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A Projection of Benefits of Adoption of the Proposed Biofuel Blending Mandate in Nigeria (2014 - 2023)

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ABSTRACT

In 2007, the Federal Government of Nigeria proposed the introduction of the National Biofuel Policy. The policy document is to *inter alia* reduce the country's dependence on imported fuel and ensure the commercial viability of the biofuel industry by ensuring compulsory blending mandate. However, the potential benefits of biofuel investment have attracted a web of chaotic contestations and denials from several quarters. These could have warranted the obvious non-implementation of the blending proposal. The main objective of this study is to therefore project the short term (2014-2043) benefits of the compulsory biofuel blending mandate as enshrined in the proposed National Biofuel Policy in Nigeria. To achieve this, secondary data on fuel consumption was used in projecting the biofuel required for blending at three scenarios of 5%, 7.5% and 10% inclusion levels. Jatropha was used as the feedstock because it is considered to be a relatively better alternative feedstock. The study found that potentials exist for the viability of biofuel production in terms of potential demand for fuel and land availability for Jatropha cultivation. Result further suggests that at the three blending scenarios, the incorporation of the biofuel with current fuel consumption offers prospects in terms of employment creation and the provision of additional sources of relatively clean energy. It subsequently recommends the implementation of investments and policy initiatives as well as the coordinated involvement of numerous stakeholder groups in order for the policy to gain broad public acceptance. Furthermore, suggestions centre on the need for practical validation of the biofuel investment from other potential feedstocks as well as practical validation of the energy equivalence from biogas production.

Keywords: Biofuel Blending, Energy, Sustainable Development, Nigeria

INTRODUCTION

Global concerns about climate change and energy security have motivated governments at all levels to encourage the production and use of biofuels as an alternative to fossil fuel. Several policies, including blending quotas or targets and price support mechanisms have been formulated to stimulate demand (Lin, 2010). In 2007, the Nigerian government, a member of Organization of petroleum Exporting Countries (OPEC) joined the global league and indicated the incorporation of biofuels production with the aim of blending it with the conventional fuel currently available in the country. Subsequently, the Nigeria Biofuels Policy was established in 2007 and it is intended to tailor the necessary measures to be applied in ensuring successful biofuels production and utilization. The policy's main target is to reduce the country's dependence on imported fuel and environmental pollution while creating an industry that is commercially viable to both investors and consumers and provide sustainable job opportunities that could reach the common man (NNPC, 2007). It similarly aimed to ensure an integration of the downstream petroleum industry with agricultural activities (NNPC, 2007; Ohimain, 2013).

There are several feedstocks that could be used for biofuel production. However, certain types of feedstock are considered directly used for human and or livestock consumption which make their use to raise genuine concerns that bothers food security (Mkoma and Mabiki, 2011). The use of *Jatropha curcas* (Linnaeus), appears to be a promising alternative for biofuel especially in tropical and subtropical regions. This is because, Jatropha does not pose serious threat to food security as it cannot be eaten and it can be produced on a small-scale level with less intensive cultivation and limited use of pesticides and fuel fertilizers with less significant impact on the ecosystem (Mkoma and Mabiki, 2011).

Notwithstanding, investment in biofuels and in the blending quotas had not been without criticisms and in some instances, questions have been raised challenging the sustainability of biofuel blending policy and its impact on food security, rural livelihoods and agro-commodity prices (Achten *et al*, 2007; Friends of the Earth, 2010). This chaotic web of contestations, denials and rebuffs of the potential benefits of biofuels could have resulted in the non-implementation of the policy document in Nigeria and in some other developing countries of the world. This therefore calls for a re-examination of the economic benefits as enshrined in the biofuel policy.

In the light of these salient observations, this study sets out to achieve the following objectives:

1. Projects a 10-year estimate of the quantity of Jatropha oil for blending at a varying mix of 5 %, 7.5% and 10%;
2. estimates the additional farmland (ha) required and jobs to be created from Jatropha cultivation for the blending; and
3. estimates the Barrel of Oil (BOE) energy and Megawhat (MwH) equivalent of the Jatropha seedcake.

METHODOLOGY

The study was conducted in Nigeria. The country is the most populous country in Africa and a member of the OPEC. The country is endowed with significant energy resources; oil reserves 36 billion barrels (2009 estimates); gas reserves 187 trillion cubic feet; and oil production 2.016 mbd (Iwu, 2008). As shown by Iwu (2008), the Oil sector has influenced significantly the growth contour of the country since 1970. Oil contributed $391b to government revenue between 1970-2005 (Iwu, 2005). Between Oil exports represented 75% of total govt revenue and 96% of foreign exchange earnings over the period (Iwu, 2008).

The study utilized secondary data. For this study, data on fuel consumption was limited to the Premium Motor Spirit (PMS) otherwise referred to as the petrol. Data on petrol consumption in Nigeria was obtained from the Nigerian-US Energy Information (EIA). The study's base estimate was the trend of consumption from 1982 to 2012. As reported form EIA (2013), about 16 million liters consumption as of 2013 and a cumulative average of 14 million for the preceding years (1982-2013). This study, therefore projected the estimates for the years 2014 to 2043 based on the average growth rate recorded for these periods as used by Hanafi *et al.*(2011).

This study estimated biofuel requirement that would be required for blending at three scenarios of 5% inclusion, 7.5% inclusion and 10% inclusion levels. To account for the quantity of Jatropha oil that would be required for the blending at the varying mix, the study estimated the respective fractions of the varying inclusion at 5%, 7.5% and 10%. These fractions formed the basis of estimating the quantity of Jatropha oil to be required.

To account for the projected farmland that would be put into cultivation, the study based its estimates on a modest yield expectation of 1.5 tons of Jatropha oil per hectare. Based on literature, one ha of Jatropha will yield between 2.2 tons-3tons of Jatropha oil. Based on 1.5 tons estimates, this study was able to determine the projected farmland (ha) to be required for the production of the oil needed for the blending capacity.

The study was equally able to estimate the additional field employment that could be generated form Jatropha cultivation (this is excluding other sources from transporting, processing and distribution of the oil) based on the rule of the thumb that for every one ha of Jatropha, 2 jobs opportunities could be made available. The employment potentials were therefore found by ascertaining the number of jobs to be generated from the determined farmland to be used.

Finally, to estimate the Barrel of Oil Equivalent (BOE) and the MwH equivalent of Jatropha seedcake from biogas production, first, the study assumed an oil extraction rate of 25% and thereafter estimated the quantity of seed cake that will be left after oil extraction. Second, it assumed that the seed cake is 100% available after extraction for biogas production. Following Mkoma and Mabiki, 2011, an estimation of the Barrel of Oil Equivalent of the methane produced from the seedcake assuming that the seed cake is 100% available for biogas production, characterized by 92% Organic Total Solids (OTS) and 92% TS, biogas production is at 350 L/KgoTS with 65% methane and that the proper technology is used resulting to efficient production and power losses during transmission are negligible (Mkoma and Mabiki, 2011). Furthermore, this study based its conversion estimates to BOE and MwH equivalent following Mkoma and Mabiki (2011) that 1 Kg of pressed seedcake will yield 1.923MwH of energy and 1 Kg of pressed seedake is equivalent to 1.15 BOE after degradation (Mkoma and Mabiki, 2011)

The study makes a projection of PMS consumption in the country following the annual growth rate in consumption observed over the period 1980-2012. Following the seminal works of Moore (1917), Ezekiel (1927), Hopkins (1927), and Nerlove (1958), a single equation-linear model was fitted to estimate for projects consumption over the subsequent years under review. The analytical framework used in this study follows:

$Y^*_t = f(\beta X^*_{t-1})$…………………………….. 1

Where;

Y*t= Projected estimate for time t

B= is the coefficient representing the annual growth rate of PMS consumption in the previous years

X^*_{t-1} = Estimate of PMS consumption in the previous year $_{t-1}$

The explanatory power of the model used for the projection of the PMS consumption is presented in Table 1

Table 1: The Result of the Statistical Explanatory Power of the projected PMS consumption Model

Projected PMS Estimate (Dependent variable)	**Coefficient**	**Std error**	**T**	**P>t**
Estimate of annual change in PMS consumption in the previous years	-9762	768.3	-12.71	0.00
Constant	1318	48.09	27.42	0.00
Adjusted R^2=0.85; F=161.45 (p=0.01); Root MSE=121.29				

Source: Statistical Analysis (2012)

As shown in the above Table 1, the model significantly explains the variation in the projected estimates of PMS consumption in the country for the year under review.

RESULTS AND DISCUSSION

The projected petrol consumption estimates for the country is presented in Table 2.

Table 2: Projected petrol consumption Based on Average Consumption Growth form 1980-2012

YEAR	PROJECTED CONSUMPTION (IN '000 BARRELS/DAY)	000 BARRELS/YEAR	IN LITERS @ 159 LITERS/BARREL
1980-2012	240.00	87600	13928400
2013	269.89	98510	15663066
2014	303.50	110778	17613771
2015	337.12	123047	19564475
2016	370.73	135316	21515179
2017	404.34	147584	23465884
2018	437.95	159853	25416588
2019	471.57	172121	27367292
2020	505.18	184390	29317997
2021	538.79	196658	31268701
2022	572.40	208927	33219405
2023	606.02	221196	35170110
2024	639.63	233464	37120814
2025	673.24	245733	39071519
2026	706.85	258001	41022223
2027	740.47	270270	42972927
2028	774.08	282539	44923632
2029	807.69	294807	46874336
2030	841.30	307076	48825040
2031	874.92	319344	50775745
2032	908.53	331613	52726449
2033	942.14	343881	54677153
2034	975.75	356150	56627858
2035	1009.37	368419	58578562
2036	1042.98	380687	60529267
2037	1076.59	392956	62479971
2038	1110.20	405224	64430675
2039	1143.82	417493	66381380
2040	1177.43	429762	68332084
2041	1211.04	442030	70282788
2042	1244.65	454299	72233493
2043	1278.27	466567	74184197

Source: Authors' Extrapolation based on projected PMS consumption

As revealed from the Table, fuel consumption is expected to more than double the current consumption and increase to an all high 35 million liters per day by the end of the year 2023. Fossil fuel combustion is expected to come with carbon gas emission which has negative environmental implication and currently, the consequence of what we use is demonstrated in several studies and campaigns that call for a reduction in fossil fuel consumption.

The projected trajectory of fossil fuel use and its related emission of greenhouse gases are unsustainable. This could have raised global concerns which subsequently warranted the partial substitution of fossil fuel with more sustainable biofuel, which is expected to reduce the carbon emission associated with fossil fuel burning.

To blend our fossil fuel, several blending ratios has been adjusted. Efforts are currently underway to implement a recommended blending ration of the conventional fossil fuel with biofuel (NNPC, 2007). The result of the relative estimate of the required biofuel that would be needed to blend at varying quantities is presented in Table 3.

Table 3: Projected Biofuel Required for Blending at Varying Blending Ratio in liters

YEAR	AT 5%	AT 7.5%	AT 10%
1980-2012			
2013			
2014	880688.5	1321033	1761377
2015	978223.7	1467336	1956447
2016	1075759	1613638	2151518
2017	1173294	1759941	2346588
2018	1270829	1906244	2541659
2019	1368365	2052547	2736729
2020	1465900	2198850	2931800
2021	1563435	2345153	3126870
2022	1660970	2491455	3321941
2023	1758505	2637758	3517011
2024	1856041	2784061	3712081
2025	1953576	2930364	3907152
2026	2051111	3076667	4102222
2027	2148646	3222970	4297293
2028	2246182	3369272	4492363
2029	2343717	3515575	4687434
2030	2441252	3661878	4882504
2031	2538787	3808181	5077574
2032	2636322	3954484	5272645
2033	2733858	4100787	5467715
2034	2831393	4247089	5662786
2035	2928928	4393392	5857856
2036	3026463	4539695	6052927
2037	3123999	4685998	6247997
2038	3221534	4832301	6443068
2039	3319069	4978603	6638138
2040	3416604	5124906	6833208
2041	3514139	5271209	7028279
2042	3611675	5417512	7223349
2043	3709210	5563815	7418420

Source: Authors' Extrapolation based on projected PMS consumption

As revealed in the Table, the demand for biofuel is highest at 10% inclusion rate. This is expected to increase from 1.7 million liters to about 4 million liters by 2023. The significant demand for biofuel justifies its huge market size and should be seen as a potential source of investment for would be investors. In addition, adoption of the Biofuel blending ratio is expected to create a platform for local farmers to diversify their income base form the conventional agricultural activities as alternative fee stock like Jatropha can be cultivated at hedges without disturbing normal agricultural activities and at the same time, provide revenue for the farmers

Farmland Requirement for Jatropha Cultivation at Varying Blending Rates

To justify the production of Jatropha for biofuel, this study ascertains the farmland in hectares that would meet with the projected demand. The result of the projection of land estimates is presented in Table 4

Table 4: Projected Farmland (ha) Required at 1.5 tons of Oil/ha

YEAR	FARMLAND (HA)@ 5%	FARMLAND IN HA@7.5%	FARMLAND@10% INCLUSION
1980-2012			
2013			
2014	587.13	880.69	1174
2015	652.15	978.22	1304
2016	717.17	1075.76	1434
2017	782.20	1173.29	1564
2018	847.22	1270.83	1694
2019	912.24	1368.36	1824
2020	977.27	1465.90	1955
2021	1042.29	1563.44	2085
2022	1107.31	1660.97	2215
2023	1172.34	1758.51	2345
2024	1237.36	1856.04	2475
2025	1302.38	1953.58	2605
2026	1367.41	2051.11	2735
2027	1432.43	2148.65	2865
2028	1497.45	2246.18	2995
2029	1562.48	2343.72	3125
2030	1627.50	2441.25	3255
2031	1692.52	2538.79	3385
2032	1757.55	2636.32	3515
2033	1822.57	2733.86	3645
2034	1887.60	2831.39	3775
2035	1952.62	2928.93	3905
2036	2017.64	3026.46	4035
2037	2082.67	3124.00	4165
2038	2147.69	3221.53	4295
2039	2212.71	3319.07	4425
2040	2277.74	3416.60	4555
2041	2342.76	3514.14	4686
2042	2407.78	3611.67	4816
2043	2472.81	3709.21	4946

Source: Authors' Extrapolation based on projected PMS consumption

The result revealed in Table 4 showed that at 10% inclusion level, the highest farmland requirement for Jatropha production (at 1.5 tons of oil/ha) is estimated to be 2,475 ha. Meanwhile, estimates of the Federal Ministry of Environment (FMEN, 2001) put the proportion of arable land in the total land area in Nigeria at 35% of which less than

20% is actually cultivated (AIG, 2012). This further stresses the fact that land availability may not be a problem. However, land acquisition may be of a difficulty as a result of the associated prevailing land tenure practices. In addition, the cultivation of Jatropha may result into diversion of farm resources and input employed in the cultivation of other arable crops which may result in competition between the two. This may warrant further investigation in these two areas.

Employment Benefits Associated with Jatropha Farming at the rate of 2 Jobs/ha

The study examined the additional employment that could be generated from Jatropha cultivation given a realistic assumption of 2 workers per ha. The result is presented in Table 5.

Table 5: Employment opportunity potential of Jatropha cultivation

YEAR	JOB AT 5%	JOB @ 7.5%	JOB @10% inclusion
1980-2012			
2013			
2014	1174.25	1761.38	2348.50
2015	1304.30	1956.45	2608.60
2016	1434.35	2151.52	2868.69
2017	1564.39	2346.59	3128.78
2018	1694.44	2541.66	3388.88
2019	1824.49	2736.73	3648.97
2020	1954.53	2931.80	3909.07
2021	2084.58	3126.87	4169.16
2022	2214.63	3321.94	4429.25
2023	2344.67	3517.01	4689.35
2024	2474.72	3712.08	4949.44
2025	2604.77	3907.15	5209.54
2026	2734.81	4102.22	5469.63
2027	2864.86	4297.29	5729.72
2028	2994.91	4492.36	5989.82
2029	3124.96	4687.43	6249.91
2030	3255.00	4882.50	6510.01
2031	3385.05	5077.57	6770.10
2032	3515.10	5272.64	7030.19
2033	3645.14	5467.72	7290.29
2034	3775.19	5662.79	7550.38
2035	3905.24	5857.86	7810.47
2036	4035.28	6052.93	8070.57
2037	4165.33	6248.00	8330.66
2038	4295.38	6443.07	8590.76
2039	4425.43	6638.14	8850.85
2040	4555.47	6833.21	9110.94
2041	4685.52	7028.28	9371.04
2042	4815.57	7223.35	9631.13
2043	4945.61	7418.42	9891.23

Source: Authors' Extrapolation based on projected PMS consumption

Employment potentials of the field activities of Jatropha cultivation is presented in Table 5. As revealed in the Table, the cultivation of Jatropha is expected to generate an additional minimum of 2475 to a maximum of 5000 jobs at varying Jatropha oil inclusion of 5% to 10%. The job opportunity is expected to be generated from on-farm cultivation and harvesting of Jatropha alone and the study did not include additional jobs from other value addition activities like processing and retailing. This study is in line with previous studies which demonstrates the potentials of biofuel investment for tackling unemployment in developing countries (Galadima *et al*, 2011). Given the current strides of the government in tackling the challenges of youth unemployment, the adoption of the biofuel policy will accommodate some of the unemployed youths who are willing to embark on the cultivation of the crop.

Energy potential of the Jatropha Seed cake

The result of the energy potential in terms of the Barrel of Oil Equivalent and MwH equivalent is presented in Table 6.

Table 6: Estimated Barrel of Oil (BEO) and Megawhat equivalences of biogas from seedcake of Jatropha

YEAR	SEEDCAKE@5% (KG)	SEEDCAKE@7.5% (KG)	SEEDCAKE@10% (KG)	BOE @5%	BOE@7.5%	BOE%10%	MWH@5%	MWH@7.5%
2014*	2,642,066	3963098	5284131	3,038,375	4,557,563	6076751	5,080,692	7621038
2015*	2934671	4402007	5869342	3,374,872	5,062,308	6749744	5,643,373	8465059
2016*	3227277	4840915	6454554	3,711,368	5567053	7422737	6,206,053	9309080
2017*	3519883	5279824	7039765	4,047,865	6071797	8095730	6768734	10153101
2018*	3812488	5718732	7624976	4,384,361	6576542	8768723	7331415	10997122
2019*	4105094	6157641	8210188	4,720,858	7081287	9441716	7894095	11841143
2020*	4397700	6596549	8795399	5,057,354	7586032	10114709	8456776	12685164
2021*	4690305	7035458	9380610	5,393,851	8090776	10787702	9019457	13529185
2022*	4982911	7474366	9965822	5,730,347	8595521	11460695	9582137	14373206
2023*	5275516	7913275	10551033	6,066,844	9100266	12133688	10144818	15,217227
2014*	5568122	8352183	11136244	6,403,340	9605011	12806681	10707499	16,061,248

Source: Authors' Extrapolation based on projected PMS consumption

As revealed in the Table, the country stands to generate considerable energy from tapping into the conversion of the Jatropha seedcake to biogas. The contribution of the energy in terms of Barrel Equivalent of Oil (BEO) in the three scenarios amounts to several Million BEO per year, which could save the country potential savings from foreign exchange saving from importation of petrol. These energy potentials may further contribute to environmental conservation due to deforestation, accelerate national development by increasing the number of Nigerians with access to electricity; allowing small scale investments and business projects, these are directly linked to the millennium development goals. The annual per capita electricity consumption in Nigeria was estimated to be about 12Watt/person in 2012 while the annual energy consumption was 18,140,000 (CIA, 2008). This is very low when compared to the world average per capita 313Watt/person (CIA, 2008). In recent years, successive governments have intensified efforts at upgrading the electricity supply in the country. With the efficient exploitation of Jatropha press cake for biogas production, the country could be guaranteed an additional supply of electricity source that would complement current insufficient supply. This is expected to translate to enhanced national development as small and medium scale enterprise will have access to energy and further contribute to sustainable national development in the country.

CONCLUSION AND RECOMMENDATIONS

This study examined the potential implication of the implementation of the blending policy as enshrined in the National Biofuel Policy in Nigeria. It subsequently projected a 10 year forecast of the use of Jatropha oil for blending at varying ratios of 5%, 7.5% and 10% inclusions with the conventional fuel. Secondary source of data was used. The result suggests the incorporation of the biofuel with current fuel consumption offers prospects in terms of employment creation, provision of additional sources of energy and could possibly lead to green gas emission reaction in the country. The study also found potentials for the viability of biofuel production as the demand for fuel is increasing and there is land which could be made available for the cultivation of the feedstock.

In relation to the conclusion from this study, the following recommendation are proffered

1. Producing several tons of Jatropha annually will require the use of technologies, and changes in the way feedstocks are collected or harvested, stored and transported, and preprocessed will also have to be made. Accomplishing these changes will obviously require investments and policy initiatives as well as the coordinated involvement of numerous stakeholder groups to gain broad public acceptance.

2. The utilization of a significant amount of biofuel would also require a concerted Research and Development (R&D) effort to develop technologies to overcome a host of technical, market, and cost barriers. Incentives like tax credits, price supports, and subsidies would be required to facilitate a successful takeoff.
3. Finally, additional studies would have to be conducted to determine the practical requirements from other feedstocks and the actual energy equivalent of biogas production from various feedstocks.

REFERENCES

Achten, W.M.J., Mathijs, E., Verchot, L., Singh, V.P., Aerts, R. and Muys, B. 2007. Jatropha biodiesel fueling sustainability? *Biofuels, Bioproducts and Biorefining* 1,283–291

American International Group (AIG) 2012. Commercial Farming will Ameliorate Africa's Food Defict and Benefit the Global Supply Chain. Assessed from www.aig.com/agriculture-potential 2590 421198.html

CIA. 2008. The World Factbook. Retrieved September, 2013 from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2042rank.html

Ezekiel, M., 1927. Two methods of forecasting hog prices, Journal of the American Statistical Association. 22, 22-30.

FMEN (Federal Ministry of Environment of Nigeria) 2001. National Action Programme to combat desertification. Assessed from http://www.uncd.int/action programmes/Africa/national/2001/Nigeria-eng.pdf on 5 September, 2013

Friends of the Earth Europe 2010. 'Africa: Up for Grabs'. The Scale and Impact of Land Grabbing for Agrofuels. Retrieved on 3/9/13 from http://www.foei.org/en/media/archive/2010/resolveuid/fa06b589da3f2f002d3217906c2af218

Galadima, A., Garba, Z.N., Almustapha, M.N., Leke, L., and Adam, I.K. 2011. Biofuels Production in Nigeria: The Policy and Public Opinions. *J. of Sustainable Development* Vol. 4, No. 4; pg 22-31

Hanafi, M., Mantari, A.R., Mohd Jafar, M.N. and Raj, A.P. 2011. Socio-economic and Feasibility Study of Utilising Palm Oil Derived Biofuel in Malaysia. *Oil palm industry economic journal* Vol. II (1)

Hopkins, Jr., J.A.. 1927. Forecasting cattle prices, Journal of Farm Economics, 9, 4333446. R SN Uses multiple regression to forecast prices of fat cattle 6 months ahead.

Iwu, B. 2008. Energy Option in the Industrialization and Development process of the Nation, What Role for Coal. The Bullion, The Publication of the Central Bank of Nigeria. 22(4), 113-117

Lin, J. 2010. The Sustainability of Biofuels: Limits of the Meta-Standard Approach. Working Paper 011. *The Governance of Clean Development Working Paper Series.* School of International Development, University of East Anglia UK

Mkoma, S.L. and Mabiki, F.P. 2011. Theoretical and Practical Evaluation of Jatropha as Energy Source Biofuel in Tanzania, Economic Effects of Biofuel Production In Dr. Marco Aurelio Dos Santos Bernardes (Ed.), ISBN: 978-953-307-178-7, Available from: http://www.intechopen.com/books/economic-effectsof-biofuel-production/theoretical-and-practical-evaluation-of-Jatropha-as-energy-source-biofuel-in-tanzania

Moore, H., 1917. Forecasting the Yield and Price of Cotton (MacMillan. New York). R SN Regression of cotton yield on May rainfall (for May forecast), on June temperature (for June, July forecasts) and also on August temperature (for August forecast) for 1892-1914 data for Georgia. Alabama and South Carolina had smaller RMSE than USDA forecasts based on condition indexes made 1 or 2 months later.

Nerlove. M., 1958. The Dynamics of Supply: Estimation of Farmers' Response to Price (Johns Hopkins Press, Baltimore). 268 pp.

Nigerian National Petroleum Corporation (NNPC) 2007. Official Gazette of the Nigerian Bio-fuel Policy and Incentives. Assessed on 10 Sepetember, 2013 from www.ecowrex.org/...epository/2007_biofuels_policy.pdf.

Ohimain, E.I. 2013. A review of the Nigerian biofuel policy and incentives (2007). *Renewable and Sustainable Energy Reviews*, Volume 22 Pg 246-256