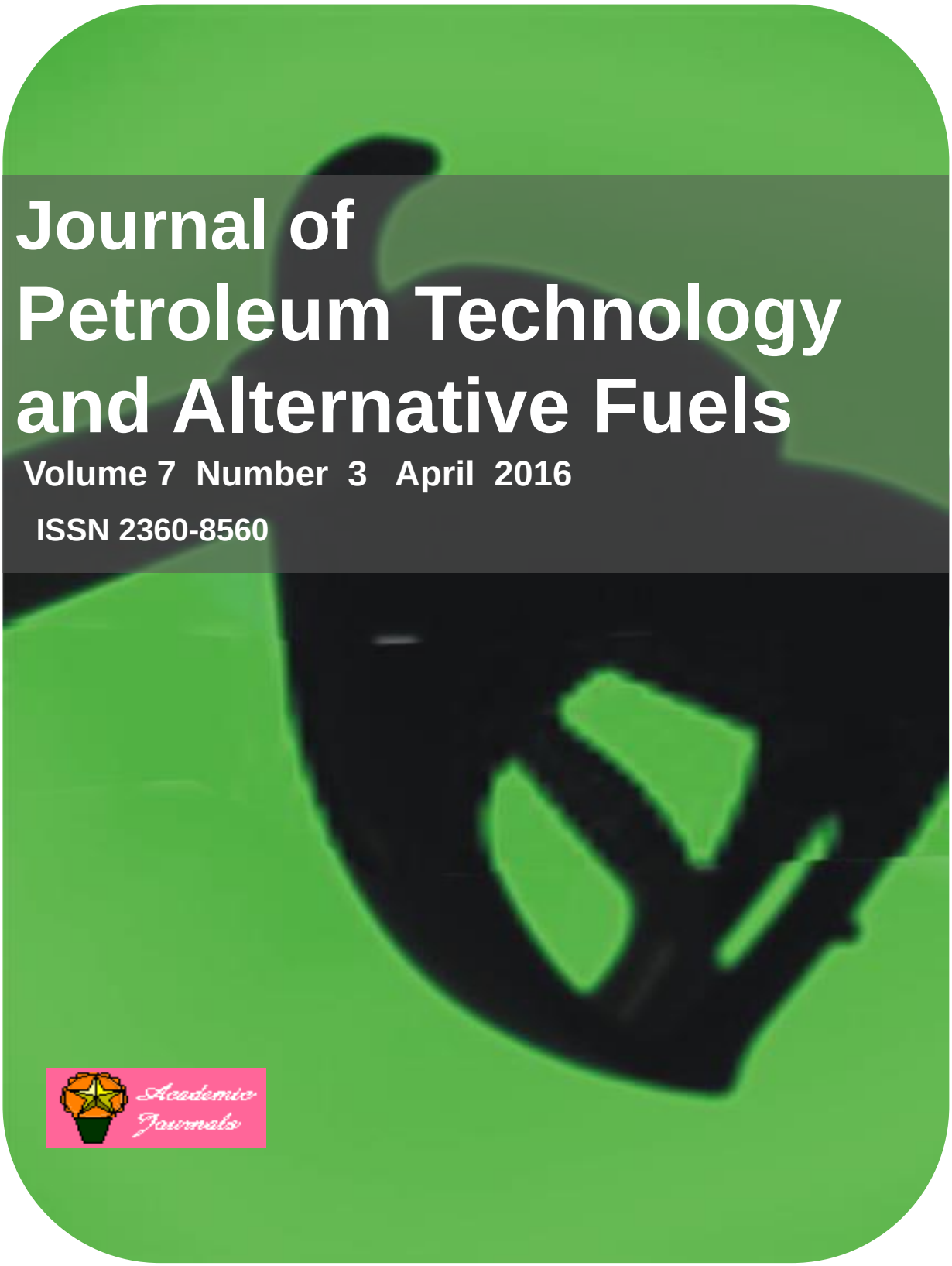

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Full Length Research Paper

Effects of biofuel production on selected local Communities in Nigeria

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Biofuel is gradually being adopted as alternative to fossil fuel in the use for automotive, thermal and power generation. The Nigerian Policy on biofuel introduced in 2007 expresses the national biofuel production programme. However, problems associated with production and uses arise from the effects on arable land and staple foods, which if diverted for production, have vast diverse effects, depending on the people, environment and pathway of production. Since there are reported activities in biofuel feedstock as well as bio-ethanol and biodiesel productions in some parts of Nigeria, the geographical zones were selected and the production sites defined. The communities around the production sites were sampled with a questionnaire to obtain perceptions of the effects. The perceptions were statistically analyzed to derive the effects for each zone and to check for significant ($p<0.05$) difference in the effects. Results showed varying effects of biofuel production in and across the zones.

Key words: Biofuel, feedstock, local communities, environment, policy.

INTRODUCTION

The global increase in biofuel investments and production is driven by several socio-economic, ecological and geopolitical benefits, resulting in both the producer and consumer countries developing policies and incentives for the industry (Timilsina and Shrestha, 2010). This has resulted in the penetration of biofuel feedstock into rural communities and forested landscapes in many poor countries due to the embracement of biofuel production by government as a means of developing the rural economy (Andrade and Miccolis, 2010). Biofuel production is a driver of multiple socio-economic developments especially in the rural communities (Domac et al., 2005). The number of Nigerians on the poverty line was reported to be on a yearly increase and the largest proportion lives in rural areas (Agba et al., 2010). Great potentials exist in rural areas of Nigeria that would support the production of biofuel, as about 70% of the country's labour force resides in rural areas (Agba et al., 2010). Rural areas are also endowed with forest produce, cassava, sugar cane, rice, maize, animal waste, crop residue, *jatropha* seeds among others, which also serve as resources for biofuel production.

The issues and concerns about biofuel production from the Nigerian public standpoint draw from the conception that biofuel production will lead to the substitution of food for fuel and agricultural land for fuels (Galadima et al.,

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2011). Generally, in the sub-Saharan Africa, the pitfalls of biofuel expansion, as exposed in many studies (German et al., 2010; Von Maltitz et al., 2010; Schoneveld et al., 2010) include, the potential social problems due to the poor land tenure security of local communities; concerns around deforestation and biodiversity loss; and, the low overall development benefits. Some of the key socio-economic indicators are: rate of poverty; access to safe water; access to sanitation; population estimates; prevalence of malnutrition; Gross National Product per capita income; aggregate net resources; consumer price inflation, etc (CBN, 2000; ADB, 2006). The major socio-economic and environmental concerns associated with biofuel production activities bother on development of rural economies (Feintrenie et al., 2010); land ownership and control (Cotula et al., 2008; Pacheco, 2009); food security (Zen et al., 2008); water availability and quality (Shah et al., 2000); and deforestation (Morton et al., 2006).

A study of the effects of biofuel production on local livelihoods, land access and ownership, food provisioning and pricing, infrastructural development and population growth, will provide useful information on the cost and benefits of the production activities to the rural areas. The understanding of the effects on the overall wellbeing of a people provides an opportunity to learn appropriate lessons, which would inform the necessary measures for prevention or mitigation. This study was carried out with a focus on the selected areas in the South West, North Central and North West zones of Nigeria, where the activities that directly connect to bio-ethanol and/or biodiesel production have been reported (Agboola et al., 2011; Oshewolo, 2012). The specific local areas within the three zones were sampled in this study to receive baseline information on the effects of biofuel production.

MATERIALS AND METHODS

Study area and criteria for selection

The factor considered for selecting the geographic zones for data collection was areas where activities relating directly to feedstock cultivation and liquid bio-fuels production have been documented to be taking place (Agboola et al., 2011; Highina et al., 2011; Oshewolo, 2012). Accordingly, the South West (S-W), North West (N-W), and North Central (N-C) zones were selected for this study (Figure 1).

Data collection and preparation

An industrial production activity, which utilizes both food crops and agricultural land, was selected in each zone. Since biofuel production is not widespread, the Purposive Sampling method (Palys, 2008) was used to delineate the sample population as the members of Jatropha Growers, Processors and Exporters Association of Nigeria (JAGPEAN), and the existing smallholder scheme made of the peasant energy crop farmers. A predesigned questionnaire, with summarized questions on the most likely effects of biofuel production was randomly administered to cover 70% of the sample populations. Responses were categorized into “agree”, “disagree”, and “undecided” using the modified approach by Galadima et al. (2011); and further assigned numerical codes equal to the frequency of occurrence of each of the categories (Acheampong and Campion, 2014).

Data analysis

The demographic data of the respondents, comprising of sex, age and educational levels was analyzed according to Ogbo et al. (2013). The assigned numerical codes from the questionnaire were summarized in SPSS and analyzed using Chi-Square to generate descriptive statistics and frequencies like in Acheampong and Campion (2014) that determined the perceptions of effects in each of the zones; and further used to test for significant difference in the effects across the zones.

RESULTS AND DISCUSSION

Biofuel production activities in the selected zones

The names and spatial distribution of biofuel production activities in the selected zones is shown in Figure 2. Bio-ethanol distilleries are mostly situated in the S-W, ostensibly due to the pervasive industrialization of the zone that offers ready markets, and proximity to the ocean and port city of Lagos, needed in the exportation and importation of crude and finished biofuel products respectively (Martin et al., 2009). It also shows that feedstock plantations are more prevalent in the N-C and N-W Zones, due to the availability of large expanse of marginal or unused land.

Feedback from the questionnaire

A total of 67, 66 and 61 copies of questionnaire were recollected in the S-W, N-C and N-W respectively, making a total of 194. Similar study by Galadima et al. (2011) on a countrywide-scale in Nigeria, recollected 185 questionnaires, while Acheampong and Campion (2014) in a study of eleven communities in Ghana recollected 234.

Demography

In Figure 3, respondents’ ages ranged from 20-30 to > 50 years, with the ages of majority of the respondents clustering around age ranges 31- 45 to > 50. This indicates respondents had sufficient maturity to respond adequately to the questions asked. Respondents above 50 years and above have the highest distribution across the three zones, which clearly suggest that the activities are mainly undertaken by the more elderly people. Field assessments further showed that retired and more elderly people constitute the majority of those engaged in feedstock planting in Nigeria as of now, which they do in

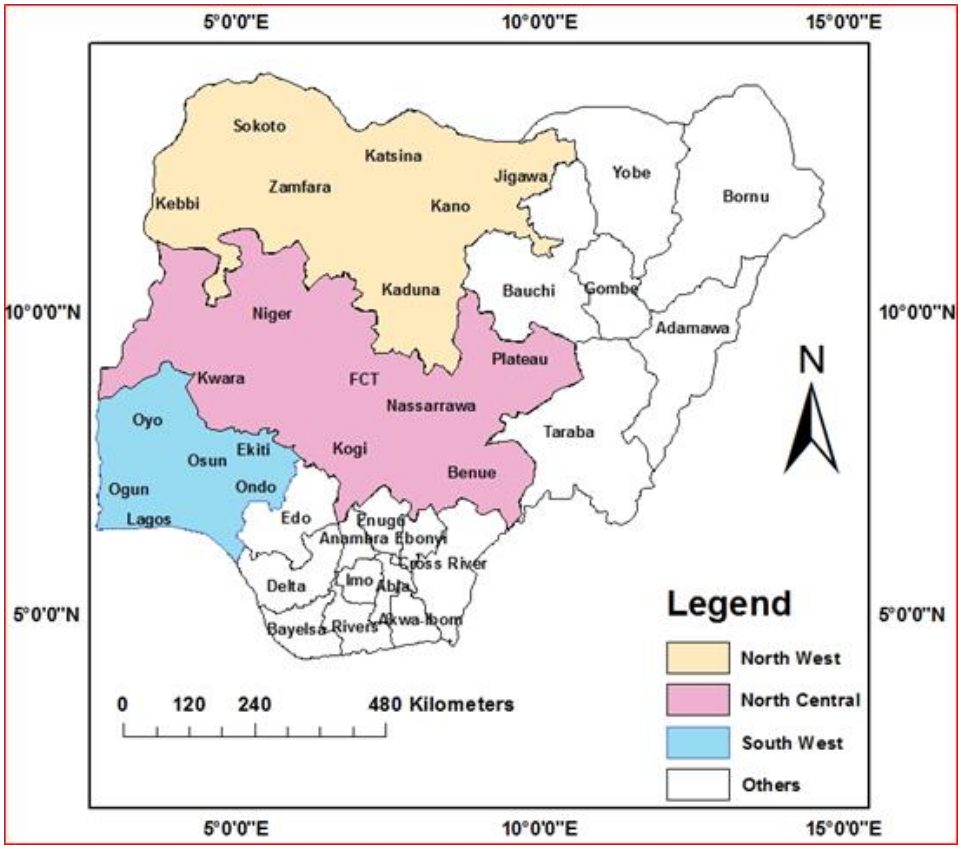

Figure 1. Administrative Boundary of the selected study area (Source: Authors).

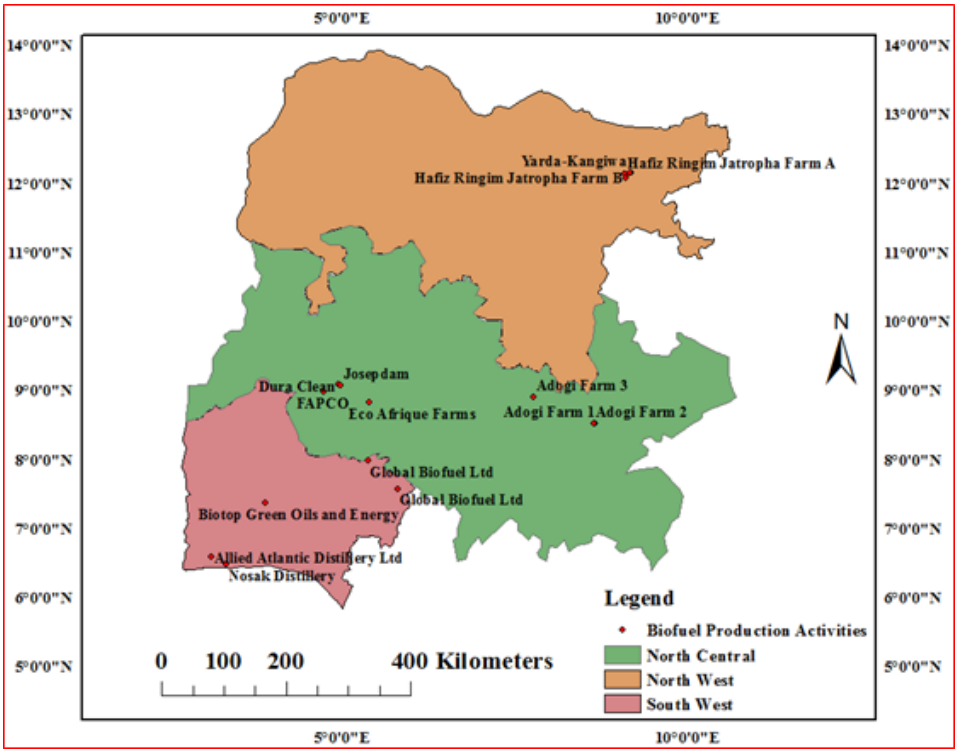

Figure 2. Biofuel production activities in the zones (Field Survey, 2013).

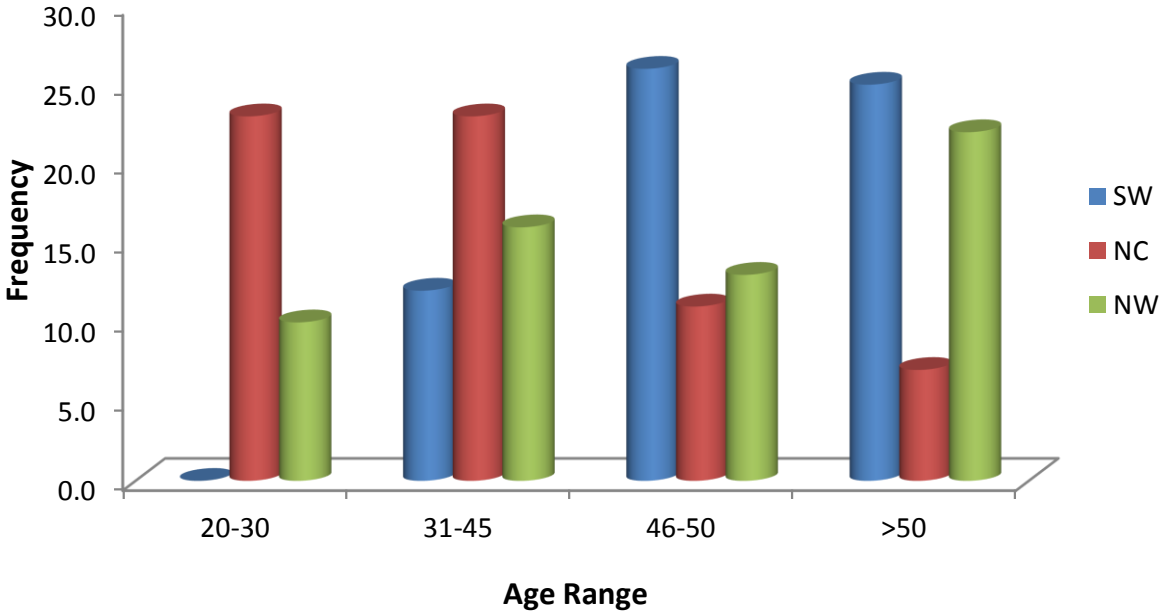

Figure 3. Age distribution of the respondents.

anticipation that when commercial production commences, it may provide them with a secondary source of income and a boost to their livelihood. On the other hand, the younger people mostly prefer to engage in salaried job as well as other vocations that bring faster monetary gains. The survey of respondents' educational qualification in the three zones (Table 1) and the frequency distribution (Figure 4), showed respondents had the capacity expected of them to read, understand and answer the instrument questions (Tourangeau and Smith, 1996; Bowling, 2005). Furthermore, activities, particularly in planting of feedstock were observed to be male dominated, given the low percentage of female (22.8%) to male (77.2%) respondents in Table 1. This was explained by the strong patrilineal societies, where allocation of land is by lineage authority to the household male head (Nnadi et al., 2012); and, religio-cultural peculiarities of the core North in which women are subject to their husband (Kritz and Makinwa-Adebusoye, 2006) and will therefore have their engagement in the activities as an extension of their spouses' engagements (Chikaire et al., 2010).

Effects on local livelihood

In Table 2, respondents across the zones agreed to the economic development benefits of biofuel production, as a result of engagement in feedstock production. The highest agreement was recorded in the N-W followed by the S-W and least in the N-C. Across the three zones, responses showed a generally high agreement that feedstock planting translated into economic gains for the rural farmers. High employment opportunities for women and youths were observed in the local communities of the three zones. The responses from the different zones to the various questions were significantly ($p<0.05$) different with the exception of the question on employment opportunities for rural women and youths ($p > 0.05$). The very high agreement by respondents that the livelihood potential of the rural people had been improved with the activities of the bio-ethanol and/or biodiesel company may not be unconnected with the employment opportunities associated with biofuel production (Domac et al., 2005) and new market opportunities for feedstock. The outcome of a research by Acheampong and Campion (2014) showed a gain in supplementary income for the rural employees of the biofuel companies. The labour used in the planting and harvesting of biofuel feedstock is mostly unskilled, making employment opportunities for rural labourers and smallholders (Ewing and Msangi, 2009). Consequently, respondents across the three zones believed biofuel production aided employment and rural economic development, due largely to the employment of the unskilled workers from the surrounding communities. In addition, local production of biodiesel can be of immense economic benefit to the poor rural women, who could use it for cooking in the household as a substitute for the often unavailable and unaffordable traditional fossil kerosene fuel (Aguilar et al., 2011). It has the potential of liberating women from the toilsome burdens of fetching firewood for cooking and heating (Singh and Sooch, 2004) and empowering them, by making fuels more accessible and

Table 1. Demography distribution in the study zones.

Demographic factors	Categories	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Sex	Male	47	71.2	41	65.1	58	96.7	146	77.2
	Female	19	28.8	22	34.9	2	3.3	43	22.8
Age Group	13-19	0	0.0	0.0	0.0	0	0.0	0	0.0
	20-30	0	0.0	23	35.9	10	16.4	33	17.6
	31-45	12	19.0	23	35.9	16	26.2	51	27.1
	46-50	26	41.3	11	17.2	13	21.3	50	26.6
	>50	25	39.7	7	10.9	22	36.1	54	28.7
Occupation	Farming	4	6.2	19	29.7	24	39.3	47	24.7
	Students	0	0.0	20	31.2	13	21.3	33	17.4
	Civil Service	10	15.4	13	20.3	10	16.4	33	17.4
	Self-employed	33	50.8	10	15.6	8	13.1	51	26.8
	Retiree	11	16.9	2	3.1	6	9.8	19	10.0
	Private Sector	7	10.7	0	0.0	0	0.0	7	3.7
Educational Level	Primary	3	5.8	0	0.0	2	3.4	5	2.9
	Secondary	9	17.3	11	17.2	19	32.8	39	22.4
	Tertiary	25	48.1	38	59.4	23	39.7	86	49.4
	Post-tertiary	11	21.2	7	10.9	1	1.7	19	10.9
	No Formal Education	4	7.7	8	12.5	13	22.4	25	14.4

Source: Fieldwork (2011).

affordable whilst freeing more time for other activities. Earlier reports attested to the potentials of biofuel development creating job opportunities with relatively higher paid labour, especially in areas with limited cash-income access (Koh and Wilcove, 2008; Domac et al., 2005). This is due to proximity advantage, and the relative high social capital associated with rural communities (van der Horst and Vermeylen, 2010). Since a sustainable biofuel production depends indispensably on access to sufficient choice feedstock (Ogbonna and Okoli, 2013), investors must ensure farmers providing the feedstock remain active.

Effects on customary land use and access

In Table 3, the highest agreement to land-grabbing was recorded in the N-W, followed by the S-W but least in the N-C. Across the three zones, there was a general high agreement. Respondents in the S-W and N-C did not strongly agree in their perception that arable lands in their rural communities were being converted to biofuel feedstock production. Consequently, the results indicated strong disagreement in perceptions in the S-W and the N-C. Conversely, most of the respondents in the N-W agreed to the conversion of arable land to feedstock production. Across the three zones, respondents generally disagreed to

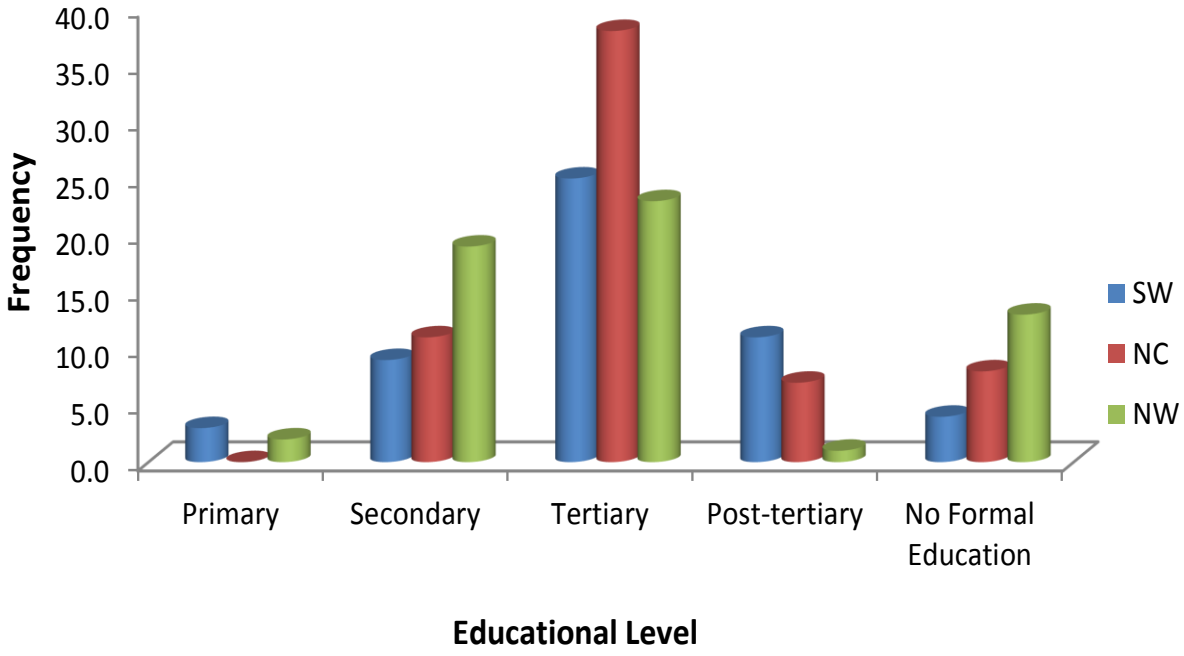

Figure 4. Distribution of the educational level of respondents.

the conversion of arable land to feedstock planting. Similarly, across the three zones, respondents overwhelmingly agreed that land will always be available for planting food and biofuel production may not reduce land available for food production. Across the three zones, the responses showed a generally high disagreement to negative effects of biofuel production on land availability for food production but a high significant ($p<0.05$) difference in the effects of biofuel production activities on customary land use and access.

The analysis of the effects revealed cases of land acquisition by biofuel investors in locations in the S-W and N-W with the incident being more prevalent in the N-W. Field observations showed the commercial feedstock plantations in the surveyed locations of N-C and N-W generally, including the northern axis of the S-W zones are situated on the vast uninhabited and uncultivated land, usually referred to as marginal land. Potential investors in biofuel began to perceive the attractiveness of vast areas of uncultivated land in Africa that could possibly be exploited for biofuel cultivation for western markets (Mercer, 2003). This is mostly associated to the developing countries of the world where weak social and environmental governance is dominant. Such defective operational governance administered by weak or corrupt leadership tends to attract investment from overseas investors desiring to reduce their production cost by evading compliance with social and environmental standards, which leads to a phenomenon referred to as 'pollution havens' (Cole, 2000; Cole and Elliot, 2005). Majority of the land proposed for biofuel feedstock plantation are the degraded or marginal lands (Francis et al., 2005) that are claimed not to be readily arable and ordinarily not cultivated for food. These plantations established on large expanse of land that is generally referred to as marginal land are reputed for their support for bioenergy production (Tilman et al., 2009), most especially in the cultivation of drought-resistant plants such as *jatropha*, sorghum (*Sorghum bicolor*) and Neem trees (*Azadirachta indica*). Most African countries are reputed to have large areas of such fertile land that is not currently used for production of food crops (World Bank Report, 2013). Major *jatropha* plantations such as owned by EcoAfrique at Lafiagi, Kwara State and Jigawa State Yarda-Kangiwa Jatropha Plantation as well as many others planted on marginal land will require substantial irrigation and fertilization for optimum yield, in spite of *jatropha* being drought-resistant. Van Eijck et al. (2010) noted that biofuel crops planted on degraded or agriculturally marginal land might not produce yields economically viable for biofuel production, since all crops respond to better quality soils. These marginal lands are assumed to be unproductive and thought to have no negative effects on local household food security; but as pointed out by Rossi and Lambrou (2008) and Borras et al. (2010), these lands almost inevitably support very important livelihood functions for the most vulnerable landless and poor people who will fall back on these areas for subsistence and support in difficult times. However, the more marginal the livelihoods of the rural people, the more they will have to depend on marginal land for their day-to-day struggle for survival (Van der Horst and Vermeylen, 2010).

Table 2. Local livelihood.

Questions	Responses	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Government and private investors are supporting feedstock cultivation in the local communities?	Agree	46	68.7	27	41.5	56	91.8	129	66.8
	Disagree	16	23.9	23	35.4	2	3.3	41	21.2
	Undecided	5	7.5	15	23.1	3	4.9	23	11.
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	**100**
	p-value 0.000								
Biofuel feedstock planting has brought economic gain to the localities?	Agree	51	76.1	41	62.1	53	86.9	145	74.7
	Disagree	12	17.9	14	21.2	4	6.6	30	15.5
	Undecided	4	6.0	11	16.7	4	6.6	19	9.8
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	**100**
	p-value 0.016								
Employment opportunities have increased for women and youths in the local communities?	Agree	56	83.6	48	72.7	53	88.3	157	81.3
	Disagree	11	16.4	15	22.7	6	10.0	32	16.6
	Undecided	0	0.0	3	4.5	1	1.7	4	2.1
	Total	**67**	**100**	**66**	**100**	**60**	**100**	**193**	**100**
	p-value 0.113								

Table 3. Customary land use and access.

Questions	Responses	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Some private investors are acquiring large area of lands for cultivating biofuel feedstock?	Agree	45	67.2	30	45.5	58	95.1	133	68.6
	Disagree	7	10.4	25	37.9	1	1.6	33	17.0
	Undecided	15	22.4	11	16.7	295.	3.3	28	14.4
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	**100**
	p-value 0.000								
There is conversion of arable lands to feedstock cultivation?	Agree	7	10.4	17	25.8	49	80.3	73	37.6
	Disagree	55	82.1	45	68.2	10	16.4	110	56.7
	Undecided	5	7.5	4	6.1	2	3.3	11	5.7
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	**100**

Table 3. Contd.

		p-value 0.000							
There is possibility there may not be enough land for planting food in the future?	Agree	1	1.5	16	24.6	9	14.8	26	13.5
	Disagree	56	83.6	39	60.0	48	78.7	143	74.1
	Undecided	10	14.9	10	15.4	4	6.6	24	12.4
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	100
		p-value 0.001							

Table 4. Food provisioning and pricing.

Questions	Responses	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Using food crops for biofuel production could affect food provisioning in local communities?	Agree	61	91.0	50	75.6	60	98.4	171	88.1
	Disagree	6	9.0	11	16.7	1	1.6	18	9.3
	Undecided	0	0.0	5	7.6	0	0.0	5	2.6
	Total	**67**	**100**	**66**	**100**	**61**	**100**	**194**	**100**
	p-value 0.000								
Using food crops for biofuel production has affected the food prices in the local community?	Agree	8	11.9	10	15.2	41	30.0	59	30.6
	Disagree	59	88.1	52	78.8	18	68.3	129	66.8
	Undecided	0	0.0	4	6.1	1	1.7	5	2.6
	Total	**67**	**100**	**66**	**100**	**60**	**100**	**193**	**100**
	p-value 0.000								

Effects on food provisioning and pricing

In Table 4, a generally high degree of agreement was recorded across the zones that a diversion of food crops to biofuel production could affect local food provisioning. The N-W had the highest agreement, followed by the S-W and least in the N-C. Across the three zones, the agreement was generally high. However, respondents in the three zones did not believe biofuel production has affected food provisioning or food prices in their local communities. Across the three zones, responses showed significant ($p < 0.05$) difference in the effects of biofuel production activities on food provisioning and pricing. Across the three surveyed zones, respondents expressed confidence in farmers' ability to produce food crops used as feedstock to meet both the need for biofuel production and the people's nutritional requirement. The choice of feedstock is very crucial in commercial production of fuel ethanol since the cost of feedstock makes up a significant percentage of the total production cost (Ogbonna and Okoli, 2013). There have been concerns over the net effects of biofuel on agricultural land, water, food supply and rise in the price of food, but this could be attributed to other factors besides biofuel, based on the belief that there are lots of marginal land resources for farming (Gressel, 2008).

However, the general belief is that the displacement of existing agricultural practices could potentially result in direct or indirect competition for food, feedstock and fuel production (Woods and Diaz-Chavez, 2007). In the U.S., expansion of cropland had been assumed to occur near planned expansion of ethanol facilities (Hill et al., 2009), while much of the expansion of a notable crop for biofuel production would likely result in shifting acreage of other food crops (Food and Agricultural Policy Research Institute, 2008). Consequently, respondents overwhelmingly agreed that privately managed farms for the production of biofuel feedstock outside the traditional agricultural lands could ensure food security. However, different farming models such as independent smallholder (Malik et al., 2009), farmers' cooperatives (Ohimain, 2013), small-scale contractors, large contract farming (Porter and Phillips-Howard, 1997), large commercial farms and plantations will have different implications in terms of food security (Tyler, 2008), employment and labour conditions, access to credit, access to local and international markets, variant seeds and technology (Von Maltitz and Stafford, 2011).

According to Agboola et al. (2011), the effect of the demand for biofuel feedstock can be measured by the share impact on commodity and food prices in their locality. Trostle (2008) showed a nexus between increased food prices and biofuel production. With sorghum and cassava being staple foods to the Nigerian people, any commercial exploitation could easily trigger hunger threats and price hike. Even though the use of palm kernel oil (PKO) under experimental conditions through trans-esterification to produce biodiesel has been reported (Alamu et al., 2007), its use is also not so much considered because it is an important staple food in Nigeria. Nonfood sources of biofuel, which offer better alternatives as feedstock, with less effect on food production capacity and therefore food prices include bagasse (Shaibani et al., 2011), molasses (Highina et al., 2011) as well as biomass, wastes and ligno-cellulosic materials (Agbro and Ogie, 2012).

Effects on the biophysical environment

In Table 5, the N-W appeared as the zone where forest clearing was most prevalent while the S-W was least affected. The situation was not very clear in the N-C with 49.2% agreement and 46.2% disagreement. Further, the result showed the highest effect on water in the N-W, where irrigation farming is prevalent. However, the least effect was observed in the S-W and N-C. The N-W showed the highest environmental effects and followed by the N-C. In the three zones, the effects of biofuel production on deforestation, water availability and the general environment were significantly ($p < 0.05$) different. Efforts to conserve the forests have been receiving increased priority and urgency (Davey et al., 2003).

One of the important concerns of environmental effects of large scale biofuel production in Nigeria and indeed, in majority of the African countries is the current high spate of deforestation of its rainforest (Ajake, 2012). Pressures on forest especially in the tropics were attributed to the need to provide resources for economic growth and cater for a burgeoning population (Salami and Balogun, 2006). Additionally, production of biofuel is believed to consume higher quantity of water than in the production of fossil fuels (Mishra and Yeh, 2011; King and Webber, 2008), leading to multiple stresses on water in terms of availability and quality through salinization and pollution from agricultural cultivations (Shah et al., 2000).

Agriculture was regarded as the biggest user of global freshwater supply, with a share ranging from 70 to 80% and increased biofuel development will have a similar effect on water sources as that of agriculture (Singh et al., 2010). Among other factors, the real effect may also depend on organizational choices and technologies used. Biofuel can be made from many different starting materials, from waste wood to algae (Grayson, 2011) that may not require irrigation, and can be produced in different climatic conditions that require less water. On the other hand, first-generation biofuel are extremely water intensive (Gerbens-Leenes et al., 2009). However, the measures of water usage, expressed in terms of volume of water per unit of biofuel energy output, are more meaningful when they are expressed relative to some measures of water availability. Local food production can be affected by decreased availability of water, which is already a limiting factor for agriculture in large parts of Africa (IEA, 2006). In addition, the processing of some feedstock requires large volumes of water and tends to generate effluents or sludge (even though it is easily degraded), its discharge if not properly handled can make the immediate environment filthy. Whether biofuel production leads to environmental problem or not depends on the production methods adopted, as cellulosic ethanol production was found to emit lower greenhouse gas than corn ethanol and gasoline (Plevin and Mueller, 2008). For commercial or large scale production and export to yield positive effects in the developing countries, it will require institutionalizing enforcement of 'pro-poor' social innovations and interventions, and in addition, a certification of the product as an 'ethical' fuel to guide consumers' demand (van der Horst and Vermeylen, 2010).

Effects on rural infrastructure and population

In Table 6, high agreement to infrastructural development was observed in the S-W, while the N-C and N-W disagreed respectively. However, the highest effect of biofuel production on population growth was observed in the N-W and followed by the S-W but lowest in the N-C. Generally, the observation of the effect that biofuel production activities had on infrastructural development

Table 5. Biophysical environment.

Questions	Responses	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Biofuel feedstock production is leading to acquisition and clearing of new forest areas?	Agree	13	19.4	32	49.2	56	93.3	101	52.6
	Disagree	54	80.6	30	46.2	4	6.7	88	45.8
	Undecided	0	0.0	3	4.6	0	0.0	3	1.6
	Total	**67**	**100**	**65**	**100**	**60**	**100**	**192**	**100**
	p-value 0.000								
Irrigation for feedstock plantation is affecting water availability?	Agree	1	1.5	17	25.8	50	83.3	68	35.2
	Disagree	66	98.5	44	66.7	9	15.0	119	61.7
	Undecided	0	0.0	5	7.6	1	1.7	6	3.1
	Total	**67**	**100**	**66**	**100**	**60**	**100**	**193**	**100**
	p-value 0.000								
Biofuel production activities have led to environmental pollution?	Agree	21	31.3	43	65.2	53	88.3	117	60.6
	Disagree	35	52.2	15	22.7	3	5.0	53	27.5
	Undecided	11	16.4	8	12.1	4	6.7	23	11.9
	Total	**67**	**100**	**66**	**100**	**60**	**100**	**193**	**100**
	p-value 0.000								

Table 6. Rural infrastructure and population.

Questions	Responses	Zones						Total	
		S-W		N-C		N-W			
		NR	%	NR	%	NR	%	NR	%
Biofuel production activities are bringing infrastructure development?	Agree	57	85.1	24	36.4	10	16.7	91	47.2
	Disagree	10	14.9	36	54.5	40	66.7	86	44.6
	Undecided	0	0.0	6	9.1	10	16.7	16	8.3
	Total	**67**	**100**	**66**	**100**	**60**	**100**	**193**	**100**
	p-value 0.000								
Infrastructural Development from Biofuel production activities have resulted in human influx?	Agree	35	52.2	30	45.5	51	87.9	116	60.7
	Disagree	32	47.8	33	50.0	5	8.6	70	36.6
	Undecided	0	0.0	3	4.5	2	3.4	5	2.6
	Total	**67**	**100**	**66**	**100**	**58**	**100**	**191**	**100**
	p-value 0.000								

and the rate of human influx into the rural communities across the three zones showed a high significant ($p < 0.05$) difference. Across the three zones, the perception of biofuel production activities resulting into infrastructural development is highest in the S-W zone. Biofuel has been pushed forward as a possible stimulator of African development (Diaz-Chavez, 2010) due to the increased demand driven by the United States and the EU´s blending targets. Many nationals and regional policies have also projected activities in biofuel as driver for rural development (Domac et al., 2005), which is in line with the Millennium Development Goal (MDG). In developing countries, biofuel has the ability to spur rural development and stimulate local employment by attracting investment to the agricultural sector, flow of new technologies, infrastructure and high-yielding varieties (Elbehri et al., 2013). Peters and Thielmann (2008) argued that biofuel promotion contributes to rural employment and development through value addition in the agricultural sector. These developmental gains open opportunities for new employment and higher rural wages with positive spill-over effects for the local economy. However, the concern is that the economic developmental benefits of biofuel to African countries may be minimal, especially if heavy mechanization is used, it lowers potential for jobs (Greenenergy, 2008); raw feedstock is exported for processing elsewhere (Von Maltitz and Brent, 2008); and raw materials rather than being produced in the country are imported for production in the country. Poor rural infrastructural amenities and unemployment are two major factors responsible for rural to urban migration and congestion, which in turn leads to a multi-faceted social and environmental malaise. According to van der Horst and Vermeylen (2010), rural communities are bequeathed with high social capital but low level of economic opportunities and when coupled with low opportunities for job result in outward migration with an accompanying social effects on such communities. Biofuel production, being labour-intensive, offers unskilled jobs in the area of manual harvesting and semi-skilled jobs, such as trucking, machinery operation and maintenance (Lanely, 2006), leading to increased labour demand that can have a substantial impact on unemployment reduction in rural areas. Agba et al. (2010), listed employment and wealth creation, rural infrastructural development, rural poverty reduction, increased school enrolment and skill acquisition as some of the numerous benefits rural areas stand to gain from a properly developed biofuel industry in Nigeria. Large plantations bring improved regional infrastructure such as roads, clinics and schools (Cushion et al., 2010).

Additionally, with the unpredictable future prices of fossil fuels (Hill et al., 2009; Nasidi et al., 2013) cum the expected increases in the price of fossil fuels (Sielhorst et al., 2008) and the shifting attention to biofuel production(Ohimain, 2013), planting of energy crops will be encouraged thereby resuscitating hopes in farming. This will expectedly lead to the emergence of several smallholder and out-grower schemes in the local communities that are able to receive soft loans and other incentives as provided for by the Nigerian Biofuel Policy and Incentives. One of such schemes is the Jatropha Growers, Processors and Exporters Association of Nigeria (JAGPEAN) founded in 2012. Cooperatives such as JAGPEAN, when operating in the best interest of members are essential in negotiating better prices and in making companies accountable to contractual agreements (Rist et al., 2010). In Nigeria, biofuel production activities may not have yet resulted in significant population increases at the local communities as observed in the three zones surveyed; but gradually as commercial activities intensify, the decline in the population of rural communities as well as the rural to urban migration in search of salaried jobs and better living standard, will be reversed (Agba et al., 2010). According to Chamdimba (2009), some necessary ingredients of good policies in biofuel industry development include policies that: are predictable and consistent over time; have clear niche for small and medium entrepreneurs' benefits; are coherent; can stimulate private and public investment; portray transparent governance; and enjoy political will for implementation. A sustainable national programme will in addition require that government provides an equitable balance through legislative framework that protects the rights of the small-scale farmers, without becoming over restrictive (Simmons, 2002).

CONCLUSION AND RECOMMENDATION

The current bio-fuels production activities in Nigeria are still at low scale. Responses from the three geo-political zones surveyed showed wide and varying effects on local livelihood, land access and use, economic development, food security, environment and infrastructure and population growth. While the gains derivable from biofuel production cannot be over-emphasized, cautionary policies would need to be put in place and enforced, so as to ensure that the public and environment derive maximum benefits from the venture. Government should create the right environment for the people of the local communities to participate effectively in activities such as allotment of land to biofuel investors within their communities. It should also ensure that food crops suitable for human consumption are not used for biofuel production. Investors on the other hand, must make sure that the members of the local communities as well as their biophysical environments are positively affected by their activities, in term of respect for customary land use and land access; quality employment creation for women and youths; creation of relevant social amenities; undisrupted local food provisioning pathway; and preservation of land and vegetation.

Conflict of Interests

The authors have not declared any conflict of interests.

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