Biofuels Production in Nigeria: The Policy and Public Opinions

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Abstract

In order to reduce the country's over dependence on oil and gas economy and establish a strong link between the downstream petroleum industry and agricultural activities, the Nigerian government has recently indicated commitment to biofuels production from local feedstock. Emphasis was given to bioethanol and biodiesel with projected annual local market possibility of 5.04 billion and 900 million Liters respectively. The study reports an over view of the biofuels policy and a survey of the public opinions on the potential impacts of its implementation. A questionnaire containing six research questions, covering the key positive and negative impacts of commercial biofuels production was designed in line with the policy objectives. 200 samples were randomly distributed to people with good biofuels education across the country, within 90 days. The recovered questionnaires (PQR = 92.50 %) were treated statistically. Additional respondents' comments were also captured and analysed. 97.30 % of the respondents expressed optimism in terms of positive impacts such as generation of revenue to the government, investments, jobs creation, energy access to rural areas and environmental sustainability. However, the remaining respondents with percentage cumulative response (PCR) of 2.7 % showed that negative consequences such as food price hike, soil degradation and diversion of food land would be the net result due to high level of corruption, poor technology and lack of transportation network. To achieve the policy objectives, appropriate planning is required. Research covering the views of all stake holders and lessons from prior countries like Brazil and India would be very important. Emphasis should be given to pre-exploited agricultural land and non-food crops that are adaptive to current and foreseeable climatic conditions in Nigeria.

Keywords: Biofuels policy, Nigeria, Overview, Public opinions, Decision making

1. Introduction

Oil and gas exploration and production has become a dominant sector of the world energy and other economic sectors since the last century. In the Nigerian perspective, since the discovery of commercial reserves in the Delta region in the mid 1950s, the sector has increasingly dominated the agriculture and solid minerals exploitation for both the source of energy and revenue to the country (Odeyemi and Ogunseiten, 1985).

Currently, these commodities accounted for over 90% of both foreign exchange benefits and total government revenues. However, continuous reliance by the country on only one sector is unsustainable, especially considering the fact the current respective proven reserves of 36.22 billion barrels and 181 trillion cubic feet of oil and gas could only last for the next 35 to 40 years. This could be attributed to the rapid increased in population and energy consumption and the associated development in science, technology and socio-economic activities (Enibe and Odukwe, 1990). Another major issue of concern about these fossil fuels is their environmental threats. They are increasingly associated with the emissions of greenhouse gases, majorly CO_2, leading to climate change, emergence of drought, spread of diseases and variation in population sizes of both plant and animal species (Lashof and Ahuja, 1990; IPCC, 2007). Within the last 20 years about 75% of human made CO_2 emissions were from burning of fossil fuels. Nigeria is the largest emitter of these undesirable gases from the sub-saharan Africa, and particularly, the second worlds' biggest gas flarer, contributing immensely to the global atmospheric pollution.

The oil and gas exploration and production being dominant in only a portion of the country, accounted for only few job opportunities to less than 1% of the over 140 million inhabitants of the country. This can also be connected with the continuous rise in poverty levels among the rural communities and the persistent rural-urban migration over the years. In an attempt to mitigate these problems, Nigerian government have recently indicated the incorporation of biofuels production, particularly bioethanol and biodiesel to be a good option. The production of these fuels could enhance fuel use in automotive industry, electric power generation and rural development, including agricultural mechanisation and light industrial goods development, and in ensuring that the common man is fully benefitted from the country's economy (Azih, 2007). These issues therefore prompted the recent Biofuels Policy (2007), which tailors 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 petrol, 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. It similarly aimed to ensure an integration of the downstream petroleum industry with agricultural activities (NNPC, 2007).

The policy designed as a mandate of the Nigerian National Petroleum Corporation (NNPC) inline with "Automotive Biomass Program in Nigeria" initiated in August, 2005 have encompasses only the benefits to be obtained from the entire program without surveying the public opinions on other foreseeable consequences. It is clear that, biofuels production in the world has become an issue of debate as to whether the production could do more good than harm in terms of environmental management and economic sustenance. For example, the current environmental degradation and food price hike in Brazil could not be separated from the long term biofuels production (Carioca et al., 2009). Therefore a survey of public opinions on whether the policy and the production process could be sustainable is very important at the initiation stage. This would provide further guidelines on what to do and what to avoid during full implementation. The objective of this paper is to survey the opinions of Nigerian elites on the most likely impacts of long term biofuels production in the country using local feedstock as proposed by the government in the National Biofuels Policy and Incentives (2007).

1.1 Nigerian Biofuels Policy and Incentives

The Nigerian Biofuels Policy and Incentives drafted in 2007 by the national oil company (NNPC) is the first of it kind established in Nigeria with the view of integrating agricultural activities with oil and gas exploration and production since the discovery of commercial quantities of oil in 1956. The policy addresses the key government plans with regards to ethanol and biodiesel production across the country from the research and development phase to large scale production and investment stages. The federal government of Nigeria inline with its program (Automotive Biomass for Nigeria) mandated NNPC to draft the policy in August 2005, such that the nation's overdependence on oil and gas economy and the environmental threats associated with the fossil fuels exploitation could be reduced to as low as reasonably practicable levels. The mandate requires that the policy is designed to allow the future usage of biofuels in the country, to make significant impact on gasoline, diesel and other petroleum products quality enhancement.

1.1.1 Objectives and the Anticipated Benefits of the Policy

The main objective of the policy is to firmly establish an ethanol and biodiesel industry, which will be solely dependent on local agricultural products as feedstocks, so that the quality of the fossil fuels for use in automotive industries and other sectors could be improved. It therefore seeks to provide an appropriate link between the agriculture and energy sector (NNPC, 2007). Further more, it aims to create an avenue for integrated national development covering all sectors of the economy. The specific anticipated benefits of the policy are as follows.

- Diversification of the country's sources of revenue as additional taxes could be generated from commercial activities attributed to the industry.
- Creation of sustainable job opportunities for citizens and the empowerment of rural communities who are currently neglected from enjoying the national cake.
- Improving agricultural benefits by advancing farming techniques and agricultural research.
- Ensuring that the projected energy demand in the country is addressed sustainably;

- Reduction in environmental pollution due to fossil fuels. Biofuels could drastically reduce tailpipe emissions and the depletion of ozone layer. They can also be used as desirable replacements to toxic octane and cetane enhancers in gasoline and diesel respectively.

1.1.2 The Policy Structure, Market and Investment Incentives

The policy has been structured into two major components inline with the available agricultural land, research and development and implementation strategy. The first phase of the program defined in the policy as "seeding the market" involve the importation of commercial quantities of fuel ethanol to seed the market base on 10% ethanol blend (E-10) with gasoline up to the time when local production could be fully implemented. This can take up to ten years from the initiation period (NNPC, 2007). The second stage of the program (Biofuel Production Programme) will begins simultaneously with the seeding phase, and would continue, involving large scale plantations using the massive agricultural land distributed across the country. Agricultural crops such as cassava, sorghum and sugar cane are the most likely options for ethanol production while Jatropha for the biodiesel production. These crops could be grown in different part of the country, especially the north and central belts.

With regards to biofuels market, records indicate that these commodities have not been use previously for any commercial fuel application. The projected demands were therefore deduced from the recent and future gasoline and diesel production in the country. For the anticipated E-10 ethanol blend in gasoline, about 1.3 billion Liters of ethanol are required annually. This has been deduced to reach 2.0 billions Liters by 2020 and beyond. The demand for biodiesel is projected based on 20% blend (B20) inline with international biodiesels specifications. 900 million Liters would be required by 2020 compared to the estimated current requirement of 480 million Liters. The market is anticipated to reach 100% establishment by the year 2020. These projections are summarized in Tale 1.

Looking at these market possibilities as well as potential exports to other African countries like Niger republic, Cameroon, Chad e.t.c the program will attracts investment from both local and international companies, especially the victims of long time Niger Delta insecurity. To aid this, the government has so far outlined the following investment incentives under section 6.0 of the policy (NNPC, 2007).

- Funding of research and establishment of biofuels agency to limit investment costs and access to any government subsidy by the companies
- Tax Holiday (Pioneer Status): All registered businesses engaged in activities related to biofuels production and/or the production of Agricultural feedstock for the purpose of biofuels production and Co-generation within the country shall be accorded pioneer status within the provisions of the Individual Development (Income Tax Relief) Act.
- Withholding tax on interest, dividends e.t.c.: Biofuels companies shall be exempted from taxation, withholding tax and capital gains tax imposed under Sections 78, 79, and 81 of the companies Income Tax Act in respect of the interest on foreign loans, dividends and services rendered from outside Nigeria to biofuels companies by foreigners.
- Waiver on Customs and Import Duties: Biofuels companies shall be exempted from the payment of customs duties, taxes and all other charges of similar nature.
- Waiver on Value-added Tax: Companies that are involved in the production of biofuels or feedstock and/or the generation of electricity from biomass shall be exempted from payment of value-added taxes on all products and services consumed.

2. Crops with Biofuels Potential in Nigeria

2.1 Sorghum

Shorgum is one the high drought resistance crop cultivated in about 50% of the Nigerian agricultural land, mostly the northern region (8 ^{0}N to 14 ^{0}N latitude), accounting for 6.86 million hectares of land. Annual production has been estimated to rise by 45% from the total production of 4.8 million tonnes in 1978 (Ogbonna, 2002). This figure gives Nigeria the opportunity to be the highest producer of sorghum in Sub-saharan Africa, accounting for about 70% of the total production in the region. The commonly grown varieties are the Farfara, Guinea and Kaura, which are all resistance to different killer weeds, and scientifically classified as given in Table 2. Sorghum is currently use in Nigeria for two main categories of purpose classified here as local and industrial. Traditionally, the crop is mostly cultivated by poor farmers to meet their local demands. They mainly use their harvest for food, beverages, and variety of drinks. Non-food uses include roofing and fencing of compounds in local communities. The local application accounts for about 73% of annual sorghum usage in the country. Industrially, the crop is used in malting and breweries. In 1984 and 1985 the demand for industrial sorghum malt in Nigeria was computed as 134170 and 161043, accounting for 64 and 74 million naira market value respectively (Ilori, 1991). This figure had since rise by about 45%.

Considering the large scale demand of sorghum both locally and industrially, diversion of the crop for fuel ethanol production could have severe consequences. One, the peasant farmers would definitely shift from

cultivating other subsistence crops to sorghum, creating an imbalance in the food circle. Secondly, the objective of the biofuels policy would be defeated by sudden rise in food price and inappropriate use of agricultural land. Thirdly, most of the agricultural land would be exposed to degradation due to continuous mono-cropping, and this can severely add to the already existing problems of soil erosion and desertification in the northern parts.

2.2 Cassava

Cassava is another crop grown on both local and commercial scales in some major parts of Nigeria, especially the rainforest, and the savannah areas of North West and North Central, due to availability of well-drained deep loamy soils. The spread of cassava production in the country could be traced to the period between 1930 and 1946, when yam production was considered unprofitable due to considerable damage by pests. Over sixty different varieties are currently cultivated. Initially, sweet varieties that could be eaten by the local people without further processing were the dominants. However, these were subsequently matched with other improved varieties such as TMS 30572, 4(2)1425, 92/0326 and NR 8082. The annual production was estimated to have increased by about 66% from 382,000 ha per year from 1946 (Nweke, 2004). Like the sorghum, cassava is used at both local and industrial scales. Peasant farmers employ the tubers for production of food in form of gari, fufu and fermented flour (Ugwu and Nweke, 1996). Industrially, the crop is used as raw material for starch, chips, pellets, unfermented flour and more importantly in beer manufacture. Cassava has been given a great emphasis for fuel ethanol production under the current biofuel implementation plan than sorghum. In areas where its production remain the only source of food and household incomes for the local farmers, an imbalance could be created, although may not be very severe if the existing pre-exploited land is used in preference. Careful planning is therefore necessary to ensure that, large scale cassava production is carried out screening out food-to-fuel diversion issues.

2.3 Sugarcane

Since its introduction into the country through the eastern and western coasts by the European Sailors in fifteen century, sugarcane has become an important crop grown in many parts of Nigeria. Traditionally, sugarcane is grown on small holdings (usually 0.2 to 1.0 ha) for chewing as juice and preparing livestock feed. However, with the increased in demand for sugar in the country, the crop is grown on large scale as raw material for sugar industry. Around 1997, the major sugar companies operating; Bacita, Lafiagi, Numan and Sunti utilised about 12, 000 ha out of the total 30, 000 ha for sugar-based sugarcane production (Agboire et al., 2002). In the year 2007/2008 an estimate of 100, 000 tonnes were produced compared to 80, 000 tonnes in 2006/2007. However, due to the persistent increased in sugar demand to 1.50 billion, making Nigeria the second largest in Africa, the local sugarcane production is insufficient to meet the demand. With the current shift to biofuel ethanol production by the government, more companies were invited to participate in sugarcane production across the country. In the last few years, a US-based company (Lemna International) proposed to establish the first ethanol production plant in Taraba State. The project analyses to cost US$ 50 million would require a land covering 30,000 to 50,000 ha for local raw material cultivation. The NNPC have clearly identifies sugarcane and cassava as the major raw materials for the bioethanol production program. Currently, investors have already invested over $3.86 billion for the 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 from sugarcane and cassava, leading to land requirement of 859,561 ha (Ohimain, 2010). Sugarcane-based fuel ethanol production would have very little threat to the local people, as the crop is not used for daily food like sorghum or cassava. However, sudden rise in prices of sugar and sugar products would be a great challenge. To address this, importation and sell of sugar to peasants at a subsidise rate is necessary. Similarly, an unbiased food price *versus* food-fuel feasibility research should be executed simultaneously, such that proper policy modification is carried out in line with real situation.

2.4 Jatropha

The policy identifies Jatropha oil as the main pilot raw material for the biodiesel industry. Jatropha is non-edible plant and therefore has not been on the large scale production by either the Nigerian food or commercial farmers. Some few research plantations were established in the recent years, as pilot studies for checking soil desertification. However, with the current biofuels plan some northern states namely Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, Bauchi, Yobe, Borno, Adamawa and Gombe (Figure 1) are selected for large scale production. A number of Literature studies have indicated Jatropha to be a very good source of oil for biodiesel production; yielding nearly 100% of the fuel in short transesterification time under both homogeneous and heterogeneous conditions (Lu et al., 2009; Sahoo and Das, 2009; Vyas et al., 2009). From the economic perspective studies indicated successes in large scale Jatropha plantations in different tropical countries. Studies by Prueksakorn et al (2010) in Thailand showed that, both 20 years perennial system and annual cultivation method, involving harvesting the trees for wood and the seed for biodiesel could produce up to 4720 and 9860 GJ of net energy per ha. In India, production and use of Jatropha biodiesel have reported to triggers 82% decrease in fossil diesel demand and 52% decrease in global warming potential (Achten et al., 2010). Therefore, selection of Jatropha in Nigeria would be a multipurpose opportunity. In addition to the sources of energy, soil degradation, desertification, and deforestation problems could be addressed. If only 10% of the available

agricultural land (60,000,000 ha) in the selected states could be utilised, additional revenue of $3 billion, which is more than the annual allocation to these states, could be generated. However, the poor farmers may shift from food crops to Jatropha cultivation due to foreseeable market value, deforming the food circle. Similarly, continuous plantation is associated with soil acidification and eutrophication (Achten et al., 2010).

3. Methodology

The production of liquid biofuels (i.e biodiesel and bioethanol) from agricultural feedstocks had been projected to be an important option that could potentially mitigate global climate change, contribute to energy security and support agricultural producers world wide. However, most recent Literature on biofuels development in Brazil and U.S.A considered the option unviable and responsible for the present global food insecurity (Carioca et al., 2009; Escobar et al., 2009). This therefore prompted us to design research questions in form of Questionnaires. The survey was simply carried out by distribution of the Questionnaires to people across Nigeria that were believed to have good understanding of biofuels perspectives at the global level and the current Nigerian economic status, as well as the implication of long term production on the economy. Secondary information was further obtained from a constructive review of critical Literature, newspapers and magazines that directly relates to the research in question.

3.1 Questionnaire Design and Distribution

The research questionnaire was designed to ask the respondents a summary of six questions that are believed to cover all the most likely impacts of biofuels production in Nigeria. The questions are listed below.

Q1.The diversion of food land for energy crops development could result in high agricultural prices?.

Q2. Biofuels demand in Nigeria could place additional pressure on the natural resource base, particularly for people who already lack access to energy, food, land and water?.

Q3. Biofuels development in Nigeria could promote access to energy in rural areas, supporting economic growth and long-term improvements in food security?.

Q4. A stronger link between agriculture and demand for liquid biofuels could result in higher farm output and gross domestic product (GDP)?.

Q5. Long-term deforestation for liquid biofuels feedstock production can contribute to an increase in environmental pollution, soil degradation and desertification?.

Q6. The current biofuels implementation policy can cause more harm than good to Nigerians in terms of jobs creation, investment, energy supply and food security?.

About 200 Questionnaires were randomly distributed manually and electronically in 90 days to different respondents whose level of education is at least a Polytechnic Diploma or National Certificate of Education (NCE), and majority of which are Lecturers and Postgraduate Students in Nigerian Universities, Colleges of Education and the Polytechnics. A respondent is expected to state his/her level of agreement (Strongly Agree, Agree, Disagree or Strongly Disagree) with each question. He has also been provided with an opportunity to add some critical comments and suggestions.

3.2 Recollection and Analysis

Since the respondents were given enough time (2 weeks) to study the research questions, so that appropriate suggestions could made, not all the research questionnaires were recovered at the end of the survey period. Out of the 200 distributed initially, 185 questionnaires were successfully recollected and analysed statistically. The results were treated according individual questions. Percentages of response to the questionnaires and agreement with a particular impact were calculated as shown in Table 3.

4. Results of the Survey and Discussion

The result of the various responses to the questionnaires recovered (92.5%) is summarized in Table 4. It generally indicates that, the Nigerian public is optimistic about the success of biofuels production in the country. Analysis of respondents' additional comments revealed that, 97.3% (Figure 2) of the elites involved believed that the program, as designed in the policy, could benefit both the common man and the government at large. According to them, there is enough capacity for feedstock production and processing, due to available productive arable land, natural resources and manpower desired for the programme. The key opportunities identified include creation of job opportunities and reducing the high level of poverty in the rural communities, particularly considering that, over 70% of the population depends on agriculture, industrialisation, revenue generation and environmental sustainability by over 70% reduction in greenhouse gases emissions. The remaining 2.7% (Figure 2, Table 4) of the respondents however, showed that, the high level of corruption, poor transportation network and lack of mechanised agricultural facilities would create a setback to the programme. They attributed long term biofuels production to negative consequences such as sudden and persistent rise in food price, diversion of agricultural land, soil degradation and conflicts among rural inhabitants over land use.

QUESTIONS 1-3: Majority of the already-exploited agricultural land in Nigeria is used by the local people for the production of food. Therefore, diversion of the land to biofuel raw material cultivation is associated with

hunger threats. In line with this, the largest percentage of the respondents (70%) strongly discouraged the used of this land. As seen from Figure 3, only 3.51% support the exploitation of the food-land. Majority of the participants therefore encouraged that; pre-cultivated land should be used instead. This opinion directly correlates with experience in countries like India and Thailand (Achten et al., 2010; Prueksakorn et al., 2010). Similarly, Msangi et al. (2007) showed that, even at the global scale, this could result to upward pressure on international food prices, making staple crops less affordable for poor consumers; potentially significant adverse impacts on both land (soil quality and fertility) and water resources, and on biodiversity and ecosystems in general.

With regards to whether, biofuels production will create additional imbalance to local people, having poor access to amenities (Q2), more than 80% of the respondents strongly disagreed (Figure 3, Table 4), basing their arguments on integrated approach whereby access to jobs would be improved. Similarly, construction of mechanised agricultural projects such as feeder roads, irrigation facilities e.t.c would promote the standard of leaving in many rural areas. On the other hand, less than 10% of the respondents strongly opposed the potential contribution of the program to economic growth and access to energy in the rural areas. 75.68% are in strong agreement with that (Figure 3, Table 4).

QUESTIONS 4-6: Revenue generation, climate change mitigation and attracting investment, thereby creating more job opportunities to jobless are the major targets of the biofuels policy, such that, the country's over dependence on oil and gas economy would be greatly reduced. These are captured in research questions 4 to 6, and the associated opinions are presented in Figure 4.

The result indicates that, 91.89% of the people strongly agreed with generation of more revenues, leading to increase in the country's GDP due to potential increase in farm output. Environmental degradation by deforestation is a key challenge as suggested by 97% of the respondents. However, the selected crops for the production are mainly adaptive to the northern part of the country that is a non-forest belt. But soil acidification and continuous cropping could be strong threats. 91.89% of the respondents strongly suggest that the biofuels policy will not create any imbalance to the nation's economy.

5. Conclusion, Limitations and Further Work

The biofuels policy is the first of its kind established in Nigeria with the view of diversifying access to energy, job opportunities, sources of revenues and mitigating greenhouse gases emissions by linking agriculture with petroleum industry since the discovery of commercial fossil oil and gas reserves in 1956. 97.3% of the public responses consider this as a welcome development with strong potentials to yield good results, especially to the local inhabitants. However, the remaining respondents argued that, large scale biofuels production would seriously create imbalances such as sudden rise in food price and diversion of food land to cash crops production.

Although the policy addressed issues such as the key feedstock, production structure, possible market demand, and investment incentives, careful planning is required otherwise the implementation may cause more problems than benefits. As the current study g ave emphasis to the views of people in the academia, it is necessary to execute both short and long term research with farmers, academicians, oil companies, marketers and their respective associations to identify what works and what doesn't in terms of finance, source of manpower, most appropriate crops, fiscal system and end-product usage. Coupling the findings with lessons from countries like Brazil and India that have already gone a long way in biofuels production would be very important. To strike a balance between food and fuels production and the associated prices, emphasis should always be given to pre-exploited agricultural land and non-food crops. Crops such as jatropha and sugarcane could be good options. However, sorghum and cassava account for over 70% of food supply to the Nigerian people and therefore any commercial exploitation is associated with hunger threats and price hike. Deforestation of the thick forest in the southern part of the country would expose the area to desertification, thereby degrading the environment and should therefore be avoided otherwise the objectives of the policy would be defeated.

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Table 1. Projected marketed possibility. **Source**: Azih (2007), Authors' modified.

S/N	**Trend**	**Market Demand per Year (litres)**
1	Gasoline (E-10 Blend) -current - 2020	1.2 billion 2 billion
2	Paraffin (Replacement With Ethanol Based cooking Gel Fuel)	3.75 billion
3	Raw Material for Portable Ethanol	90 million
	Total Market Size	5.04 billion
4	Current market possibility (B-20), Biodiesel	480 million
5	Estimated bio-diesel demand by 2020	900 million

Table 2. Different varieties of shorgum cultivated in Nigeria as classified scientifically by Nigerian Agricultural Research Institute Samaru, Zaria. Source: Modified from Aba *et al.* (2004)

Name	Properties/characteristics	Ecological zone
SANSORG-3	Short season type: maturity period = 95-105 days; seed colour: cream; potential yield: 1.5-2.5 ton ha-1.	Sudan Savannah
SANSORG-5	Short season type: maturity period = 95-105 days; seed colour: white; potential yield: 1.5-2.5 ton. ha-1	Sudan Savannah
SANSORG-6	Short season type: maturity period = 95-105 days; seed colour: cream; potential yield: 1.5-2.5 ton. ha-1	Sudan Savannah
SANSORG-13	Medium season: maturity period = 130-145 days; seed colour: cream; potential yield: 1.5-2.5 ton. ha-1.	Northern Guinea
SANSORG-14	Medium season: maturity period = 130-140 days; seed colour: white; potential yield: 2.5-3.0 ton. ha-1, used for malting and brewing.	Northern Guinea
SANSORG-17	Long season: maturity period = 165-175 days; seed colour: yellow; potential yield: 2.5-3.5 ton. ha-1; used for malting and brewing, livestock and confectionary.	Southern Guinea
SANSORG-21	Medium season: maturity period = 150-160 days; seed colour: white; potential yield: 3.0-3.5 ton. ha-1.	Northern Guinea
SANSORG-23	Medium season: maturity period = 150-160 days; seed colour: cream; potential yield: 2.5-3.5 ton. ha-1.	Northern Guinea
SANSORG-24	Medium season: maturity period = 150-160 days; seed colour: cream; potential yield: 2.5-3.5 ton. ha-1.	Northern Guinea
SANSORG-38	Short season type: maturity period = 95-105 days; seed colour: cream; potential yield: 1.5-2.5 ton. ha-1.	Sudan Savannah
SANSORG-39	Short season type: maturity period = 95-105 days; potential yield: 1.5-2.5 ton. ha-1.	Sudan Savannah
SANSORG-40	Short season type: maturity period = 95-100 days; seed colour: cream; potential yield: 2.5-3.5 ton. ha-1; used for malting and brewing.	Sudan Savannah
SANSORG-41	Short season type: maturity period = 95-100 days; potential yield: 2.5-3.5 ton. ha-1.	Sudan Savannah

Table 3. Some formulae used in questionnaires analysis

$$\mathbf{PQR = \frac{NRQ \times 100\ \%}{NQA}}$$

$$\mathbf{PAI = \frac{NAR \times 100\%}{NRQ}}$$

Where PQR is the percentage of questionnaire responses,

PAI is the percentage agreed impact, NQR the number of recollected questionnaires and NQA and NAR are the number of questionnaires administered and agreed responses respectively.

Table 4. Percentage Agreement with Impact (PAI) by Respondents for the various questions

Question	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)
1	70.00	26.49	3.51	00.00
2	0.00	08.11	10.81	81.08
3	75.68	16.22	00.00	08.10
4	91.89	05.41	01.08	01.62
5	97.30	02.70	00.00	00.00
6	01.08	01.62	05.41	91.89

Figure 1. Map of Nigeria showing various states (including those selected for Jatropha plantations). The map is still valid for the current generation. **Source**; Author's modified

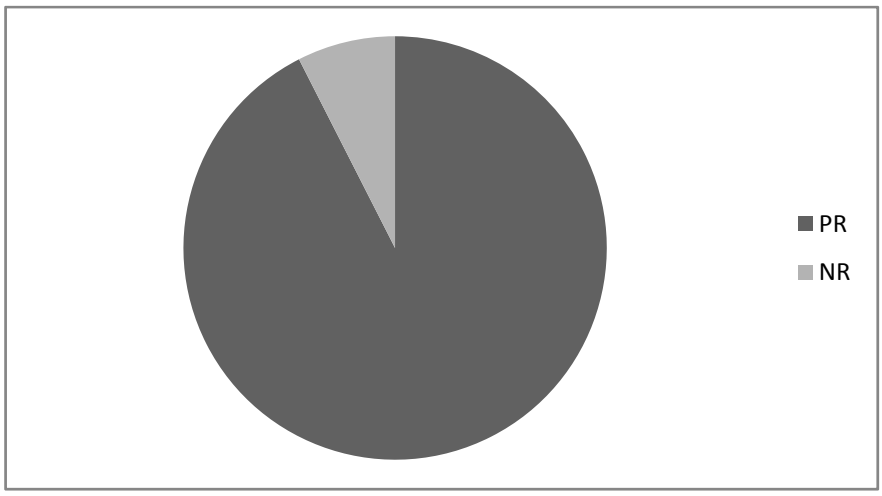

Figure 2. Percentage cumulative responses to the questionnaires. Positive response (PR) refers to response of people who are optimistic to successful program while negative response (NR) implies that, the program will yield more harm than good.

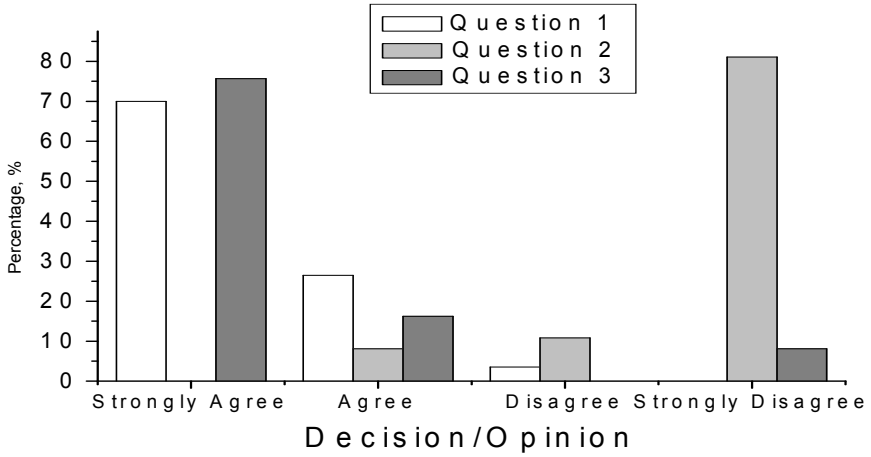

Figure 3. Responses to Questions 1-3.

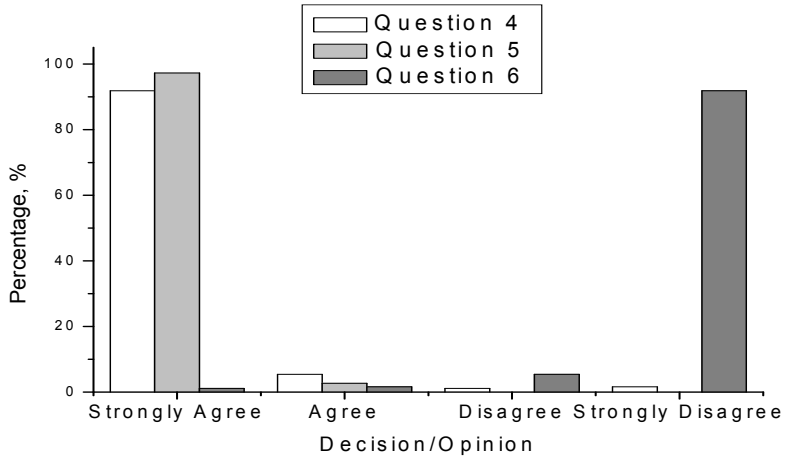

Figure 4. Responses to Questions 4-6.