government to rural farmers are often small. The cultivation of biodiesel crops often requires long term loan and great incentives. Inadequate loans and incentives might frustrate farmers from engaging in biofuel crop, thus affecting their productivity.

### **8.Recommendation**

In line with aforementioned challenges to Biodiesel establishment, our position is to utilize the industry as total for socio and economic development in Nigeria, the following recommendations are made:

- long term facilities and long term loan facilities and agriculture incentive should be made available to interested people especially in biorefinery where bulk of biofuel crops are produced. Commercial banks should be mandated by law to expand their loans to farmers. Government should also stand as guarantors to farmers who are ready to cultivate biofuel crops.

- the land use act of the country should be amended, with the aim of making land available for biofuel crop production.

- tax holidays should be given to pioneers in the biofuel industry. Investors' interest and dividends should not be taxed for a period of ten years. Levies paid to government department and agencies should be eliminated for the same number of years.

- export and import duties should also be waived for ten years. This would attract foreign investors into the biofuel in Nigeria, hence boosting rural economy. It would also make the development of bioenergy industry to be both government and private sector driven.

- biofuel industry comes with new technology. Research institutions should be established by government with support from the private sector. These institutions should be saddled with the responsibilities of making recommendations of government and investors on the way forward in the biofuel industry.

- adequate legislature should be made by government to prevent environmental pollution by biofuel industry. The law should promote clean production process, with minimal pollution. Again adequate laws should be made

that would spell out companies-community relations. Biofuel industries should be told at inception, their corporate social responsibilities to host communities.

- adequate enlightenment program should be embarked upon by government to educate rural folks on food security. They should be made to understand that, with the increase in loans agriculture incentives, and mechanization food production would be surplus leaving no room for storage.

### Conclusion

Biofuel industry is another way of developing clean energy that is environment friendly. It carbon dioxide emission is equal to its absorptions during crops production. The industry is endowed with great opportunities and would assist in rural development in Nigeria. It would create jobs, wealth, develop rural infrastructure, expand rural market, and reduce the scourge of poverty. Although there are challenges that may face the development of biofuel industry in rural Nigeria, these problems can be overcome through careful planning and implementation strategies as recommended in this study.

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