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Assessment of Crop Farmers Perception of Climate Change and Indigenous Adaptation Strategies in Southern Part of Borno State, Nigeria

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ABSTRACT

The study assessed the perception of food crop farmers of climate change and indigenous adaptation strategies in southern part Borno State, Nigeria. Multi stage sampling procedure was used in drawing one hundred (100) registered crop farmers from Biu, Kwaya-Kusar and Bayo Local Government Areas. Frequencies, percentages and Pearson product moment correlation was used in analyzing the data. Result showed burning of firewood as energy, deforestation, over-grazing, gases emissions from factories and industries as some of the perceived causes of climate change in the study area. Change in planting dates, mulching and relay cropping were the leading indigenous strategies adapted to cope with changes in climate conditions for favorable agricultural cultivations. In determining the relationship between perception and utilization of climate change adaptation strategies, ther value was found to be positive (0.7333) and significant. This indicated a strong relationship between perception and indigenous adaptation strategies to climate change. Food crop farmers in the study area adapted strategies that were indigenous in nature to mitigate the effect of climate change on agriculture. It was recommended that suitable and efficient indigenous adaptation strategies should be identified for optimal utilization, farmers should be informed on changes in weather conditions and also efforts should be made in educating farmers to knowing that climate change is a global problem beyond individual faith.

Keywords: *Crop farmers, Perception, Climate change, Indigenous and Adaptation strategies.*

INTRODUCTION

Food crop farmers rely solely on favorable climatic factors for optimal agricultural production. Natural resources such as land, water, air and vegetation when not altered, provides a lasting means of livelihood for food crop farmers. Indigenous food crop farmers in developing countries had over the years observed changes in their ecosystems that resulted to decreased in agricultural production. Food crops occupied about 94% of the already experienced decline in production rate of maize, sorghum, millet, rice and legumes due to adverse effect on climate change (Odjogo, 2009). Climatic factors like rainfall has not kept a regular pattern, temperatures are rising and forest has not been flourishing. Planting periods and harvest time kept changing over time and space. These changes compelled food crop farmers to adapt to some indigenous strategies in creative ways drawing from traditional

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adaptation knowledge to new technologies that proffer solutions to climate variability (Ishaya and Abaje, 2008).

Climate change has been defined as a significant variation in weather events that persist for an extended period of a decade or longer (Intergovernmental Panel on Climate Change, 2007). These variations manifest in a number of ways which includes; changes in average climatic conditions (drier lands, wetter lands, erratic rainfall patterns and extreme weather temperatures), depletion of the ozone layer and certain human activities such as deforestation and industrialization (Mohammed *et al*., 2013 and Audu, 2003). Agriculture is however, affected by alteration of the ecosystem that resulted to depletion of soil water, distortion in carbon and nitrogen cycle and rise in temperatures (Smith and Skinner, 2002). These alterations, had adversely affected the social and economic means of food crop farmer's livelihoods.

Perception is the process in which people viewed events through interpretations, stimulations, evolutions and organizations of a practice. Perception strongly affects how farmers deal with climate-induced risks and opportunities, and the precise nature of the behavioral responses to the perception will shape adaptation options (Adger*et al.,* 2009). Perception to changes in climatic conditions varies across communities among food crop farmers. These variations are as a result of the perception views and interpretations based on distinct beliefs and understanding (Wolf and Moser, 2011). Adejuwon (2004) observed the effect of climate change on food crop farmers as not only in the changes on climatic conditions but on resilient methods employed based on perceived causes to achieve food production, viable environment, retained soil moisture and quality.

Adaptation to climate change referred to adjustment in natural or creative system in response to harm or exploits to the environment (IPCC, 2007b and Mustapha, 2014). To food crop farmers, it can be referred to as adjustment in practices, processes and structures that suits agricultural production (FAO, 2008). In northern Nigeria, the indigenous adaptation strategies to climate change used by farmers includes; use of wetlands, contour cropping across slopes, planting deeper than usual, intensive manure application, moving to new sites, change in planting dates, agro forestry and alternating animal and crop farming (Blessing *et al*., 2011). These practices are called indigenous because they are readily available to farmers and requires little or no technology for implementation and adaptation. Adaptation helps farmers achieve food security, income and livelihood in the face of climate change through enabling farmers to engage in practices that are practicable under the "new" climate regime (Kandlikar and Risbey, 2000).

This study tried to look at the perception to climate change and the indigenous adaptation strategies employed by food crop farmers in Southern Borno State. Although the issue of climate change perception and adaptation strategies has been recently studied by Abdulhamid and Bamusa (2018), the study looked at farmers' perception of the influence of climate change on agricultural production. This study tried to look at the indigenous adaptation strategies employed by food crop farmers which was missing in the previous study. Thus the objectives of this study were to;

i. Investigate the perceived causes of climate change by food crop farmers;
ii. examine the indigenous climate change adaptation strategies utilized by food crop farmers;

iii. determine the relationship between perception and utilization of climate change indigenous adaptation strategies.

METHODOLOGY

Southern part of Borno State, Nigeria consists of nine Local Government Areas (LGAs) which include; Askira Uba, Bayo, Biu, Chibok, Damboa, Gwoza, Hawul, Kwaya Kusar and Shani. It borders internationally with Republic of Cameroun to the east and nationally with Adamawa State to the south, Gombe Sate to the southwest, Yobe State to the west and Bama, Damboa and Maiduguri to the north intra-state. It lies between latitude $11^0$09'0''N and longitude $13^0$41'29''E of the equator and covers a land area of about 21,787.4 Km^2. The region has a projected population of about 1,759,900 persons as at December, 2016 (NPC, 2017). The annual rainfall in southern part of Borno State varies yearly but averages between 800mm-1200mm that lasted from May to October (IITA, 2009). Vegetation is Sudan savannah interspersed with tall trees and woodlands, arable lands and favorable weather for agricultural production. The people of the area are predominantly farmers that cultivate food crops like maize, millet, sorghum, rice, soybeans, cowpea and groundnuts as their major sources of livelihood (IITA, 2009).

Data from primary and secondary sources was used for the study. One hundred (100) respondents were selected using multi stage sampling procedure. In the first stage, three local government areas Biu, Kwaya Kusar and Bayo were purposively selected out of nine LGAs because of relative absence of security threats and accessibility. The second stage involved random selection of three communities from Biu being the largest LGA and two each from KwayaKusar and Bayo to give a total of seven communities. In the last and third stage, 12% of registered crop farmers obtained from the ADP were selected out of the seven communities to constitute 100 respondents. Descriptive tools such as frequencies and percentages were used to analyzed the data. Pearson Product Moment Correlation was also used to determine the relationship between perception and utilization of climate change adaptation strategies in the study area. The structured questionnaire covers respondent's perception of climate change and adaptation strategies. The PPMC is given as;

$$r = \frac{n\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}}$$

Where:

r = Pearson correlation coefficient
x = Perception variable
y = Indigenous adaptation strategies variable

$\sqrt{\sum(x-\bar{x})^2}$= variance of perception

$\sqrt{\sum(y-\bar{y})^2}$ = variance of indigenous adaptation strategies

The r value ranges between 0 and 1, when $r = 0$ it signifies no relationship and $r = 1$ indicates perfect relationship. A negative r value also indicates that increase in one variable, result to decrease in another.

RESULTS AND DISCUSSIONS

Farmers Perception to Climate Change

Table 1 presents results on perceived causes of climate change in the study area. Respondents were asked on their opinion regarding the causes of climate change in their environments. Majority (96%) of the respondents revealed that burning of firewood for energy was the major caused of climate change. Deforestation activities (75%), over-grazing (78%) was ranked 3rd, carbondioxide emissions from motor vehicles and motorcycles (75%) and continuous use of inorganic fertilizers (67%). Gases released from factories and industries (65%) although, there were no factories and industries in the study area, but crop farmers were aware through local media and extension agents that emissions from factories and industries have adverse effect on the ecosystem. Others causes of climate change identified were superstitious belief (42%), continuous cropping (34%) and religious beliefs (23%) ranked 7th, 8th and 9th respectively. Local farmers in the study area were either Muslims or Christians with few who are of traditional religion. Attributing climate change to their beliefs cannot be neglected as they believed that climate change occurred as a result of manifestation of their religious scriptures. This agrees with Cyprain*et al*. (2014) who found that superstitious and religious beliefs were some of the perceived causes of climate change among rural people in Cross River state, Nigeria.

Table 1: Distribution of Respondents by Perceived Causes of Climate Change (n=100)

Causes of Climate Change	Frequency	Percentage*	Rank
Burning of firewood for energy	96	96.0	1st
Deforestation	93	93.0	2nd
Over-grazing	78	78.0	3rd
Emissions from vehicles and motorcycles	75	75.0	4th
Continuous Use of inorganic fertilizer	67	67.0	5th
Gases released from factories/industries	65	65.0	6th
Superstitious belief	42	42.0	7th
Continuous cropping	34	34.0	8th
Religious belief	23	23.0	9th

Source: Field Survey, 2016

***** Multiple response.

Indigenous Adaptation Strategies to Climate Change

Table 2 presented results on indigenous adaptation strategies employed by food crop farmers to mitigate the effect of climate change in the study area. Change in crop planting dates ranked 1st, mulching 2nd, relay cropping 3rd and contour cropping across slopes 4th. Others were mixed farming, intensive manure application to farm lands, expansion of cultivated areas, inter cropping, agro-forestry practices, planting deeper than usual, change in harvesting dates, prayers to God(s) and use of wetland/river valley. Popular among the indigenous adaptation strategies employed by food crop farmers were change in planting dates and mulching. Change in planting dates by local farmers in the study area ranges from early

planting to delay in planting depending on nature of the perceived cause. Mulching was done to mitigate adverse temperatures, sun intensity and help crops to retain moisture. This strategy was mostly used in rain fed agriculture especially when rainfall declined. This is however labor intensive as observed by most of the farmers and commonly practiced in legumes and other cover crops. Otitoju and Enete (2014) observed mulching as one of the strategies to mitigate the effect of adverse temperature on food crops in Nigeria. Use of wetlands/river valleys for planting was found to be the least employed strategies. This is because wetlands and rivers were scanty in the study area and farmers rarely use such for crop planting especially during dry season, except the few who resides close to riverbanks.

Table 2: Utilization of Indigenous Climate Change Adaptation Strategies by Food Crop Farmers. (n=100)

Use of indigenous adaption strategies	Frequency	Percentage *	Ranks
Change in planting dates	78	78.0	1st
Mulching	76	76.0	2nd
Relay cropping	74	74.0	3rd
Contour cropping across slopes	71	71.0	4th
Increased weeding	71	71.0	4th
Mixed farming	68	68.0	5th
Intensive manure application	67	67.0	6th
Expansion of cultivated areas	65	65.0	7th
Prayers for God's intervention	65	65.0	7th
Intercropping	56	56.0	8th
Multiple cropping	51	51.0	9th
Agro-forestry practices	48	48.0	10th
Planting deeper than usual planting depth	45	45.0	11th
Moving to a different site	43	43.0	12th
Change in harvesting dates	40	40.0	13th
Use of wetland/river valleys	34	34.0	14th

Source: Field Survey, 2016
* Multiple responses.

Correlation between Perception and Indigenous Adaptation Strategies

In Table 3, perception was found to relate significantly to adaptation strategies in the study area and is because farmers were aware on climatic changes in their environment. This implies that the first step towards adaptation is the perception of the problem. The knowledge on perceived causes of climate change has determined the extent and appropriate strategies for adaptation. It can be deduced from this finding, that farmers experiences to climate change in their environment overtime has increased their awareness and adaptation strategies for mitigation.

Table 3: Correlation between Perception to Climate Change and Utilization of Climate Change Indigenous Adaptation Strategies (n=100)

		Perception	Indigenous Adaptation Strategies
Perception	Pearson Correlation	1	.733**
	Sig. (2 tailed)		.000
	N	100	100
Climate Change	Pearson Correlation	.733**	1
	Sig. (2 tailed)		.000
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Field Survey; 2016.

CONCLUSION

This study has explored the perception of food crop farmers to climate change and how indigenous adaptation strategic methods was used to mitigate changes in climate in the study area. The findings has shown that climate change was perceived to have been caused by factors ranging from burning of firewood for energy to religious and superstitious beliefs. Change in planting date was found to be the leading strategy adapted by food crop farmers in the study area. Others are mulching, relay cropping, mixed farming and some various indigenous methods that are readily available to food crop farmers. Perception and utilization of indigenous adaptation strategies was found to correlate, indicating that various adaptation methods were used by the farmers.

RECOMMENDATIONS

Metrological agencies and extension agents should sensitize farmers on changes in weather conditions and appropriate farming activities including time for planting. Efforts should be made by government and non-governmental Organizations to educate local farmers to know that climate change is a global problem that requires collective actions beyond individual faiths. Additionally, awareness of the use of alternative energy sources other than fuel wood should be focused on. In addition, government should support the practice of ranching to avoid indiscriminate livestock grazing.

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Analysis of Allocative Efficiency of Small Scale Maize Production in the Guinea Savannah Region of Borno State, Nigeria

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ABSTRACT

The study analyzed allocative efficiency in small scale maize production in the guinea savannah region, Nigeria. One hundred and twenty small scale maize producers were randomly selected for the study. Data were collected using structured questionnaire. Data were analyzed using stochastic frontier cost function. The result revealed that in the cost frontier, the sigma square is 0.360significant a 1% and gamma is 0.830 is significant at 5% respectively. The cost efficiency index ranged from 0.124 to 0.851 with a mean of 0.766 implying that an average farm in the study has the scope for increasing cost efficiency by 23% given the existing technology. Cost of labour was significant at 1%, cost of fertilizer was significant at 5% implying that 1% increase in cost of labour will result to 4.4% increase in the cost of maize production. Whereas 5% increase in cost of fertilizer will result to 0.8% increase in the cost of maize production the study area. Results of inefficiency revealed that, age, extension visit, farming experience were all significant at 1%. While education status was significant at 5%.Based on the findings of this research, the study recommended that there is need for farmers to acquire basic education since education positively influences efficiency.

Keywords: *Allocative Efficiency, Small Scale, Maize, Stochastic Frontier.*

INTRODUCTION

Nigeria with a population of over 180 million people is the Africa's most populous nation and agriculture is the predominant activity (Daniel, 2009). Agricultural sector was the major source of national income, foreign exchange, employment and contributor to the Gross Domestic Product (GDP) and it employs about 70 percent of the rural working population (Joshua and Teli, 2010).

Agricultural sector still remains the major source of food and raw materials for the teeming population and domestic industries and had sustained the growth of the Nigerian economy for decades. However, Nigerian agriculture is characterized by small scale farm, low farm income,and primitive techniques of production (Obadun, 2008). The development of agriculture is one of the crucial requirement for overall economic growth, there is little consensus with respect to most appropriate strategy for securing increase farm output and productivity in developing agriculture. Moreover, as a result of the seasonal nature of production, government opted to embark upon various strategies that aimed at ensuring continues production of crops, the most recent being the agricultural transformation agenda (Makama, 2006).

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Maize (*Zea mays L*) is a versatile crop with wide adaptations, it can be produced in large volumes in small area, it is easy to grow and harvest, is readily storable over the seasons and has multiple uses. Maize can be suitably intercropped with potatoes and grain legumes, and variety of other vegetables which enhance effective land utilization. Maize has multiple uses and the green stover is an excellent fodder for cattle in the critical feed storage months. Maize stover produces an average of 6.89 t/ha of dry matter, which is good enough to feed up to 5 adult cows for about five months (Dukpa and Rai, 2015). Maize by-product from processing is also an important source of feed for backyard piggery and poultry. Maize is a nutritious crop and a wholesome food. On average maize kernel contains about 71% starch, 9.9% protein and 4.45% fat (Watson, 2007).

Recent studies in Nigeria have shown that maize is now ranked third to rice and wheat as food crop and cash crop in the northern guinea savannah of Nigeria (Mboya, 2011). It is reported that over 12million farmers are scattered in different ecological zones, engage in the production of a wide variety of arable crops and this is done under traditional subsistence agriculture (National Bureau of Statistics, 2010). Individually, while not exerting much influence, they collectively form an important foundation on which nation's economy rests (Olayemi, 2008; Okuneye, 2006). Ado (2010) reported that 90% of the Nigerian total food production comes from these small scale farms. Therefore, effective economic development strategy will depend critically on promoting production and output growth in the agricultural sector, particularly among small scale producers since they are responsible for the bulk of the nation's agricultural production.

Resource allocation and productivity are important aspect of increased food production which is also associated with the management of the farmers who employ these resources in production. Furthermore, efficiency in the use of available resources is a major pivot for profitable farm enterprise and sustainability. Therefore, inefficiency in the use of resources, wrong choice of enterprise combination and cropping system constitute the major constraints to increased food production in Nigeria (Okorji and Obechina, 2005). In Nigeria, maize is produced across the country right from Mangrove Region in the South to the Sahel Savannah in the North (Olukosi and Raphael, 2015). Maize production in Nigeria has been on the increase both in terms of hectares and production. A seven fold increase in production occurred between 1984 and 1994. Similarly, production increased from 6,515,500.0 to 7,019,500.0 tonnes (7.75%) between 2012 to 2015 respectively (CBN annual Report).

Maize production is carried out in various Local Government Areas across Borno State. This study tried to analyze allocative efficiency and it's determinants in small scale maize production in the guinea region of Borno State, Nigeria using the stochastic cost frontier function. Cost efficiency (CE) is the product of input-oriented technical and allocative efficiency. Input oriented technical efficiency measures the ability to produce a given level of output with minimum inputs. Allocative efficiency measures the ability to produce the given level of output with the input bundle that costs the least under current market prices. Cost efficiency therefore measures the ability to produce a certain level of output at minimum cost (Jiang and Sharp, 2014). Most researches carried out on efficiency of food crops in Borno State are on technical efficiency (Bukar *et al*., 2016), this study will contribute to literature by examining allocative efficiency.

METHODOLOGY

Study Area

Guinea region of Borno State is one of the three Agro Ecological Zone of Borno State, Nigeria. It borders internationally with Republic of Cameroun to the East and nationally with Adamawa State to the South, Gombe State to the South West, Yobe State to the West and Maiduguri and Bama to the North Intra State. It lies between latitude $11^{0}09'0''N$ and longitude $13^{0}41'29''E$ of the equator and covers a land area of about 21,787.4 Km^2. The region has a projected population of about 1,759,900 persons as at December, 2016 (NPC, 2017). The annual rainfall in Southern Borno State varies yearly but averages between 800mm-1200mm that lasted from May to October (IITA, 2009). Vegetation is Guinea Savannah interspersed with tall trees and woodlands, arable lands and favorable weather for agricultural production.

Agriculture is the main stay of the economy of guinea region. Crops grown reflect the nature of the Agro-ecological zones. The major crops cultivated include millet, sorghum, groundnut, maize, cowpea, and vegetables (onion, pepper, tomatoes, spinach, lettuce, chili pepper, carrot garden egg). The major livestock reared in the area are cattle, camel, sheep, goats and poultry.

Sampling Procedure

Multi stage sampling technique was used to select farmers for the study. Guinea Savannah comprises 7 Local Government Areas which are Bayo, Kwaya-Kusar, Hawul, Biu, Shani, Chibok, and Askira/Uba. At the first stage, a random selection of Biu and Hawul Local Government Area was made by ballot box method. At the second stage a random selection of 4 villages from each L.G.A. making a total of 8 villages that were sampled. The villages were Yawi, Galdimare, Dugja and Zarawuyaku from Biu L.G.A. while, Shafa, Marama, Kida and Kwajafa from Hawul L.G.A. At the final stage, 10% from the number of registered farmers from the villages were randomly selected. Therefore, a total of 120 farmers were selected to serve as the sample size for the study.

Table 1: Sample Selection from Sampling Frame

Selected LGAs	Selected Villages	NO. of Registered Farmers	10% of the NO. of Registered Farmers
Biu	Zarawuyaku	181	18
	Dugja	140	14
	Yawi	160	16
	Galdimare	150	15
Hawul	Shafa	147	15
	Kida	152	15
	Marama	98	10
	Kwajafa	172	17
Total		**1200**	**120**

Data Collection

Primary data were used for this study. Data for the study were collected with the aid of structured questionnaire by the researcher and with the assistance of trained enumerators. Data were collected based on allocative variables such as cost of seed, cost of fertilizer, cost

of labour, cost of herbicide and price of output (revenue) obtained in naira. Data on socio economic characteristics were also obtained which include age, marital status, educational background, farming experience, house hold size and frequency of extension visits.

The allocative efficiency model

The stochastic cost function which is the basis for estimating allocative efficiency of the farms is specified as follows:

$$LnC_1 = \beta_0(Y^*) + \beta_1 Ln(P_{1i}) + \beta_2 Ln(P_{2i}) + \beta_3 Ln(P_{3i}) + \beta_4 Ln(P_{4i}) + \varepsilon_i \quad \ldots\ldots 1$$

P_1 = Cost of seed in ₦

P_2 = Cost of fertilizer in ₦

P_3 = cost of labour in ₦

P_4 =cost of herbicidein ₦

E_i= composite error term comprising V_1 and U_1

Where:

V_1 = Random error that measured to be independently and identically distributed of the U_1

U_1 = one sided disturbance cost term representing the cost inefficiency.

Allocative inefficiency: Allocative inefficiency was estimated with the socioeconomic variables as the independent variables:

$$\mu_{ij} = Б_0 + Б_1 Z_1 + Б_2 Z_2 + Б_3 Z_3 + Б_4 Z_4 + Б_5 Z_5 + Б_6 Z_6 \quad \ldots\ldots 2$$

μ_{IJ} = Allocative inefficiency of the ith farmer

Z_1= Age of farmer (years)

Z_2 = household size (numbers)

Z_3 = educational status (years of schooling)

Z_4 = farming experience (years)

Z_5 = Denotes sex (male =1, otherwise = 0)

Z_6 = Denotes frequency of extension visit (number of contact).

RESULTS AND DISCUSSION

Maximum likelihood estimation (MLE) of the parameters of the stochastic cost frontier function was obtained. The MLE is presented in Table 2.

Table 2: Stochastic Cost Frontier Estimates for Small Scale Maize Production

Variables	Parameters	Coefficients	T – value
Constant	β_0	1.504	24.647***
Cost Seed	β_1	0.057	2.108***
Cost Fertilizer	β_2	0.008	0.134**
Cost Labour	β_3	0.044	4.874***
Cost Herbicide	β_4	-0.002	-2.348
Inefficiency model			
Constant	δ_0	3.096	32.097***
Age	δ_1	0.193	1.0647***
Household size	δ_2	0.032	1.8312*
Extension visit	δ_3	-0.769	45.249***
Education status	δ_4	-0.048	-2.2718**
Farming experience	δ_5	-0.027	-6.2371***
Sigma square	δ^2	0.360***	
Gamma	γ	0.830**	
Log likelihood function		212.115	

Source: Field Survey, 2016. ***<0.01,**<0.05,*<0.10

The maximum likelihood (ML) estimates of the stochastic frontier cost parameters for small scale maize producers are presented in table 3. For the cost frontier the sigma square is 0.360 and gamma is 0.830 and significant at 1% and 5% level of probability respectively. The significant value of sigma indicates the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idong, 2005). The gamma is 0.830 which shows that 83% of the variation in the output of maize that are unexplained by the function is due to allocative inefficiency.

The estimated coefficients of the parameters of cost frontier are all positive except for herbicide which is negative. The cost of seed and labour are significant at 1%, while fertilizer is significant at 5% level of significance. The coefficient of the cost of seed (0.057) was positive and significant at 1% level of probability. This implies that seed are important in crop production in small scale maize farms. The implication of this is that 1% increase in the cost of seed will give rise to5.7 increase in the cost of maize production. The cost of labour (0.0442) is positive and significant at 1% significance level. This implies that 1% increment in cost of labour will increase the total cost of maize production by 4.4%. The significant influence of seed and labour is in agreement with the finding of Okoh (2009), who found seed and labour costs as determinants of allocative efficiency in the Fadama production of Tomato in Benue State, Nigeria.

The coefficient of the cost of fertilizer (0.0075) was positive and significant at 5% level of probability. This implies that fertilizer is also important in maize production. The implication of this is that 5% increase in the cost of fertilizer will give rise to 7.5%. increases in the cost of maize production. The coefficient of the cost of herbicide (-0.0052) is negative and not significant. This implies that the cost of herbicide is however not significant in determining cost of maize production.

The result of the inefficiency model of the stochastic frontier cost function revealed that Age, household size, extension visit, educational status and farming experience were the determinant of allocative efficiency among the small scale maize producers. The coefficient

of age, experience and extension visit were all significant at 1% level of significance, while education status and household size were significant at 5% and 10% level of significant.

Age has an estimated coefficient of 0.193. This implies that the more advanced in age a maize farmer is, the higher will be his allocative inefficiency. That is to say the older a farmer is, the poorer his ability as a decision maker to obtain and process information about prices and technology. Household size has an estimated coefficient of 0.032. This implies that, the smaller a maize farmer household the more efficient it will be in the allocation of production resources. This may be due to the fact that larger maize farmers household have more mouth to feed than small maize farmers households, as a result of this, the ability to make appropriate choices between alternative farm inputs is constrained by the shortage of financial resources.

The coefficient of extension visit was -0.769, indicating that extension visit reduces allocative inefficiency among small scale maize producers. This implies that increase in extension services tend to decrease cost inefficiency in small scale maize production. The findings agree with the study of Ajani (2012), who observed that extension visit enhances farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State, Nigeria.

The coefficient of educational status was -0.048. This implies that the more educated a farmer is, the more allocative efficient he becomes. As farmers acquire more education the better their allocative efficiency thereby, decreasing the level of allocative inefficiency. This result tally with the finding of Ajani (2012), who observed that education status of a farmer enhances his ability to derive, decode and evaluate useful information in his study of resource productivity in food crop farming in Northern area of Oyo State, Nigeria.

The coefficient of farming experience was -0.027. This shows that the more experience the farmer is, the higher will be his level of allocative efficiency or lower his level of allocative inefficiency. This implies that the more experience a farmer the more his likely to take cost decision that will lead to allocative efficiency compared to farmer who has little or no experience.

Allocative Efficiency Level in Small Scale Maize Production

Table 4 depicts the frequency distribution of the allocative efficiency estimates of small scale maize producers in the study area.

Table 3: Distribution of Small Scale Maize Producers by Allocative Efficiency Level

	Allocative Efficiency	
Efficiency level	**Frequency**	**Percentage**
0 – 0.2	3	2.50
0.21 – 0.4	43	35.83
0.41 – 0.6	10	8.33
0.61 – 0.8	60	50.0
0.81 – 1.0	4	3.33
Total	120	100
Minimum	0.1239	
Maximum	0.85120	
Mean	0.7661	

Source: Field Survey, 2016

The result revealed that 53.33% of the small scale maize producers had allocative efficiency of 0.61 and above while 46.66% of the producers operate at less than 0.61 allocative efficiency levels. This implies that majority of the small scale maize producers were allocative efficient as 53.33% of them attained efficiency level greater than 0.61 and above allocative efficiency levels. That is, the farmers are allocative efficient in producing maize at given level of output using cost minimizing input ratio as about 53.33% of small scale maize producer have allocative efficiency differ substantially among the producers ranging between minimum value of 0.124 and maximum value 0.851 while the mean value was 0.786. The study further revealed that the average producer to become the most allocative efficient producers, he will need to realize about [1-(0.79/0.85)*100] that is 24.7 cost saving, while on the other hand, the least allocative efficient producer will need about [1-(0.79/0.14)*100] that is 51.2 cost saving to become the most allocative efficient maize farmer.

CONCLUSION AND RECOMMENDATIONS

Small scale maize producers in the study area showed low allocative inefficiency scores. However, there is room for improving the level of allocative efficiency by reducing the cost of production without decreasing the output. Based on the findings of this research, the study recommended that there is need for farmers to acquire basic education since education positively influences efficiency. Effective extension programs that will educate farmers on efficient allocation of production resources are points upon which the various smallholder development programs initiated by government should be building. To this end, the extension arm of the ADP should be resuscitated and strengthened through adequate funding by the government instead of introducing new schemes and programs which duplicates tasks.

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Analysis of Food Security Status among Rural Farming Families in Jigawa State, Nigeria

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ABSTRACT

This study was designed to analyze the food security status among rural farming families in Jigawa State. The study utilized multistage random sampling technique to obtain a sample of 184 respondents. Primary data were collected using structured questionnaire with the help of well-trained enumerators. Data were analyzed using descriptive statistics and food security index. Results revealed that rural farming households head were predominantly male (71.7%) and most (79.9%), were married with one level of education or another (67.4%).The mean age for the households' head was 42 years and the mean household size was 10 persons per household. The mean for farming experience and annual farm income of the respondents were 21.9 years and ₦32,238 respectively. Using the recommended calorie required approach, the study revealed that 30.4% and 69.6% of the households were food secure and food insecure respectively. The perceived coping strategies in cushioning the effects of food insecurity include consumption of less preferred food, reduction in quantity and quality of food consumed, borrowing money to buy food, sales of some assets. Based on the recommended energy level of 2, 900 Kilocalories per person per day, it could be concluded that the study area is food insecure since a higher proportion of the sample households are food insecure. The study therefore recommends that formal education be promoted by government and other stakeholders as a means of improving food security as it opens up more income earning opportunities for the farming households especially in the non-farm sector, farmers should be encouraged by government and nongovernmental organizations to increase their food crop production by providing subsidized farm inputs, increase in access to credit facilities, this is necessary for increased per capita food availability that is necessary for food security, enlightenment programmes on health education and birth control measures should be directed at the farming households, this is to reduce the large family size observed in the area which could have effects on household food security, food insecurity coping strategies adopted by the households can only minimize its the impact therefore household heads should adopt more sustainable approaches such as, engaging in income generating activities such as petty trading and other off-farm activities.

Keywords: *Food Security, Farming Families, Rural Jigawa, Nigeria.*

INTRODUCTION

The idea of food security was presented for the first time at the world food conference in 1974, viewed solely from the perspective of having adequate availability of food on a national scale. Today, it is a condition in which all people have access at all times to enough food for an adequate nutritional quality for a healthy and active life (Tollens, 2000).

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Food security is a term commonly linked to hunger and food access related issues (West African insight, 2010). The main goal of food security is for individuals to be able to obtain adequate food needed at all times and to be able to utilize the food to meet the body needs (Nnadi *et al*, 2012).

In Nigeria the percentage of food insecure household was reported to be 18% in 1996 and over 40% in 2005 (Sanusi *et al*. 2006). Agricultural growth is particularly effective in reducing hanger and malnutrition (FAO, 2012). The agricultural growth rate relative to population growth is said to be low in Nigeria (Word Bank, 2008). Agriculture is reported to grow at a rate of 2.5% per annum as against 3.5% per annum of population growth rate, thus resulting to food insecurity in the nation (Icheria and Kabill, 2012).

A household is said to be food secure if it can reliably gain access to give in sufficient quantity and quality food for household members to enjoy a healthy and active life (Barret, 2002). Household food security depends substantially on household income and asset (or wealth) of the states. A low-income household is more likely to suffer food shortages than a wealthier household. The relationship between a household's food security states and its purchasing power is far from static it changes over time (Aliber, 2009). Household food security will only be stable when there is good food availability at relatively low prices.

Food insecurity is a major development problem that is caused by myriad of factors in the global, regional, national and local spheres of human life. Several efforts have been put in place to alleviate food security, globally, nationally and even locally (Icheria and Kabill, 2012).

It is obvious that Nigeria is endowed with both physical and human resources and fertile land to produce food for their entire population and even marketable surplus for exports but, nevertheless, food has been imported to support the insufficient domestic production. However, the farming households in Nigeria are poor and subsistence farmers and their food security status always varies (Nnadi *et al*, 2012).

The supply side approach of measuring food security (e.g. measurement of total food production and availability and food Balance sheet) commonly used in Nigeria only focuses on food availability at the macro or national level and does not satisfactorily capture what happens in terms of food availability, access and utilization at the households and individual levels (Akinyele 2009, Liverpool-Tasie *et al* 2011, Adebayo 2010, Oruche, 2012.).This study would be able to provide latest information regarding food security status of rural households. The objectives of this study, therefore, were to:

i. describe the socio-economic characteristics of the rural farming families,
ii. determine the food security status of the rural farming families, and
iii. Identify the coping strategies employed among food insecured farming families in cushioning the effects of food insecurity.

METHODOLOGY

Description of the Study Area

Jigawa State is located in the North-Western part of the country between latitude 11^0N to 13^0N and longitude 8^0E to 10.15^0E, Kano State and Katsina State border Jigawa to the West, Bauchi state to the east and Yobe State to the Northwest. Jigawa state shares an international border with Zinder region in the republic of Niger. The state has a total land area of

approximately 22, 410 square kilometers with a population of 4,361,002 (NPC, 2006). The economy of Jigawa State is largely characterized by informal sector activities with agriculture as the major economic activity. The dominant ethnic groups in the state are Hausa and Fulani. Major crops produced in the area include: millet, wheat, sorghum, rice and cowpea.

A tropical wet and dry climate prevails over the state and it has two distinct seasons; wet and dry seasons. The wet seasons lasts between May and early October while the dry season lasts between November and April. The total amount of rainfall ranges from 600mm in the north to 1000mm in the southern part of the state. Average temperature of the state is 29^0C with 21.2ºC asminimum temperature occurring between November to February and 31.3ºC asmaximum temperature occurring between March and April. Relative humidity is highest in August with 80% and low in January through March with 23-30%.

Sampling and Data collection

A multi-stage sampling procedure was used to select one hundred and eighty-four (184) respondents for the study. In the first stage two local government areas (LGAs) from each of the four agricultural zones in the State was randomly, selected. Dutse and Jahun in Zone I, Kaugama and Auyo Zone III, Ringim and Taura in Zone II, Kazaure and Roni in Zone IV were selected.

In the second stage, 5% of the list of villages in each of the LGAs were randomly selected. The last stage also involved a random sampling of 10 % of the population of rural farming households from each of the villages selected make a total of one hundred and eighty-four (184) respondents as sample size for the study. Primary data were used for the study. The data were generated using structured questionnaire administered to the respondents with the assistance of trained enumerators.

Data Analysis

Data collected for the study were analyzed using descriptive statistics such as frequencies, percentages, standard deviation and food security index. The food security index is given as follows:

$$Zi = Yi/R \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Zi = Food security index of the household
Yi =Daily per capita calorie intake of rural farming households
R = Recommended per capita daily calorie intake (2,900 kilo calorie)
Zi = 1 for Yi greater than or equal to R
Zi = 0 for Yi less than R

To obtain per capita daily calorie intake, daily calorie intake of each household was divided by its household size. To determine recommended per capita calorie intake of the households the FAO (2000) standard of 2,900 kilo calorie was used.

The household, daily calorie requirement was estimated by first of all categorizing members of each household into different age group based on the fact that different age groups have different calorie requirements. The daily energy (calorie) requirements of various compositions of the households were converted into adult equivalent using the equivalent scales as shown in Table1.

Table 1: **Recommended Daily Energy Intake and Equivalent Scale**

Age Category (Years)	Average Allowance Per Day	Equivalent Scale
Children(<6)	1150	0.4
Children(6-18)	2250	0.7
Adults(>18)	2900	1

Source: FAO Stat (2000).

Total household composition or calorie requirement was obtained by multiplying the total number of adults in each household by the recommended calorie requirement of 2,900 kcal. The total foods requirement for children was converted to adult equivalent; this was done by multiplying the total number of children below the age of six (6) years in each household by recommended daily calorie Requirement of 2,900 kcal and a conversion factor of 0.4 to obtain their adult equivalent.

The total number of children between the ages of 6 to 18 years in each household was also multiplied by the Recommended Daily Requirement of 2900 kcal and a conversion factor of 0.7 to obtain their adult equivalent. The total daily calorie requirement for each household was obtained by summing up the requirement for the three age groups estimated in Table 1.

Households' daily food consumption (daily calorie intake) was obtained from household own food production and purchase to supplement own food production. The data on actual food consumed (maize, rice, sorghum, cowpea and millet) by each household per week were obtained and converted into kilogram. The energy content of 1kg of each food stuff was obtained from literature as shown in Table 2.

Table 2: **Cereal Equivalent Conversion Ratios**

Food Crop	Calorie/kg
Maize	3,590
Rice	3,640
Sorghum	1,190
Millet	2,891
Cowpea	3,340

Source: FAO Stat (2000)

The total quantity of each food (in kilogram) consumed was then multiplied by the energy content. The total kilocalories of maize, sorghum rice, millet and cowpea consumed by each household were summed up and divided by 7 (days in a week to obtain the actual daily calorie intake).

Additionally, the head count ratio of food security was calculated for the sample households based on food security line. The headcount ratio (H) measures the percentage of the population of households that are food insecure/secure (Seid, 2007)

The Head Count ratio (H)

$$H = M/N \text{ ---------- (2)}$$

Where:

M = Number of food insecured/secured households
N = Number of households in the sample

RESULTS AND DISCUSSION

Table 3. Socio-Economic Characteristics

Socio –Economic Characteristics	Frequency	Percentage	Mean	Min	Max	Standard Deviation
Sex						
Male	132	71.7				
Female	52	2				
Marital status						
Single	8	4.3				
Married	147	79.9				
Divorce	11	6.0				
Widow	18	9.8				
Level of education						
Primary	16	8.7				
Secondary	23	2.5				
Tertiary	15	8.2				
Qur'anic education	56	30.4				
Never been to school	60	32.6				
Adult	14	7.6				
Age (Years)						
21 - 30	49	26.6	41.7	21	8514.069	
31 – 40	38	20.7				
41 – 50	51	27.7				
51 - 60	23	12.5				
61 –85	23	12.5				
Household size (Person)						
1 - 5	45	24.5	9.61	1	30	5.73
6 - 10	66	35.9				
11 -20	63	34.2				
21 – 30	10	5.4				
Total annual income (Naira)						
1001 - 10,000	44	24.0	32,238	1,000	600,000	60628.79
10,001 - 20,000	55	29.9				
20,001 – 30,000	42	22.8				
30,001 - 40,000	14	7.6				
40,001 - 50,000	16	7.1				
50,001 - 600,000	13	8.6				
Farming experience (Years)						
5 - 15	6	3.1	21.85	5	70	13.128
16 – 26	61	33.1				
27 - 37	38	20.7				
38 - 48	21	11.4				
49 – 59	20	10.8				
60 – 70	38	20.7				

Source: Field Survey, 2018.

Table 3 shows the socioeconomics characteristics of respondents in the study area. The results of the finding show that the majority of the respondents were males (71.7%) while only 28.3% were females. According to Ziervogel *et al,* (2006) men, have easier access to farmland through paternal inheritance than women in Nigeria but this is not so in the study area. About 67% of the households' head have one level of education or the other ranging from primary education (8.7%), secondary education (12.5%) and tertiary education (8.2%) adult education (7.6%), Qur'anic education (30.49). About 32.6% of the households' head have no education at all. According to Babatunde *et al,* (2007) education is a social capital which could impact positively on household's ability to take good and well-informed production and nutritional decisions. The table further showed that 27.7% of the household heads were between the ages of 41 and 50 years 26.6% were within 21 to 30 years' age group while 20.7% were between the ages of 31 and 40 years. Hence they are energetic to cultivate large size farms for increased food production and engage in off-farm jobs so as to increase household income.

Majority of the respondents (79.9%) are married; and the average household size was 10. This implies that most of the farmers had large household sizes which could probably serve as an insurance against shortfalls in the supply of farm labor. According to Sule, Ogunwale and Afala (2002) household size, this plays important role in family labor provision in the agricultural sector.

The results also revealed ₦32, 238 as the average annual income which implies that majority of the respondents (76.6%) were low income earners considering the magnitude of their total monthly income from farming which was their major occupation and that might have affected their food security status. The result further showed that majority (63.5%) had at least 27 years of exposure to farming experience which could have exposed them to the skills and knowledge of their chosen profession.

Food Security Status of Rural Farming Families

Table 4 presents the summary statistics of food security indices among the sampled households.

Table 4: Summary Statistics of Food Security Status in the Study Area

Variables	***Mean***		
Food Security Indices	***Food Secure***	***Food Insecure***	***Total***
Percentage of Households	*30.4*	*69.6*	*100*
Number of Households	*56*	*128*	*184*
Food security index (Z)	*1.52*	*0.57*	
Head count Ratio (H)	*0.30*	*0.69*	

Source: Field Survey, 2018

The results showed that the study area could be regarded as food insecure given the fact that only 30.4% of the populations were able to meet the recommended calorie intake of 2900 Kcal per capita per day while 69.6% could not. The mean food security index of food secured household was 1.52 and 0.57 for the food insecure household.

Coping Strategies Employed Among Food Insecure Farming Families in Cushioning the Effects of Food Insecurity

Table 5 presents the coping strategies employed by households in cushioning the effects of food insecurity.

Table 5: Coping strategies employed among food insecure farming families in cushioning the effects of Food Insecurity.

Coping Strategy	Frequency	Percentage	Rank
Consumption of Less Preferred Food	50	27.2	1st
Reduction in quality and quantity of food consumed	27	14.7	2nd
Diversion of money meant for other purposes to buy food	26	27.2	3rd
Borrowing money to buy food	23	14.7	4th
Reduction in Number of Meal	21	11.4	5th
Sales of some Assets	20	10.9	6th
No Response	17	9.2	7th
Total	**184**	**100.0**	

Source: Field Survey, 2018

The Table indicated that the major coping strategies employed by households include consumption of less preferred food (27.2%), reduction in quality and quantity of food consumed (14.7%).Due to high food prices and lower income, household resort to the consumption of less preferred food and less expensive food so as to feed and produce more food.(Ibrahim *et al*,2009).

Other coping strategies employed by the households include reduction in the number of meals per day (11.4%), Diversion of money, meant for other purpose to buy food (14.7%), Borrowing money to buy food, (12.5%), sales of some assets (10.9%). According to Amaza *et al*, (2008) household assets is considered one of the measures of household resilience, which cushions the effects of adverse circumstances such as crop failure or drought on household food security.

CONCLUSION AND RECOMMENDATIONS

Based on the recommended energy level of 2900 Kilocalories per person per day, the study concluded that a higher proportion of the sample households are food insecure. From the respondents' opinion consumption of less preferred food, reduction in quantity and quality of food consumed, borrowing money to buy food, sales of some assets were major coping strategies employed to cushion the effects of household food insecurity.

It is therefore recommended that farmers should be encouraged by government and nongovernmental organizations to increase their food crop production by providing subsidized farm inputs, increase access to credit facilities. This is necessary for increased per capita food availability that is necessary for food security. Enlightenment programmes on health education and birth control measures should be directed at the farming households.

This is to reduce the large family size observed in the study area which could have effects on household food security.

Food insecurity coping strategies adopted by the households can only minimize its impact, therefore, there is a need for households to adopt more sustainable approaches such as engaging in income generating activities such as petty trading and other off-farm activities.

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Analysis of Household Vegetable Consumption in Federal Low Cost Area of Bauchi Metropolis, Bauchi State, Nigeria

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ABSTRACT

The study analyzed household vegetable consumption in federal low cost of Bauchi Metropolis, Bauchi State. A total of 72 respondents were selected for the study using a systematic random sampling technique. Primary data were collected using questionnaire. Descriptive statistics was used for data analysis. The result showed that most of the respondents were females, representing the male heads, (66.7%) were aged 36-55 years, (71%). Majority were married (93.1%) with an average household size of 10 persons and had educational level above primary school (88.9%). The result indicated a mean monthly household income of ₦130,794. Mean food expenditure of ₦47,697, expenditure on vegetable; ₦15,320 accounting for 36% and 12% of total household expenditure respectively. The result of consumption shows that tomato, pepper, onion, spinach, cucumber and cabbage were the types of vegetable consumed in the study area with tomato, pepper, onion and spinach being the mostly consumed vegetables with 44.4%, 29.2%, 13.9% and 12.5% respectively. It was also found that vegetables are more abundant and accessible during the dry season than the rainy season as claimed by 83.3% of the respondents. The mean quantity of vegetable consumption was 37.4 kg, 17.4 kg, 11.6 kg, 8.1 kg, 7.8 kg and 14.5 kg for tomato, pepper, onion, spinach, cucumber and cabbage respectively. The major constraints impeding the consumption of vegetable in the study area were seasonality, perishability and storage with 100%, 98.6% and 76.4% respectively. It is therefore recommended that the populace should be enlightened on the health benefit of vegetable consumption and more adequate storage devised to reduce household waste.

Keywords: *Household, Vegetable, Consumption, Federal Low Cost.*

INTRODUCTION

Vegetables are edible parts of plants that are consumed whole or in parts, raw or cooked as part of main dish. The tropical and sub-tropical countries of the world are blessed with varieties of vegetables some of which are domesticated, while others grow wild with relatively affordable prices when compared with other food items (Uzuegbu and Eke, 2000 and Okaka *et al.,* 2010). Leafy vegetables from a wide variety of plants including potherbs, green vegetables, green or leafy greens are eaten as food. Nearly one thousand species of plants range from short-lived herbaceous plants such as Lettuce, Spinach, to woody plants

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such as Aralia and to fodder crops which include alfalfa, wheat and barley with edible leaves are known (Adeyanju, 2014). They can be grown in pots, plastics, at home garden to make them available and accessible.

Vegetables are an important component of healthy human diet. They are good sources of vitamins and minerals, vegetable proteins, protective micronutrients and dietary fibres (which help to prevent constipation) (Balasubramanian & Raghunathan, 2012). For example, a diet including mainly spinach can boost memory power and help in cognition and better learning (Vishal, 2014). High vegetable intake can promote health and prevent chronic diseases such as heart diseases and certain types of cancer. The health benefits of vegetables seen in epidemiological studies are the main reason for the recommended intake of at least 400 g of fruits and vegetables per day (World Health Organization, 2004).

In time past, an average Nigerian rural dweller depended on subsistence farming in which he cultivated indigenous leafy vegetables crops at least for his immediate family consumption (Berinyuy, 2010). The production of these vegetables is increasingly targeted as a livelihood strategy as the level of urban unemployment rises (Smith and Eyzaguirre, 2007). Estimates of vegetable consumption in sub-Saharan Africa range from 70 to 312 g per person per day, which is far below the WHO/Food and Agriculture Organization's minimum recommendation of 400 g per person per day or 146 kg per person per year (Ruel *et al*, 2005). Facts from WHO information sheet showed approximately 2.7 million of deaths and 1.8% of global disease burden worldwide are attributable to low vegetable consumption. Insufficient intake of vegetables is estimated to cause around 14% of gastrointestinal cancer deaths, about 31% of heart disease and about 11% of stroke deaths (WHO, 2004). As a result, increasing vegetable consumption among children and adolescents is an important public health issue (Rasmussen *et al*, 2006).In spite of the importance of an adequate intake of vegetables, large population group in Nigeria eat less than the recommended amount of vegetables.

To develop effective interventions to increase vegetable intake, an understanding of the level of vegetable consumption among the populace and those factors that influence its consumption are necessary (Yngve *et al.,* 2005). Despite the dietary guideline recommendation of consuming five servings of vegetables of 80g per day, most people in developing countries are consistently not reaching even half of this requirement (FAO, 2009 and Biing-Hwan *et al.,* 2004).

In developing countries like Nigeria, the most important way of sustainably solving Vitamin A deficiency problems at the resource-poor household`s level is by encouraging improved production and consumption of vitamin A rich indigenous food items like green leafy vegetables(Adedoyin *et al.,* 2002).

The study intends to investigate vegetable consumption in Federal Low Cost Area of Bauchi Metropolis. However, the specific objectives are to;

i. examine socio-economic characteristics of vegetable consumers in the study area;
ii. identify the type of vegetable consumed in the study area; and
iii. examine constraints militating against vegetable consumption in the study area.

METHODOLOGY

Bauchi Metropolis lies between latitude 10.18^{o} S and 57.00^{o} N of the Equator and longitude 9.50^{o} W and 39.00^{o} E of the Greenwich Meridian. (Bauchi State Diary, 2010). It is situated within the Northern Sudan Savanna ecological zone of Nigeria and has an elevation of 690.20 metres above sea level. The climatic condition of the town is characterized by two distinct seasons; dry and wet. Wet season lasts for five months (from May to September), while the dry season lasts for 7 months (from October to April). The mean annual rainfall varies from 600mm to 1300mm, while the temperatures range from 18.33^{o}C-32. 39^{o}C with April being the hottest month and January as the coldest (Bauchi State Agricultural Development Project, 2007). The agricultural produce consumed in Bauchi metropolis Rice, Maize, Sorghum, Millet, Sweet potato, Water melon and Mango. Arable farming is the main agricultural practice in the area. Maize, sorghum, Millet, water melon, sweet potato and legumes are produced in commercial quantities as principal crops. The farmers in the study area also embark on small, medium and large-scale livestock production such as rearing of goats, sheep, cattle and poultry as well as marketing of their products. In Nigeria, the 2007 estimated production of vegetables was 8.082 million tonnes, while its consumption was estimated at 47.52 g/capita/day (FAO, 2008).

Sampling Technique

A systematic random sampling was used in the selection of respondents. Federal low cost has 24 streets; out of each street, 3 households were randomly selected making a total of seventy-two (72) respondents. Primary data focusing on socio-economic characteristics, expenditure and consumption of vegetables as well as constraints limiting vegetable consumption were collected using a well-structured questionnaire.

Analytical Technique

Descriptive analysis in form of frequency distribution, percentages and arithmetic mean were used to analyze the data collected for this study. It will be used to achieve objectives (i), (ii) and (iii).

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Age

The age distribution of the respondents is presented in Table 1. The result indicated that 45.9% of the respondents were within the age bracket of 36-45 years, the mean age was 42 years. From the age distribution of the study area, 95% of the vegetable consumers comprise of young and middle-aged group who need vegetable for cognitive development and memory power respectively. The aged make up less than 5% of the population sampled. Nayga (2008) ascertained that age distribution of the family has an influence on household's vegetable consumption with household having younger members having higher vegetable consumption compared to households with older members. On individual level, older people consume more vegetables, while on the aggregate, young people constitute a larger number of the household population thereby having a higher percent of vegetable consumed. Consumption is influenced by the number and composition of persons in a household.

Sex of the respondents

The result on Table 1, revealed that 66.7% of the respondents were females, representing the male heads, while 33.3% were males. A study in Central Nigeria found that females consumed more vegetables than males (Banwat *et al.*, 2012). In the study area, males being the heads of households are bread winners and spent most of the day outside the home, women and children being at home most of the time and eat meals at home with vegetables. Also, Ruel *et al.* (2005) added that, seven out of ten countries in Sub-Saharan Africa, the female-headed households spent more on consumption of vegetable than male-headed households.

The results on Table 1 shows that most (93%) of the respondents were married while 7% were single. Mohammad *et al*. (2006) reported that married men and women consumed more vegetables than single. While Akande *et al.* (2009) reported that polygamous families usually spent less on unessential vegetables due to higher family responsibilities. Contradictions could be due to differences in the locations of their studies, while Muhammad carried out his research in Isfahan, Iran, Akande's research was in Ibadan, south- western Nigeria. Climatic and socio-cultural factors of the regions differ.

The result on Table 1 indicated that 44.4% had 11-15 persons per household, 45.8% had 6-10 persons while 9.7% had 1-5 persons and the mean household size is 10 persons. Obayelu *et al.* (2009) identified household size affect the food security level of households and significantly affects the consumption of Vegetables. The implication is that as household size increase, food expenditure also increases expenditure on vegetable; being considered a luxury food may decrease.

The result on Table 1 also revealed that 58% of the respondents had tertiary education, while 30.6% and 11.1% had secondary and primary education respectively. This implies a high literacy level in the study area. Education is identified to increase the probability of consuming vegetables because the knowledge of nutritional content of vegetable encourages people to develop a vegetable inclusive feeding habit (Dunn *et al.* 2012).

Table 1 shows that half of the respondents (51.4%) were civil servants, this may not be unconnected to residential area which was established for civil servants, while 41.7% and 9.7% were traders and farmers respectively. Occupation plays a significant role in consumption, because consumption is determined by the level of income of the consumer (Adengan and Adeoye, 2011).The more people earn, the more they can expend on vegetable.

The result on household income on Table 1, shows that 33.3% of the respondents had a total monthly income ranging between ₦101,000- ₦150,000, 30.6% had ₦51,000-₦100,000, 23.6% had ₦151,000-₦200,000, and 5.6% had a monthly income of less than ₦50,000, while 4.2% and 2.8% had a monthly income greater than ₦200,000. The average monthly income is ₦130,794. The amount of money that individual spends on any particular goods or service is mainly determined by disposable income (Babalola & Isitor, 2014).A higher income influences food quality and quantity. Consequently, increased food quality may lead to higher consumption of vegetables.

Table 1: Socio-Economic Characteristics of Respondents

Characteristics	Frequency	Percentage
(a) Age (years)		
<35	18	25.0
36-45	33	45.9
46-55	18	25.0
56-65	3	4.2
(b) Sex		
Female	48	66.7
Male	24	33.3
(c) Marital status		
Single	1	1.4
Married	67	93.0
Divorced	1	1.4
Widow	3	4.2
(d) House hold size		
1-5	7	9.7
6-10	33	45.8
11-15	32	44.0
(e) Educational level		
Primary	8	11.1
Secondary	22	30.6
Tertiary	42	58.3
(f) Occupation		
Civil servant	35	48.6
Traders	30	41.7
Farmers	7	9.7
(g) Household Income		
>50,000	4	5.6
51,000-100,000	22	30.6
101,000-150,000	24	33.3
201,000-250,000	3	4.2
>250,000	2	2.8

Source: Field Survey 2018

Households monthly expenditure on vegetables

The household monthly expenditure on vegetable on Table 2 shows that 48.6% of the households spends ₦5,000-₦15,000 on vegetables monthly, 31.9% spends ₦16,000-₦25,000, 8.3% spends ₦26,000-₦35,000, 6.9% and 4.2% spends less than ₦5,000 and greater than ₦36,000 on vegetable stuffs respectively. The mean monthly household expenditure on vegetable was ₦15,320 and accounts for about 12% of average total household expenditure, which implies a low consumption of vegetables in the study area. This is in line with the findings of Ruel *et al.* (2005) who reported that the share of total and food budget allocated to vegetables in Sub-Saharan Africa ranges between 3-13%.

Table 2: Distribution of respondents based on Monthly expenditure on vegetables

Amount (₦)	Frequency	Percentage
<5000	5	6.9
5000-15000	35	48.6
16000-25000	23	31.9
26000-35000	6	8.4
>36000	3	4.2
Mean 15,320 (₦)		

Source: Field survey, 2018

Types of vegetable mostly consumed in the study area

Table 3 revealed that the most widely consumed vegetables were tomato, pepper, onion, spinach, cucumber and cabbage with 37.4 Kg, 17.4 Kg, 11.6 Kg, 14.5 kg, 8.1 Kg and 7.8 Kg as mean monthly consumption per household respectively. The high consumption of tomato could be because of its being the basic component of soup in the study area. The consumption of these vegetables may not be unconnected with their availability, affordability and accessibility to the consumers, as Bauchi state is a major producer of vegetables. Poly-Mbah *et al.* (2010) also reported that tomatoes and onions are among the food products that significantly contribute to the Nigerian consumer food price index and should be in focus of government programs that address food insecurity. Increasing consumption of plant based foods like cabbage decreases the risk of diabetes, obesity, heart disease and overall mortality. It can also help promote a healthy complexion, increased energy, and lower weight (Agbugba and Thompson 2015). Cucumbers are good sources of phytonutrients such as flavonoids, lignin and tryptophan which have antioxidant, anti-inflammatory and anti-cancer benefits. The peels and seed also contain minerals, calcium and beta-carotene which is an antioxidant that helps to boost immunity, freshen skin, strengthen eye vision and prevent of cancer (Jessie, 2017).

Table 3: Types of Vegetable mostly consumed by the Household

Vegetables	Frequency	Percentage
Tomato	32	44.4
Pepper	21	29.2
Onion	10	13.9
Spinach	9	12.5
Total	**72**	**100**

Source: Field survey, 2018.

Constraints to Adequate Vegetable Consumption

The constraints impeding the consumption of vegetable as presented in Table 4, revealed that seasonality, perishability and storage were the major factors limiting the consumption of vegetables with 100%, 98.6% and 76.4% respectively. Others are preference and low income with 22.1% and 5.6 % respectively. Availability and access to most vegetables depend on their seasons, and this may affect the quantity and variety of vegetable available to the consumer. Many of these vegetables are not available all year round, especially in Africa where technologies to extend harvest period or facilitate storage are limited.

Table 4: Distribution of Respondents based on constraints to vegetable consumption

Variable	Frequency	Percentage
Perishability	71	98.6
Seasonality	72	100
Low income	4	5.6
Storage	55	76.4
Preference	16	22.2

Source: Field survey, 2018. *= multiple choice

CONCLUSION

Based on the findings of this study, the average consumption of vegetable is below the WHO recommendation of 400g/individual/day. It can therefore be concluded that there was inadequate consumption of vegetables in the study area. Also, perishability and seasonality are the major constraints hindering the consumption of vegetables in the study area.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made;

1. There is need for policies to promote and support vegetable consumption. This could be in the form of education and behavior change programmes to promote vegetable consumption.
2. Attention should focus on the processing of vegetables into forms that can be stored, this will reduce post-harvest losses as well as making vegetables almost available and affordable all seasons.
3. Vegetable production should be encouraged particularly in urban areas so as to overcome the problem of transportation as well as promote their availability and affordability.

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Households' Clean Energy Demand in Nigeria and Its Implication on the Environment

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ABSTRACT

Understanding the demand for clean energy in Nigeria may have an important influence on the policy of achieving a sustainable environment. Hence, the extent of clean energy use has a direct positive impact on the environment with regard to global warming inducement. This study therefore looks at the pattern and determinants of clean energy demand among households in Nigeria using GHS 2016.The data of the study was analyzed using descriptive statistics and multiple regression analysis. The results show that the demand for clean energy is low except for electricity by urban households which recorded over 50% use. Also, majority (78%) of the households were male headed with a mean age of 53 years and an average of six persons per household with a mean monthly income of ₦32, 200. About 53% of the respondents had secondary to tertiary level of education. All the variables considered in the study were found to have influence on the expenditure of clean energy at 1% level of significance. Among these variables, area of residence, household income and educational level were associated with increase in clean energy demand while age of household head and family size had negative influence on demand for clean energy. As a result of these findings, it was recommended that electricity supply should be improved by investing in solar and wind energy sources. Also,LPG use should be improved because it will play a great role in reducing the use of dirty fuelsespecially for cooking.

Keywords: *Clean Energy Household Demand Environment.*

INTRODUCTION

Clean energy are those fuel sources that create less negative externality (pollution) by emitting less amount of Green House Gases [GHG] such as Carbon-dioxide CO_2 to the atmosphere. These energy sources include wind, solar, Hydro and Geothermal sources of energy (Quaschning, 2016). In another development, clean energy is viewed more as renewable energy/technologies that have much lower contribution to global warming, and harm the environment minimally in comparison to others, is constantly replenished and will never run out (Europa, 2015). Clean energy types are very important when measured on a total fuel cycle because burning them emit lower GHG than biomass (Fuel wood and Charcoal) and fossil fuels (kerosene, petrol and diesel) used by households for cooking and lighting (Maina, 2018). Although, Liquefied Petroleum Gas [LPG] originates mainly from natural gas production; however, it is non-toxic and does not contaminate soil or aquifers in the event of a leak. In addition, it is cost-effective, since a high proportion of its energy content is converted into heat. Therefore, it can be up to five times more efficient than

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traditional fuels, resulting in less energy wastage and better use of our planet's resources (Nett technology, 2017). Clean energy sources are more environment friendly, emit the least amount of negative externality of CO_2 into the atmosphere and contribute less to indoor air pollution and health implications among women and children (Quaschning, 2016).

The most used clean energy source by households in Nigeria are electricity and LPG (Maina, Kyari & Jimme, 2019). Although solar energy power is also used by some households, due to its high cost of installation, low awareness on its advantages among its limitations when compared to electricity, its demand still remains insignificant in the country (Maina & Kyari, 2019). On the other hand, most other energy sources in Nigeria such as Fuel-wood, charcoal, petroleum, diesel and Kerosene emit a substantial amount of negative externality of CO_2 into the atmosphere resulting in more negative impact on the environment (Maina, Dantama & Kyari, 2017).

The demand for clean energy (electricity and LPG) in Nigeria is influenced by various factors such as affordability, availability, accessibility and in the case of LPG low awareness about its importance on environmental sustainability through less air pollution (Source). Furthermore, in the urban centres, demand for electricity is often limited by the epileptic nature of supply of electricity due to supply and demand imbalance (Olaleye & Akinbode, 2012; Okunede, 2011 & Olufemi *et. al.*, 2012). The demand for LPG is low in some parts of urban Nigeria like the north east region, because it is usually scarce and where it is available, it is mostly unaffordable (Maina, 2018). Meanwhile, in the rural areas of Nigeria, about 86% of the households depend solely on solid fuels (Fuelwood and Charcoal) as their source of energy. This is because most of the households are not connected to the National Electricity Grid and have little access to LPG due to absence of good road networks (Maina, 2018) as well as its relative high cost. Thus, it makes them to depend highly on alternative source of fuels that are environmentally dirty.

Household socio-economic characteristics have been observed to tend to exert influence on the demand pattern of and the expenditure on clean energy. Factors such as monthly income, family size, age of household head and rural urban dichotomy (area of residence) are found to be positively related to expenditure on energy sources (Bello, 2011; Busola & Olaniyi, 2012, Olaleye & Akinbode, 2012 and not listed). Hence, there is the need to understand the demand for clean energy and its determinants in order to inform household energy decision and their implication on the environment.

There are a lot of studies that were conducted on household energy demand or consumption in Nigeria. Among them are the study by Olaleye and Akinbode (2012) on demand for Alternative fuels in Lagos state Nigeria; Bello (2011) assessed the impact of wealth distribution on energy consumption in Gombe state. Another study (Maina *et al.*, 2017) looked at determinants of energy demand in the north east zone of Nigeria. Each of these studies dwelt on energy demand for all the sources available to households without given emphasis to whether they are clean or otherwise. Therefore, this paper bridges the gap by assessing the demand for clean energy (Electricity and LPG) and its implications on the environment. This study considers two objectives: the pattern of clean energy demand and the socio-economic characteristics of household heads and the determinants of expenditure on clean energy sources (LPG and Electricity) demanded by households in Nigeria.

METHODOLOGY

Study Area

The study was conducted in Nigeria. It lies between latitudes 4º 12′ 40.37″ N to 13º51′ 36.50 ″ N of the equator and longitudes 2º 45′ 47.735″ E to 14º42′ 55.123″ E of the Greenwich meridian. Located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa, Nigeria occupies an area of 923,768 sq. km (356,669 sq mi), extending 1,127 km (700 mi) East to West and 1,046 km (650 mi) North to South. The country has 36 states and a projected population of 214, 312, 387at the end of 2018 (National Population Commission [NPC], 2006).The study area suffers from acute shortage of electricity supply. Its energy demand far outstrips the supply (Ogunleye & Ayeni, 2012).

Secondary data set was used for the study, obtained from the database of the National Bureau of Statistics (NBS) on General Household Survey, Panel 2015-2016. A total of 5000 households were interviewed across the country. The relevant information collected in the survey include household socio-economic characteristics, information on farm, non-farm enterprise, income generating activities, food consumption expenditure, and other non-food expenditure. This paper considered only two energy sources (LPG and electricity) and six independent variables (Household income, age, sex, area of residence, household size and educational level of the household head).

Model Specification and Method of Estimation

Multiple regression analysis

In this study, multiple regression analysis was used for households that record 100% expenditure share to the use of any of the clean energy source and linear regression was chosen as the lead equation based on the coefficient of determination (R^2), the magnitude of the t-values and the significant difference. The model is specified as:

$$Y = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + U_i \text{ …….. (i)}$$

Where:

Yi	=	Household monthly expenditure on clean energy source (₦)
X_i	=	Household income(₦)
X_2	=	Age of household head (Numbers)
X_3	=	Sex of respondent(Male 1, Female 0)
X_4	=	rural/urban dichotomy (Urban 1, Rural 0)
X_5	=	Household size (Numbers)
X_6		= Educational level (Years)
U	=	Error term

A priori expectation

The coefficients of household Income, Educational level, area of residence rural and urban residence areas as classified by the GHS data and age would have positive effect while the sex of household head and family size would have a negative effect on clean energy.

RESULTS AND DISCUSSION

Pattern of Clean Energy Demand

The demand for clean energy is estimated in this study in terms of the expenditure share of the two clean energy sources among both rural and urban households. The demand for household clean energy demand is presented in Table 1 and figure 1.

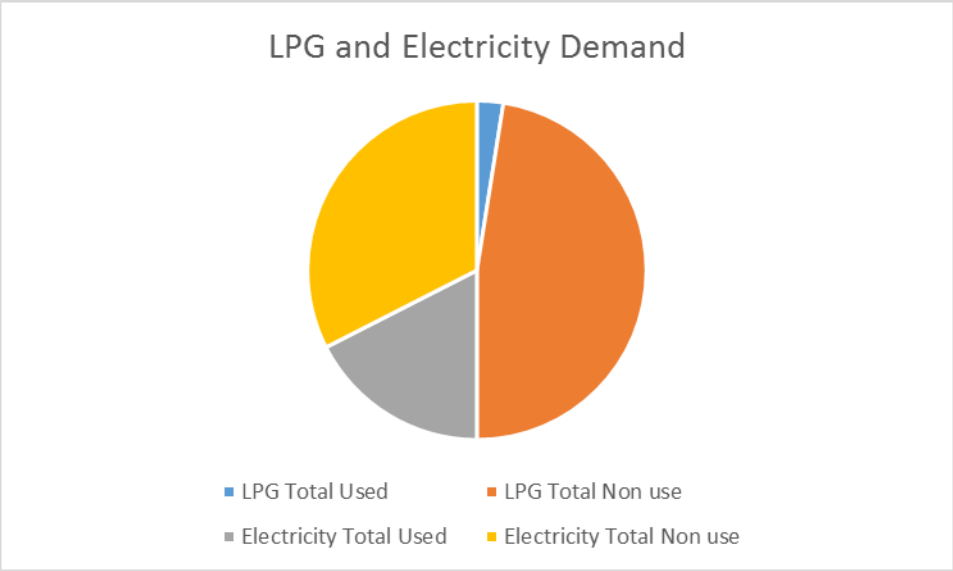
Table 1: Demand for Clean Energy Demand in Nigeria

Energy	Frequency in %
LPG Rural (Non Use)	98
LPG Urban (Non Use)	91
LPG Rural (Used)	2
LPG Urban (Used)	9
Electricity Rural (Non Use)	76
Electricity Urban (Non Use)	47
Electricity Rural (Used)	24
Electricity Urban (Used)	53

Source: Generated by Meltab from GHG 2016 data

From Table 1 it can be seen that both electricity and LPG demand were very low in rural and urban households. Among the rural households only 2% and 24% of them used the LPG and electricity respectively. Similarly, in the urban areas only 9% used LPG. The result in Table 1 also reveals that demand for electricity was more than demand for LPG in the urban areas because most of the households (53%) used electricity while 47% did not even though almost all households are connected to the national electricity grid. They use it for lighting homes and cooking. This could be justified by the fact that most households were forced to resort to the use of alternative (dirty) energy sources due to the epileptic nature of power supply in the country as opined by (Olaleye & Ainbode, 2012). Figure 1 presents a pie chart representation of the demand for clean energy in Nigeria.

Figure 1: LPG and Electricity Demand



Source: Generated by Meltab from GHG 2016 data

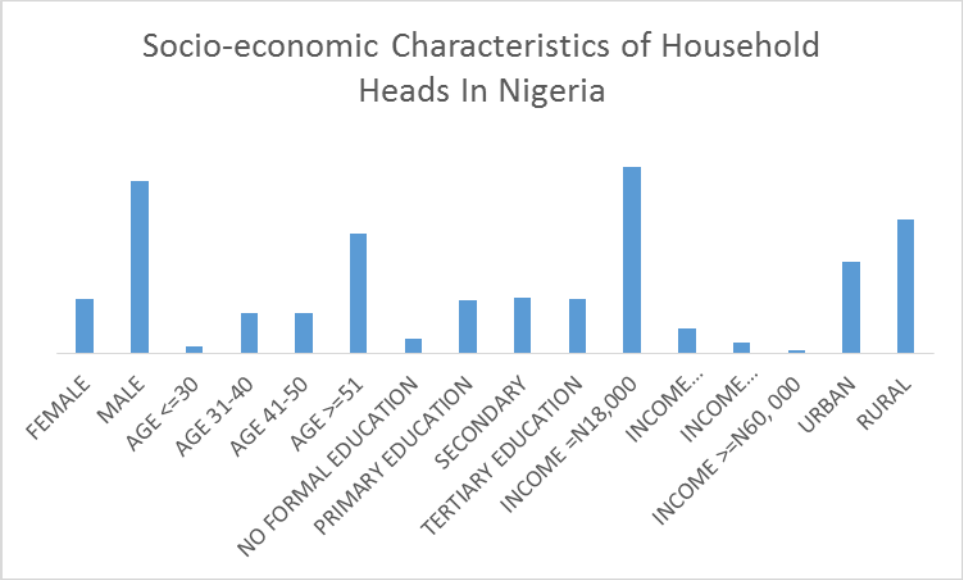
Figure 1 is the virtual presentation of clean energy demand vis a vis electricity and LPG demand in Nigeria. It can be observed that the two wide areas represent the percentages of those who did not use the energy sources with LPG having the widest of 98% and 91% for rural and urban areas respectively. These represent the percentages of the households that did not allocate any budget share to it. The two smallest areas represent the households that demanded for the two clean fuels.

These show that the demand for clean energy is very low in Nigeria which proves that the households are using other inefficient energy sources to sustain their livelihood. Thus, the implication on the environment would be detrimental and consequently affect the globe and the climate in the long run. This agrees with the findings of Kavi & Brinda (2007).

Socio-economic Characteristics of the Respondents

Previous works have shown that household socio-economic characteristics differ significantly and could influence household energy demand pattern. Figure 2 presents the socio-economic characteristics of the household heads in Nigeria.

Figure 2: Socio-economic Characteristics of Household Heads in Nigeria



Source: Generated by Meltab from GHG 2016 data

Sex of Household Head: Figure 2 shows that about 78% of the respondents were male. This implies that there is dominance of the male as household head in Nigeria. A similar classification was reported for north east region of Nigeria in the study of north east region of Nigeria by (Maina, Kaura & Kyari, 2017). The household head is often responsible for decisions on household expenditure including decision about household expenditure on energy. Furthermore, given the relative high cost of clean energy compared to cost of dirty energy, the household head would prefer to dedicate his income on inexpensive cooking fuels even if they are not clean. Thus, he would choose affordability over comfortability of the energy type even if it will have a negative implication on the environment.

Age of Household Head: The result showed that the mean age of the respondents was 53 years. Most (%) of the respondents were in the age range of 50 years and below. This falls within the range of active age identified by Food and Agricultural Organization [FAO],

(1992). This implies that the household heads could support the demand for energy either for cooking or lighting their respective homes because mostly at this age they are already married as shown by the (GHS, 2015). However, the demand for clean energy sources could be influenced by factors such as income. Thus, the type of energy used by household over the years whether clean or dirty type could have the most influenced either positive or negative on the environment.

Rural/Urban Dichotomy: The demand for clean energy could be low in both rural than urban areas. This is justified by the fact that in terms of electricity most of the rural households are not yet connected to the National Electricity Grid as opined by (Maina, Kyari & Jimme, 2019) which is also justified by figure I. While the urban centres on the other hand have low expenditure on clean energy due to demand and supply imbalance. With regards to LPG, lack of awareness on its efficiency in terms of environmental sustainability and low risk/less health implication, availability, affordability and accessibility could be the reason for its low demand (Adepoju., *et al.,* 2012).

Household Size: The result revealed that the household size with the highest frequency was between one to six persons constituting a total of 66% with an average of six persons per household. A similar range was reported by Maina, Kaura & Kyari, (2017) this could mean that the higher the household size the more the use of energy by the household in form of cooking, ironing clothes, and other appliances. However, *Ceteris Paribus* the higher the household size the more the use of cheaper fuels even if they are dirty because the more the financial burden on a household head the more he opts for cheaper energy sources that have negative implications on the environment.

Household Income: The finding in figure 2 reveals that majority (%) of the households in the study earned ₦18, 000 and below. The mean monthly income of respondents was ₦32, 200. This shows that majority of the household in Nigeria are low income earners. The result reflects the poverty status and wealth inequality situation in Nigeria. A similar report was presented by Bello (2011). Moreover, income is one of the determinants of effective demand and it is expected that the higher the income the more the demand for clean energy sources as postulated by the energy ladder model (Maina, 2018). However, the prevalence of low income among respondents implies less demand for clean energy especially LPG and therefore, more negative implication on the environment due to high demand for alternative energy sources that are dirty.

Educational level of household head: The result reveals that most of the respondents (53%) have secondary to tertiary level of education. High level of education is perceived to be generally linked with high levels of awareness. Thus, it is assumed that the more educated a household head is, the more well informed he is about the current environmental trends and the more logical he would be about his fuel choices towards achieving a sustainable environment. Education is also related to income such that people with high levels of education are likely to have higher incomes than people with low or no education.

Determinants of Clean Energy Demand

Multiple regression analysis was employed to determine the socio-economic factors influencing clean energy demand in the Nigeria. The coefficients and the significant levels are presented in the Table 2.

Table 2: Socio-economic Determinants of Clean Energy Expenditure

Variable	Coefficient	Standard error	T value	p>[t]	R^2
Constant	4.780335	.3371886	14.18	0.000*	**0.774**
Rural-urban dichotomy	.4627846	.0906047	5.26	0.000*	
Monthly Income	.4144782	.018944	21.88	0.000*	
Household size	-.3039194	.0401087	-7.58	0.000*	
Sex	-.4763712	.0906047	-5.26	0.000*	
Educational level	.2507012	.0222897	11.25	0.000*	
Age	-.6507781	.0142047	-20.87	0.000*	

Source: Generated by Meltab from GHG 2016 data

Household Monthly Income was a significant determinant of clean energy demand with regard to LPG and Electricity use at 1% level. This corresponds with the findings of (Olaleye and Akinbode, 2012). Moreover, the result is in line with the *a priori* expectation which assumes that the coefficient of income would be positive. *Ceteris paribus,* income is one of the major determinants of budget share allocation among households. Also, the coefficient of income was the highest among all the others. This indicates that the higher the income of the household heads in Nigeria the more they will spend on clean energy sources. Hence, the higher the income level, the more the demand and the lesser the use of dirty fuels by households if clean fuels are available and accessible. Invariably, this finding implies that the higher household monthly incomes are, the more sustainable the environment would be.

Age of Household Head: The coefficient of age of household head was found to be a negative influencing factor of the level of expenditure on clean energy sources significant at 1%. This is contrary to the findings of Busola & Olaniyi, 2012 who found that age of household head was positively related to expenditure on clean energy sources. Moreover, the finding is contrary to the *a priori* expectation which assumed that the coefficient of age would have positive effect on expenditure for clean fuels. This result suggests that *Ceteris paribus* the older the household head, the less the use of clean energy sources (electricity and LPG). The demand for electricity declines as household head gets older this could be because for so many years now the supply of electricity in the country has being epileptic, thus the more the years of being a household head the more the adoption of other alternative reliable energy sources. Similarly, LPG demand decreases as household head gets older. This could be justified by the fact that the older the head gets in a married household it is expected that the more the family size increases due to child birth. Hence, for convenience and less risk, household with more children would prefer other energy sources especially for cooking over LPG which is perceived to be complicated to use and requires more caution. This is in line with the findings of Olufemi, *et al.* (2012).

Sex of Household Head: was negatively related to expenditure of clean energy sources but significant at 1% level. This agrees with the *a priori* expectation which assumed that the coefficient of male household head would be negative for cleaner fuels. This is however, in contrast with the finding of Busola & Olaniyi, (2012), who found that the coefficient of expenditure for clean energy in relation to male household head was positive. The result implies that the more the household head is a male the lower the demand for clean energy. In

most households', women and children are the ones responsible for household chores including cooking and ironing clothes. However, there is the dominance of male gender as the household head in the study area as shown by figure 2. Also due to the culture and the religions of the study area as opined by Akinleye (2009), the household head is responsible for going out to purchase material needs of the family, including energy sources. Hence, he would prefer to support an energy type that is affordable not really minding whether it is a clean fuel or otherwise.

Rural-Urban Dichotomy: The result shows that rural urban dichotomy was a factor that influences clean energy expenditure in Nigeria. This is in consonance with the *a priori* expectation which assumed that the coefficient of urban area would have positive effect on the expenditure for clean energy sources. This implies that *Ceteris paribus*, households in the urban areas use more clean fuels than ones in the rural areas. This finding is contrary to that of Olufemi *et al.* (2012), who found that the coefficient of urban area has a positive effect on the expenditure for clean energy sources. The result could be justified based on Table 1, where it shows that about 53% and 9% of the urban households use electricity and LPG respectively. The reason for the low electricity demand of only (24%) by rural households could be owing to the fact that most households are not connected to the National Electricity Grid compared to the proportion of the households in the urban areas. The low demand for LPG on the other hand could be due to poor road networks to link the rural and urban centres thereby causing shortage in supply and consequently high price and low demand. This agrees with the finding of Adepoju, Oyekale & Aromolaran, (2012).

Household Size: The coefficient of household size appeared to be negative and significantly related to expenditure for clean energy. This is also contrary to the finding of Bello (2011) and to the *a priori* expectation which assumed that the coefficient of family size would have positive effect on clean energy sources. This finding suggests that all things being equal, an increase in household size would result in decrease in the expenditure for clean energy sources. The higher the household size the lower the expenditure on clean energy sources because an increase in family size would increase the need to iron more clothes, heat more water for bathing during Harmattan season and cool rooms with air conditioning appliances during hot season. Therefore, if these increases are not accompanied by increase in incomes it would result to additional financial burden. Thus, a rational consumer would switch to other affordable and convenient energy sources.

The coefficient of Educational level of the household head was significant at 1% and positively related to the expenditure for clean energy. This finding agrees with the *a priori* expectation which assumed that the coefficient of educational level of household head would have positive effect on clean energy sources. This suggests that *Ceteris paribus*, increase in the educational level of household head would increase his expenditure for clean energy sources. This could be because the more educated a household head is the more his level of awareness on the importance of the use of clean energy sources. In addition, the more the education of household heads, the greater the likelihood of higher paying jobs which could make clean energy more affordable compared to people with lower education.

CONCLUSION

This study analysed the demand for clean energy sources (LPG and Electricity) by various households in Nigeria. The results show that the demand for clean energy sources are generally low in both rural and urban households although demand for both LPG and electricity as sources of household domestic energy in the rural areas were higher than those

for urban areas. In general, the demand is low and this could place a considerable burden on the environment as demand for clean energy is replaced with the use of dirty fuels. The household heads in the study are in the most, male headed, low income literate and rural. The demand for clean energy was significantly determined by the level of education, age, household size income, sex, and either rurality or urbanism of household heads.

RECOMMENDATIONS

Based on the findings of the study, the following policies are recommended to government/ policy makers.

- Firstly, Nigerian government needs to by all means improve electricity supply. This can be achieved if the ongoing hydroelectric dams are completed. Also, there should be investment on solar and wind energy sources in the various zones where such resources are abundant in the country.

- Secondly, there is the need to improve the income level of the consumer because increase in income induces the demand for clean energy. Hence, the the welfare of the populace should be improved. Policies similar to the trader mony and N power packages that are in existence now should be considered and be sustained beyond short term targets.

- Finally, the use of LPG as a source of clean energy should be improved. This can be achieved if the governement adopts a proper policy either by given some incentives, quota or subsidizing the cost of installation or making some of the equipment reasonably affordable for households to switch to in order to encaurage the use of LPG as their major source of energy for cooking.

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Assessment of People's Awareness and Commitment toward Control of Gully Erosion along River Ngaddabul Flood Plain, Maiduguri, Nigeria

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ABSTRACT

The study assessed the awareness of people and their commitment towards the control of gully erosion along River Ngaddabul flood plain. The study assessed the people's awareness in the study area, examined the community efforts in controlling the problem and also it assessed the government efforts put in place to control the problem in the study area. Data used included both primary and secondary sources. The primary data were generated through structured questionnaire and the data obtained was analyzed using simple descriptive statistics. The results revealed that almost all the respondents were aware of the presence of the gully erosion in the study area. In addition, the study found out that 57% of the respondents were affected by the gully erosion. Furthermore, the study showed that majority (67.9%) of the respondents is not aware of any self-help effort being made by the community to tackle the menace of the gully erosion. In addition, the study noted that Government was also not making any effort towards controlling the gully erosion in the area. Hence, the study concluded that the major causes of the problem of gully erosion include both natural and anthropogenic factors via sand excavation. It was recommended that the relevant governmental and non-governmental agencies should encourage people to engage in community development practices while government also needs to construct new drainage systems and repair the collapsed ones in the study area.

Keywords: *Awareness, Commitment, Gully erosion, Control.*

INTRODUCTION

Environmental problems have lately become major topic of discussion globally, nationally and even locally due to their effect of causing destructions to human lives, property, farmland and biodiversity (Abdulfatai et *al*., 2014). There are so many environmental problems that have been identified by previous researchers such as drought, pollution, climate change, cyclone, tsunami, earth quake and many more. Similarly, in Nigeria, over 860,000 hectares of land are badly affected annually resulting in the daily loss of Farm produce due to erosion (Eze, 2007). Erosion could be defined as washing of soil from one place to another by the agent of denudation which includes wind, water and Man. This mentioned agents may work together to form one form of erosion or another.

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The type of erosion in the study area is caused by water and has the following classification: sheet, Rill, Channel and Gully erosion. Sheet erosion begins with slow and progressive removal of a thin but fairly uniform layer of topsoil from an area by flood or run-off. Rill erosion on the other hand occurs when run-off water laden with soil particles and debris erodes an area of land surface more than others (Igbokwe *et al.,* 2008). Channel erosion occurs when there is repeated rill erosion along a run-off path which creates a vertical bank not deeper than three meters (Igbokwe *et al.,* 2008) while, Gully erosion is formed whereby runoff water accumulates in narrow channels and removes considerable amount of soil from this narrow channel over a short time period (Mbaya *et al*., 2012). Thus, the precise type of erosion in the study area is the gully which is a linear deep erosion feature with active head cut, unstable side walls, subject to mass movement, and non-graded longitudinal profile with temporal water flow (Obiadi *et al.,* 2011).

Moreover, gully erosion has been identified as the major and most serious environmental problem faced in the northern part of the country due to the sandy nature of the soils which usually have low organic matter status (Mbaya, Ayuba and Abdullahi, 2012).

A similar research work was conducted by Mala et *al*. (2012) but that study assessed the problem based on the extent of physical damage caused by gully erosion. It did not look at peoples' awareness and commitment towards controlling the problem of gully erosion in the study area. This study however assessed people's awareness of gully erosion, the effect of gully erosion, and community and governmental efforts in controlling the problem of gully erosion in the study area.

METHODOLOGY

Study Area

Maiduguri, the capital of Borno State, lies between latitudes $11^0$47'00''N and $11^0$52'00''N and longitudes $13^0$4'00'' and $13^0$11'00'' E (See Fig. 1) .It is located in the Ngadda Basin, a seasonal stream that flows through Maiduguri. However, the town Maiduguri, according to NPC 2006 census official gazette, has a total population of 540, 016 and the projected population in 2019 is 630,599. Most of the people living along the floodplain are small scale farmers. Land use at the study area is characterized by permanent rain fed cultivation of grain crops such as sorghum and millet. Dry season Fadama (Market gardening) cultivation is practiced at some points, using shaduf irrigation system. Also cultivations are usually carried out right to the edge of gullies. Other land use activities include sand mining, grazing, urban house construction, garden and orchards. The climate of Maiduguri is generally semi-arid, with moderate variations in temperatures; the monthly minimum temperature is lowest (13.5^0C) during the period of strongest and most constant northeast winds (Harmattan) in December and January; and highest 24.7^0C in April. The monthly maximum temperature is highest 40.2^0C prior to and during the onset of the rains in April and the lowest 31.3^0C during the peak rained period of August (National Meteorological Office Maiduguri, 2003 - 2008).

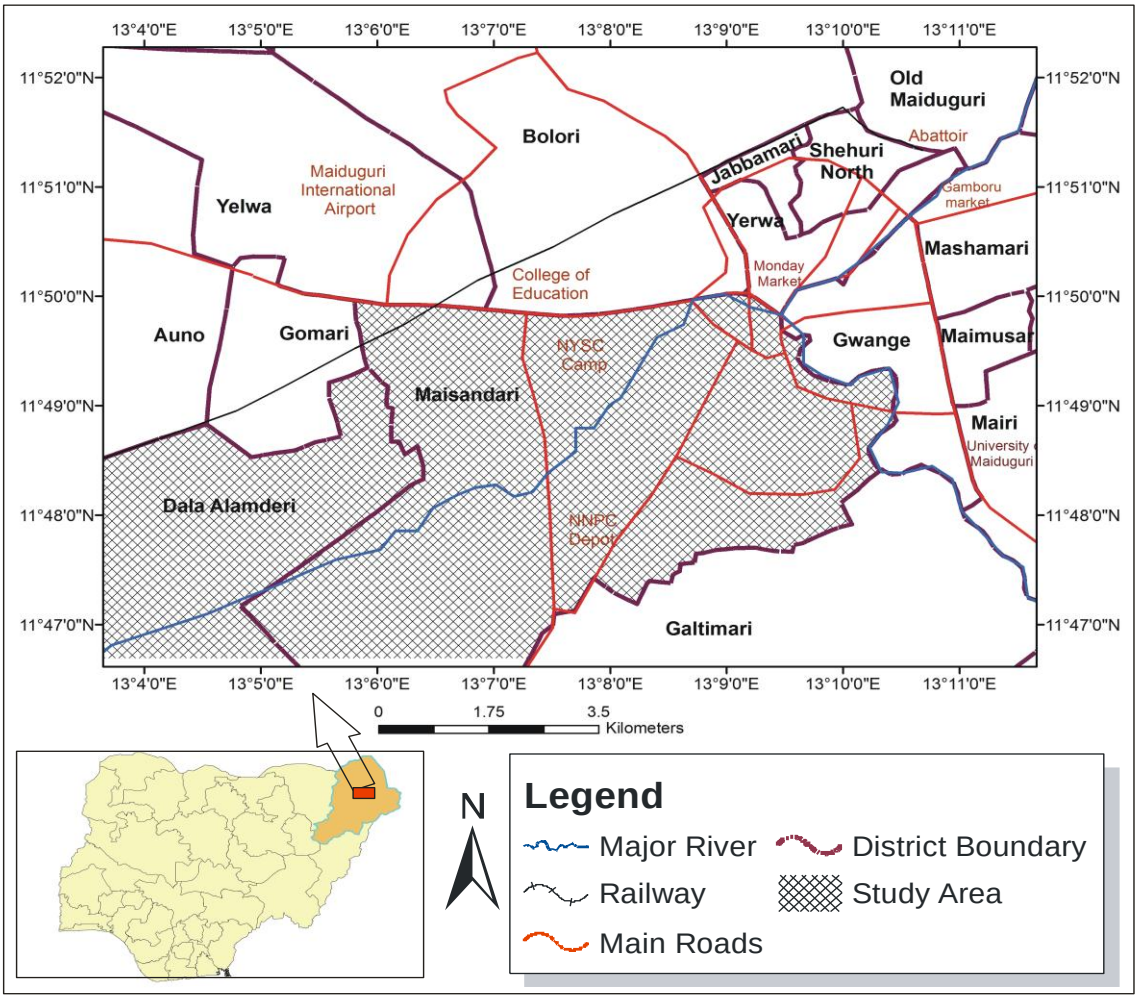


Fig 1: Map of Borno State showing Maiduguri

Source: *GIS Unit, Dept. of Geography Unimaid, 2019.*

The study used both Primary and secondary sources of data. The primary data was obtained from field survey and the instrument for data collection was a well-structured questionnaire. The results obtained were subjected to simple descriptive statistics in form of percentages presented in form of tables, graphs, bar charts and pie charts. The secondary sources of data involved the use of related literature and journals. Primary data were collected on socio-economic characteristics of the respondents, duration of their stay in the area, their awareness of gully erosion, its effects on them and the measures taken to manage the gully erosion. Data were also collected on efforts made by the community and government to manage gully erosion in the study area.

Two areas namely Dala Alamdari and Moduganari in Maisandari wards were selected purposively in Maiduguri. This is because they are the most affected areas by gully erosion. The population of the ward in the year 2019 was projected to 136,221 (NPC, 2006).

Using Krejcie and Morgans (1970) formula with 95% confidence level and 5% margin of error, data was obtained from 131 respondents in both areas. Purposive sampling technique was adopted for this research, to enable the selection of community members that are engaged in the community effort to control the gully erosion and adults that are affected by

the problem. The data collected were analyzed using statistical package for social sciences (SPSS) to obtain the descriptive statistics.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1: Level of education of the respondents in the study area

School	Frequency	Percentage
Primary	21	16.20%
Secondary	30	22.90%
Tertiary	50	38.20%
Others	30	22.70%
Total	131	100%

Source: Field Survey, 2019.

The results in Table 1 shows that all the respondents in the study area had one form of formal education or another with tertiary education (38.20%) and secondary (22.90) being the most predominant. This shows that majority of the respondents are literate in the study the area. Education is an important factor for development because it could mean high level of awareness and positive attitude to environmental development.

Table 2: Occupation of the respondents in the study area

Occupation	Frequency	Percentage
Farmer	40	30.60%
Civil servant	59.0	45.00%
Driver	21.0	16.00%
Other	11.0	8.40%
Total	131	100%

Source: Field Survey, 2019.

Table 2 reveals that the most predominant occupation among the respondents was the civil service (45.0%). it could be justified based on their literacy level because majority of them have gone to school. The majority (55%) however were farmers, drivers and those doing other kinds of occupation. This indicates that most residents were low income earners in the study area. This may limit the capacity of residents to contribute to community self-help projects.

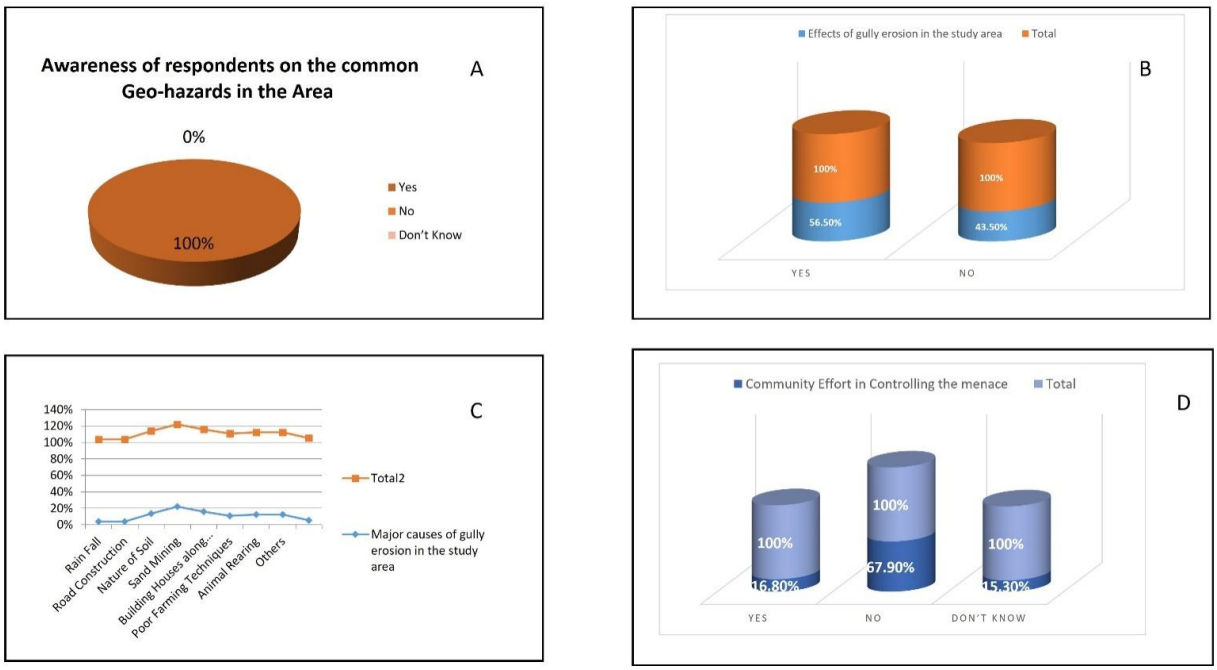
Table 3: -Duration of Stay of the Respondents in the study area

Duration	Frequency	Percentage
1 – 5	11.0	8.40%
5 – 10	20.0	15.30%
10 – 15	22.0	16.80%
15 – above	78	59.50%
Total	131	100%

Source: Field Survey, 2019.

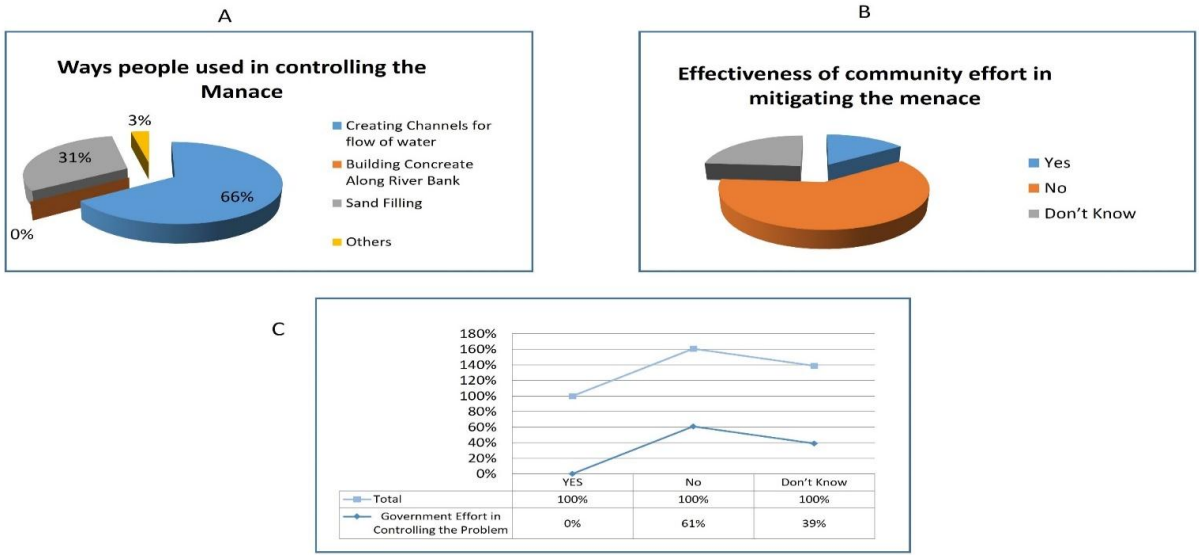
Table 3 shows that the duration of stay of the respondents varies but majority (76%) of the respondents have been staying in the area for over 10 years. This implies that most of the respondents were aware of the menace of gully erosion in the area.

Awareness of the Respondents about the Menace of Gully Erosion in the study Area



Source: Field Survey, 2019.

Figure1**A** shows that all the respondents were aware of the presence of gully erosion in the study area. The presence of the gully erosion in the study area cannot be denied whether the respondents are affected or not because is something that can be physically seen (Visible). Figure 1**B** outlined the views of the respondents on whether or not they were affected by the problem of the gully erosion. Based on the study it was found out that majority (56.5%) of the respondents were affected by menace of gully erosion. This outcome agreed with the work of Mala *et al.* (2012). Furthermore figure 1 **C** revealed that sand mining (sand excavation) is the major anthropogenic factor that leads to occurrence of the gully erosion in the study area. Majority of the respondent reported that sand mining was among the major causes. This was closely followed by nature of the soil and building along water ways. Sand excavation is commonly practiced in the area as a means of earning extra income. Over exploitation of resources without land management alters the ecology of the area resulting in phenomena like gully erosion. This agrees with the finding of Mngeni et al. (2016) which asserted that sand mining activities are mostly deemed to be unsustainable not only because they exploit resources, but also because they destroy the environment and society and leave impacts that are irreversible. Figure 1**D** represents the level of awareness by the respondents on the efforts made by the communities towards averting/controlling gullies in the study area. Majority (67.9%) of the respondents revelled that they were not aware of any effort made by their community to control the menace.



Source: Field Survey, 2019.

Figure 2**A** presents views of the respondents that said community is making efforts towards controlling gullies in their area. Majority of the respondents reported that much of the community developmental program is channelled towards creating ways for free flow of water such as emptying drainage system. This involves clearing refuse dumped inappropriately in the water ways. Only 10% reported that sand filling was a measure taken by the community members to control gullies in the area. The reasons could also be like that of individual efforts, most capital intensive projects could not be embarked by communities because of cost. This research agreed with the observation of Oladimaje *et al*. (2017). Figure 2**B** shows the views of the people residing within the study area on the effectiveness of the efforts put in place to control the menace of gully erosion. Majority of the respondents (61.0%) reported that the efforts made by the community are not effective while 31% were undecided. Only 20 % were of the opinion that the community self-help efforts were working. Thus, perhaps the little efforts made were not enough to make a huge difference. Furthermore, Figure 2**C** shows that about 61% of respondents reported that government was not making any effort to control the impact of gully erosion in the area.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the study found out that majority of the residents are aware of the presence of gully erosion in the area. This is mostly as a result of both natural and anthropogenic factors (human impact) via continuous mining sand in the area. Although most the people residing in the area are being affected by the problem of the gully erosion, neither the community nor the government is making much effort to tackle the menace in the study area.

Based on the findings of the study, the following recommendations were proffered: Firstly, community leaders should encourage residents to engage in community development practices so that they will contribute to tacking the problem by themselves. In addition, relevant government agencies should enlighten citizens on environmental best practice so as to reduce the incidence acts such as sand excavation. Government should construct an effective drainage system to enable free flow of water within the drainage system. Government should also eradicate poverty by creating more job opportunities for citizens in order to reduce their over dependence on environmentally unfriendly activities like sand excavation as a business in the area.

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Challenges of Agricultural Statistics and Database Management in Kogi State, Nigeria

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ABSTRACT

The paper investigated the challenges of agro-data statistics and database management in Kogi State, Nigeria. The various constraints in agro-data management were examined. Questionnaire and interview schedule were used to obtain information from 180 farmers and 30 extension agents proportionately and randomly selected from three Local Government Areas in Kogi State. The collected data was analyzed using Likert scale, charts and percentage. The results reveal that farmer and institution related problems are the types of constraints facing agricultural data collection and processing in Nigeria. The farmer related constraints include: illiteracy/lack of skills, motivation requirement to give information, uneasiness of the farmer to disclose information and fear of taxation with weighted average of 4.7, 4.5, 3.6 and 3.0 respectively. The institution related constraints include: underdevelopment of agriculture, lack of government personnel and unenforced company tax on cooperate farms with weighted average of 3.9, 3.8 and 3.3 respectively. These constraints made collection of agro-data difficult and statistics inaccurate and unreliable. However, there were prospects for overcoming the challenges with increase in budgetary allocation and training of personnel of extension services. It was recommended that the extension contacts of the farmers should be increased, farmers should be involved in the planning stage of farm survey, and free farm record books might be given to the farmers, statistical officers and enumerators should be trained and re-trained and logistics and infrastructure be provided.

Keywords: *Agro-database, Agricultural statistics, Farmers' related Constraints and Institutional Constraints.*

INTRODUCTION

Agriculture sector is a central key to the national food security and welfare of the majority of the Nigerians. It is a major driver of economic growth in Nigeria (Igwe *et al.*, 2013). It contributes about 42.07% to her GDP (FAO, 2011; Simpa and Peter, 2015). It plays a critical function in the alleviation of poverty among low-income people. Based on these indispensable roles play by agriculture in Nigeria, adequate and reliable data on agro-food are of necessity for policy makers and agricultural promotion.

Despite the importance of agricultural data production, Nigeria has not conducted a conclusive agricultural census in the last three decades (FAO, 2011). The results of some survey-census exercises were not analyzed while another attempt ended at the pilot stage; thus resulting in agricultural data gap. The federal and state governments' counterpart funding for the exercise was not released even after donor agencies and development partners had redeemed theirs (FAO, 2011).

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The key objectives of the agricultural survey include: collection of relevant statistics to compute the contribution of agriculture to the production of GDP, for use of institutions and agencies within and outside the country, for farm planning and organization, planning agricultural extension services, appraisal and evaluation of agricultural projects, government budgetary policies, preparation of food balance sheet, agricultural production forecasting and pricing policy (Adegeye with Dittoh, 1985; Reddy et. al., 2008). Agricultural statistics such as institutional data, price data, production data, government expenditure, and import and export data are useful for research, development and investment. Agro-food data helps to monitor some of the government policies in food security programmes. Therefore, agricultural data should be relevant, reliable, consistent and easy to be interpreted and understood.

However, agricultural sector is fraught with serious data problems (Oladuni, 2015). Agricultural policy formulations are drawn from the scanty available statistics (FAO, 2011). Agricultural statistics ranks very low among government commitments and thus National Statistical System has been poorly resourced in that direction (Oladuni, 2015). Also, farmers do not appreciate the role of farm survey and agriculture activities are not properly captured leading to non-availability of reliable data (Oladuni, 2015; Adegeye and Dittoh 1985). The peculiarities of agricultural data production, especially with reference to scope, geographical coverage, cost, the need for regular farmer-enumerator interaction and multiplicity of participating agencies makes it a difficult task. Again, some of the data problems result from method of collection. Therefore, unavailability of accurate data makes research a guess work (Reddy *et. al*., 2008). More importantly, structures such as National Bureau of Statistics (NBS) and Agricultural Data Bank Project of Federal Ministry Agriculture and Natural Resources that are involved in the Agricultural Data Management in Nigeria (collection and processing of agricultural data) are not active for lack of funding (FAO, 2011).

The National Bureau of Statistics (NBS) which was established in 2004 is the apex statistical body in Nigeria responsible for implementation of all statistical activities under the National Statistical System (NSS) and in particular ensures data storage, output processing, direct access and retrieval from database. The various bodies under NSS produce various data according to diverse numbers of products such as tree and arable crops, forestry, livestock and fisheries, which are usually regional and climatic specific. The generated data through surveys and censuses can be classified into basic data, current data and survey data (Adegeye and Dittoh, 1985).

Nigeria's crops and livestock data are characterised by un-timeliness, incompleteness (space- and time-wise) and absence of information on reliability of estimates (Oladuni, 2016). Data timeliness and punctuality are still challenges to the Nigerian statistical system (Adegeye and Dittoh, 1985, NBS, 2015). The agro-food data collection system in Nigeria is uncoordinated and weak due to duplication of mandates, poor funding, lack of equipment and physical infrastructure, as well as few and poorly motivated personnel. The consequence is that the system could not sustain regular surveys and therefore unable to produce reliable, complete, consistent and timely statistics to meet the needs and expectations of the users. And data generated from such process is not detailed enough to be useful (Oladuni, 2015).

The problems which affect the production of crops and livestock data in the country can be grouped into those resulting from resource limitations as well as from methodological and non-response problems. In Nigeria, data production is yet to be recognised as a costly venture. Every agency involved in production of crops and livestock data are inadequately

funded. They also lack resources, especially vehicles and equipment (NBS, 2015). Also, the interval between data production, data release and the effective date of dissemination varies significantly. The reason is that the conduct of agricultural surveys is not regulated, but subject to availability of funds. The delay of three to four years in publishing results of data collected is partly due to these problems (FAO, 2011).

Due to some weaknesses in the National Statistical System and the poor implementation of the NSDS, many organizations are known to embark on agricultural data collection exercises and come up with varying data sets on similar subjects. Much of the State-based data on crops and livestock are published with numerous blank cells for several years (NBS, 2015). This makes nonsense of any national aggregate that may be computed for the reporting States. Most of the estimates of parameters such as production, area, yield obtained from surveys and censuses have no standard errors and the reliability of such estimates cannot be assessed (FAO, 2011).These are some of the problems which render some estimates of key parameters for example; crop yields, inconsistent with peer country data, and compel international agencies to search for non-domestic sources. Data producers lack the culture of properly documenting the methods and procedures leading to the generation of their data. Data production should be user focused (Carkner, 2000). Generally, users appreciate data that are reliable, consistent, complete, timely and sufficiently disaggregated. Therefore, the objectives of this paper are: to investigate the farmer and institution related challenges facing agricultural data collection and processing in Nigeria and prospects of building a reliable database for agriculture.

METHODOLOGY

The Study Area

Kogi State, has a population of 3,314,043 (NPC, 2006). The State is located between latitude 6º30'N and 8º30'N of equator and longitude 5º51'E and 8º00'E of Greenwich Meridian. It has an area of 30,554.74 square kilometres (Simpa, 2014; KOSEEDS, 2004). The state has two main seasons, viz; rainy season (March to October) and dry season (November to February). The state is regarded as confluence state and found in the Guinea forest-savanna ecological zone of Nigeria. Kogi State is bordered by other states as follows: to the North East by Nasarawa State, East by Benue State, South East by Enugu State, South by Anambra State, West by Ondo and Ekiti States, North East by Kwara State and North by Niger State and Federal Capital Territory, Abuja (Simpa, 2014). Kogi State has an average of 172,000 farm families. Over 70% of this population live in rural areas and engage in agricultural production (Simpa, 2014; Kogi ADP, 1995). The farmers produce arable and tree crops and rear animals of various breeds.

Data were collected from 180 farmers and 30 extension agents. The respondents were purposively selected from Adavi, Okene and Okehi Local Government Areas (LGAs) in Kogi State because of preponderance of farmers in these areas. A multi-stage random sampling technique was used for the selection of the respondents. Questionnaire and interview schedule were the instruments used for data collection. Thirty (30) respondents each were randomly selected from six farm centres from the three selected LGAs. The selected farm centres were Osara and Irepeni, Ogunda and Achoze and Utoro and Abobo from Adavi, Okene and Okehi respectively. Ten (10) extension agents each were randomly selected from the headquarters of each LGA. The analytical technique used for the data collected on farmer and institution related constraints of agricultural data collection and processing was descriptive statistic (frequencies, percentages and likert scale type).

Likert scale degree: very important = 5 points, important = 4 points, undecided = 3 points, not important =2 points and not very important = 1 point.

$$Total\ Weighted\ score = \sum X1W1 + X2W2 + X3W3 + X4W4 + X5W5 - - - -(i)$$

$$Weighted\ mean = \frac{total\ weigted\ score}{N} -(ii)$$

$$Critical\ mean = \frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.0 - - - - - - - - - - - - - - -(iii)$$

Where; X = no of respondents, W = no of ranks, N = total number of sample.

RESULTS AND DISCUSSION

Socio-economic-educational Characteristics of the Respondents

Table 1: Socio-economic-educational characteristics of respondents

Variables	Frequency	Percentage	Variables	Frequency	Percentage
Farmers			**Extension Agents**		
Formal education			**Formal education level**		
No education	70	38.9	O'level	5	16.7
Primary	50	27.8	OND	15	50.0
Secondary	35	19.4	HND	8	26.6
Tertiary	25	13.9	First degree	2	6.7
Total	**180**	**100**	**Total**	**30**	**100**
Mean	6.0		**Mean**		
			Mean		
Farming experience (years)			**Years of experience**		
<10 years	42	23.3	<10 years	10	33.3
11 -20	74	41.1	11 -20	14	46.7
>20	64	35.6	>20	6	20.0
Total	**180**	**100**	**Total**	**30**	**100**
Mean	16.7		**Mean**	14.2	
Extension contact			**Seminar Attendance (at least once a year)**		
0 – 1	120	66.7	**Yes**	4	13.3
2 – 3	45	25.0	**NO**	26	86.7
< 3	15	8.3	**Total**	**30**	**100**
Total	**180**	**100**			
Mean	0.9				

Source: *Field Survey, 2015.*

Most of the farmer respondents as shown in Table 1 had no formal education (38%) and few had primary (27%) and secondary (19.4%). This may influence the nature and accuracy of records kept by them which is one of the fundamental issues in agricultural data collection. This confirms the assertion of FAO (2015) that training personnel on data collection is very

necessary as farmers are not educated and kept no record. More than 76% of the farmers had more than 10 years of farming experience which shows that they may be knowledgeable in the data they gave to the enumerators in the course of this study. The farmers' extension contact was poor; about 68.7% of them had one or less contact throughout a farming season. This conforms to the findings of Simpa (2011) and Nwaru *et al.* (2011).

Eighty-three percent of the respondent extension agents had OND certificate and above with about 17% holding school certificate. This shows that they are educated enough to give enlightened responses in the course of the study. Sixty-eight percent of the extension agents had more than 10 years of working experience although about 87% of them had not attended any seminar in the past one year. This indicates that these extension agents though quite knowledgeable might not be informed about the most current issues in agriculture and so, may not be able to relate with farmers beyond their previous knowledge.

Farmer Related Constraints to Agricultural Data Production and Statistics

Table 2: Farmers' Related Constraints to Agricultural Data Production and Statistics

Likert items	**No of Respondents**	**Weighted score** (X)	**Weighted Average**	**Remark**
Illiteracy/lack of skills	180	860	4.7	1st **
Motivation required to give information	180	820	4.5	2nd **
uneasiness of the farmers to disclose information	180	655	3.6	3rd **
Fear of taxation	180	540	3.0	4th *
Lack of farm records	180	520	2.8	5th *
Fear of enemy	180	460	2.5	6th *
Small scattered farm plots	180	380	2.1	7th *
Total (X)		**5415**		
Average of weighted score (all)		**601.7**		
Standard Deviation		**2701.7**		
Max		**860**		
Min		**380**		
Critical mean				≥3.0 =** <3.0 =*

Source: *Field Survey, 2015*, **Accepted as a serious constraint, *Not a serious constraint.

Table 2 shows the constraints facing agro-data collection as enumerated by the farmers. The individual weighted averages obtained from the weighted scores were used to rank the problems of data collection. The overall weighted mean was 601.7, standard deviation of 2701.7 and maximum and minimum scores of 860 and 380 respectively. This overall result shows the institution related constraints are important in data management in Nigeria generally and in study area in particular.

The serious constraints are ones with average weighted mean equal or greater than the critical mean of 3.0. The unserious constraints have average weighted mean of less than 3.0.

For the ranking; illiteracy and lack of skills was ranked 1st with weighted mean of 4.7; implying that this constraint was the most prominent among all the constraints considered?

Lack of formal education and skills in record keeping affect the accuracy of the data produced by illiterate rural farmers who are the key players in Nigerian agriculture (Stock, 2009; Simpa and Peter, 2015). This implies that the agro-data collected from farmers are doubtful and this would affect the aggregate of Nigeria's agro-food data which are used in policy formulation and decision making. This would invariably affect the quality of Government agricultural policies.

Farmers' quest for motivation before giving out their farm data was ranked 2nd. The popular jargon of; 'nothing goes for nothing;' is usually applied and more so; they strongly feel that the enumerators stand to gain from the information received from farmers and as such, farmers request for their own share. Therefore, in a situation where the enumerators are not able to afford any form of inducement, they get poor attention of the farmers and invariably poor information.

Uneasiness of Nigerian small-scale farmers to disclose information to agro-data enumerators was ranked 3rd. The farmer does not see the need to disclose data concerning his farm to a third party. This again affects the aggregate data collected (FAO, 2011). This too affects the quality of data collected and invariably statistics derived from them. This conforms to the finding of Oladuni, (2015).

Fear of taxation or similar implications that could result from volunteering information by farmers. This affects the quantity and veracity of information disclosed by farmers who sometimes believe that the purpose of all agricultural surveys is to gather information for taxing farmers. This makes insecure and dishonest farmers conceal information in a bid to save themselves from imagined high taxes. This is similar to the observation of Carkner (2000). This constraint was ranked 4th.

Lack of farm records was ranked 5th. Majority of the farmers did not keep written records and as such, they depended on their mental recalling ability whenever data was required from them (Oladuni, (2015; Adegeye and Dittoh, 1985). This also affects the quality of the information collected from farmers for agricultural database.

Fear of enemy by the farmers was ranked 6th. The farmer fears that if he discloses information about his farm, rivals and enemies may out of envy use the information against him. This results in an incomplete disclosure of information by the farmers.

The problem of scattered farm plots was ranked 7th. The farmers' plots are often small and scattered over places and thus making farm data collection tiresome and cumbersome. This results in scanty information and guess work.

Institution Related Constraints Facing Agricultural Data Production and Statistics Collected from the Extension Agents

Table 3: Institutional Related Constraints Facing Agricultural Data Production and Statistics

Likert items	**No of Respondents**	**Weighted score (X)**	**Weighted Average**	**Remark**
Under development of agriculture	30	126	4.2	1st **
Lack of government trained personnel	30	124	4.1	2nd **
Unenforced company taxes on farm firms (corporate farm)	30	119	3.9	3rd **
Inadequate extension programmes	30	115	3.8	4th **
Lack of facilities from banks.	30	100	3.3	5th **
Lack of association of farm managers	30	88	2.9	6th *
Inefficient marketing systems	30	86	2.8	7th *
Farm record books are expensive	30	76	2.5	8th *
Unregistered farms	30	70	2.3	9th *
Total (X)		**904**		
Average of weighted score (all)		**100.4**		
Standard Deviation		**466.1**		
Max		**126**		
Min		**70**		
Critical mean			3.0	≥3.0 =** <3.0 =*

Source: *Field Survey, 2015*, **Accepted as a serious constraint, *Not a serious constraint.

Table 3 is a Likert scaled and ranked using the individual weighted averages of the weighted scores of institution respondents. The overall average of the weighted score was 100.4, with standard deviation of 466.1 and maximum and minimum scores of 126 and 70 respectively. This overall result shows the institution related constraints are important in data management in Nigeria generally and in study area in particular.

Underdevelopment of agriculture, which means inability of Nigerian farmers to adopt modern scientific methods which invariably affect record keeping and attitude towards farm data. The farmers are have not progressed technologically. This was ranked 1st among all the variables and this shows its significance as a constraints.

Lack of government trained personnel in agro-data collection and production was ranked 2nd. Personnel that are involved both in data collection and processing are not usually well trained and this affects the quality of data collection, processing and management.

Unenforced company tax on farm firm (corporate farms) was ranked 3rd. If farms are taxed based on their output, the farmers would be forced to keep records to determine or for calculation of appropriate income tax. Without appropriate records the farmers might be under evaluated and assessed in tax payment.

Inadequacy of extension programme in educating farmers about how farm data affects agricultural statistics and it was ranked 4th. The extension programmes would have been avenues for training and educating farmers on the importance of farm data and agricultural statistic in general and how to keep farm records.

Lack of facilities from banks does not motivate the farmers to keep records. It was ranked 5th. One of the functions of records kept by farmers is to aid farmers in securing loans from

banks. Therefore, as farmers are not able to secure loans from banks, they are not motivated to keep farm records for that purpose. If banks were to inspect their records and give them loan, the farmers would have known the importance of farm data and then keep them accordingly.

Lack of association of farm managers was ranked 6th. Through association, members would have been motivating and influencing each other to keep accurate record and disclose them when demanded. This makes agricultural data unavailability.

Inefficient marketing system of agricultural product also affects agro-data and this ranked 7th. Efficient marketing system would have kept the record of all products that pass through it, but this is not obtainable in Nigerian agricultural marketing system. Therefore, this contributes to unavailability of accurate and reliable agricultural data.

Farm record books are expensive and this was ranked 8th. Some farmers could not afford the record books for record keeping. This discourages them from keeping farm records.

Unregistered farms was ranked 9th. Nigerian farms are not registered and as such they could not be easily traced for data collection. The unregistered small and scattered farms found all over the rural and remote areas make data collection difficult, tiresome, demanding in terms of time and capital intensive (Simpa, 2014).

Prospects of Agro-data Production and Statistics in Nigeria

Figure I depicts the factors that can result in accurate, consistent and reliable data management in Nigeria. The factors were listed on the questionnaire and respondents were allowed to make multiple choices and these were reduced to percentages and charted as shown below. All the factors were important, but increase in budgetary allocation to the course of farm data production, involvement of the farmers at the planning stage, provision of logistics, provision of infrastructure and farmers' education took the lead.

If the collected data are true representative of farm data, the result of processed data would be accurate and lead to a better agricultural policy formulation.

Farm records as part of the school curriculum would lead to a greater awareness of the importance of farm records and agricultural data right from secondary school level.

Distribution of free farm record books would provide enable environment for the farmers to keep records. It would motivate farmers to keep farm records. This would also make farm record keeping easier and less expensive.

Participation and involvement of farmers in the planning of agricultural data collection would make the agencies that are responsible for data collection to gain the confidence of the farmers even before going to the field work. This would make the farmers to be involved in data collection process and thus ask fewer questions and become less sceptical. The farmers would be happy that they are recognized and therefore, they would be ready to disclose accurate information.

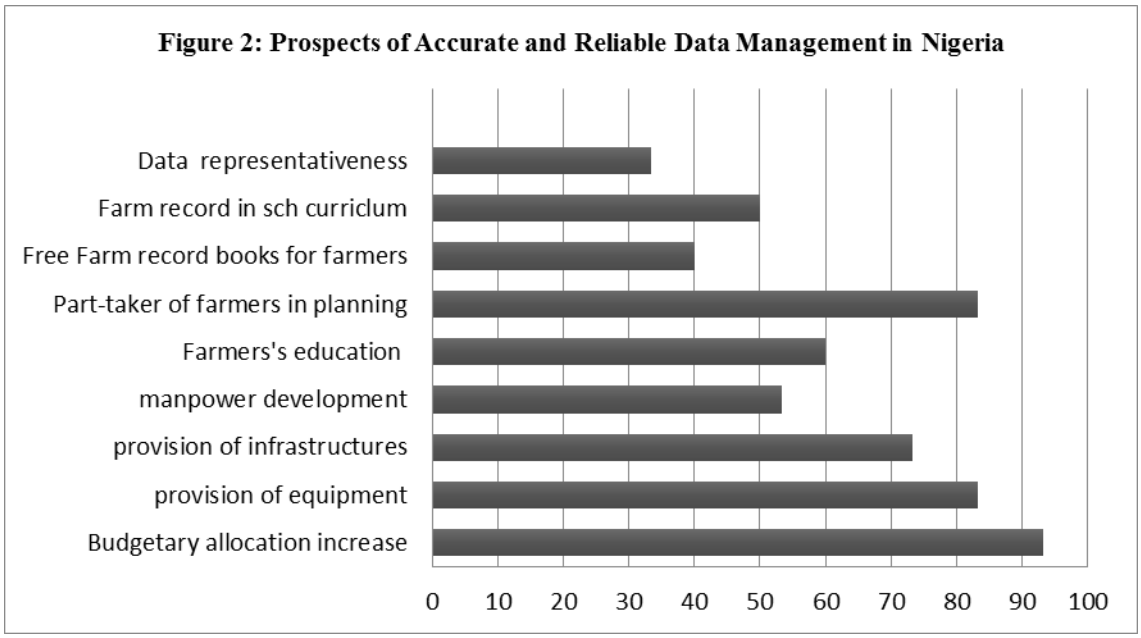
Formal and informal education of the farmers would make them to be enlightened about the purpose of data collection and use of data and they would no longer be sceptical about field officers or the enumerators or the use of the data being collected.

Agricultural and statistical man power development would lead to improvement in the process of data collection and processing. This would improve the efficiency of the workers that are involved in the collection and processing of data. The data generated and processed by empowered staff would be more accurate and reliable and more user friendly.

Provision of equipment for the purpose of data collection and processing would make the processes efficient. Lack of adequate equipment for data collection and processing is always a problem facing farmers and agricultural data enumerators and processors.

Provision of infrastructures like roads, electricity, and portable water in the rural areas where the farmers are settled would make agricultural data collection field officers to settle in rural areas and do their work with all zeal. More people would be willing to settle in rural areas and do their work more efficiently. This would lead to a more reliable and accurate data.

Improved budgetary allocation to agricultural sector and invariably to data collection and processing would lead to a more reliable data being collected and processed. Funding is always a problem to agricultural sector and data collection and processing in particular. The field officers would be motivated to put in their best in data collection. All the necessary equipments would be provided and fringe benefits provided for the staff. All these would lead to a more accurate and reliable data.



Source: Field survey, 2015.

CONCLUSION

The study examined the challenges facing agricultural data collection and processing in Nigeria. The respondents of this study were well experienced but had poor extension contact. Agricultural data management in Nigeria faces farmer related constraints (such as illiteracy, lack of skills and uneasiness to disclose information) and institution related constraints (such as under development of agriculture, lack of trained personnel and inadequate extension programmes). However, these problems are surmountable with increased budgetary allocation to the bodies that are saddled with the responsibility of agro-data collection and processing; involvement of the farmers at the planning stage and provision of equipment and infrastructure.

RECOMMENDATIONS

- Extension contacts of the farmers should be increased in order to educate farmers on the need for accurate record keeping and disclosure of same for reliable data collection and production.
- Farmers should be involved in the planning stage of farm survey so that they would cooperate with the enumerators for reliable data collection.
- Free farm record books might be given to the farmers to encourage them to keep records.
- Statistical officers and enumerators should be well trained for effective data collection.
- The government should increase the budgetary allocation to the Statistical Units for effective data management.
- The government should provide equipment and other basic logistics support for adequate coverage and supervision of data collection.

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Socio-Economic Determinants of Household Dirty Energy Use in Nigeria

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ABSTRACT

The issue of climate change has gone beyond the boundaries of science and environmentalism to involve both economists and political scientists as the policymakers. Moreover, as environmental economists, one of our roles is to examine our contribution to this negative externality through our unsustainable energy use in order to proffer ways to curb it. This study analyzed the major energy used by households in Nigeria and their implication on the environment based on two objectives. It identified the patterns of energy sources used by households and analysed their determinants. The study utilized descriptive statistics (bar chart) and multiple regression analysis using General Household Survey data by NBS. The results showed that most of the energy sources used by households in Nigeria for cooking and lighting homes are dirty with the most common energy used as kerosene 31%, Petrol 21%, Fuelwood 30% and Charcoal. The results further revealed that increase in income, educational level and having a female as a household head were associated with less dirty energy use, where increase in family size and age are associated with high dirty fuel use. Finally, policies to improve awareness on the impact of the use of dirty energy sources on the environment and the health implications are recommended. Also, there is the need to improve income level of the consumers and the supply of clean energy sources by making them more available and affordable.

Keywords: *Household, Dirty, Energy, Use, Nigeria.*

INTRODUCTION

Nigeria is well endowed with natural resources such as abundant solar radiation, wind, water (hydro) and crude oil in the various geo-political zones of the country. These resources are however underutilised towards generating environmental sustainable fuel sources such as electricity and Liquefied Petroleum Gas (LPG), thus, influencing the pattern of household energy used in the country negatively (Maina, Kyari and Jimme, 2019).

Moreover, the various energy sources used by households are categorised into two, clean and dirty. Clean energy sources are identified as Liquefied Petroleum Gas (LPG) and electricity generated through hydro, solar and wind and other renewable energy sources that are constantly replenished. These energy sources have very low composition of the negative externality of Carbon-dioxide (CO_2) which has much negative impact on the environment (Maina, 2018).

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Dirty energy sources on the other hand, include all forms of fossil fuels such as coal, oil, natural gas that cause a serious damage to the environment and to the planet in general (Greenpeace, 2016). Moreover, these fuels when burn release harmful greenhouse gases, mostly in form of CO_2 which accelerates the Climate Change (CC) impact (James & Alhaji, 2017). Unlike renewable energy sources which can in certain situations cause some environmental damage, fossil fuel burning always causes environmental damage (Ciolkosz & Wallace, 2011).

In addition to fossils, solid fuels such as fuel wood and charcoal also contribute to global warming. Although it is relatively less discussed aspect because they are considered as "carbon neutral" i.e., the carbon released into the atmosphere through burning of these fuels is considered to be recaptured during the growth of the biomass (Kavi & Brinda, 2007). However, in Nigeria trees are been indiscriminately cut down without replacement which has resulted to high rate of deforestation and desertification. Moreover, the country is now losing about 350,000 to 400,000 hectares of land per year, which consequently results to high concentration of CO_2 in the atmosphere (Food and Agricultural Organization [FAO], 2016).In addition, charcoal has the highest composition of CO_2, it is about 70% pure carbon (United States, Environmental and Protection Agency [EPA], 2013).Thus, it is regarded as the dirtiest fuel if used in large quantities because it would emit the most CO_2 per kg than other fuel types (Maina, Dantama & Kyari, 2017).

Due to the acute electricity supply and a low demand for LPG because of high installation cost in Nigeria, the household sector has been forced to rely heavily on alternative energy sources for lighting homes, cooking and for other household uses (Maina, 2018). Consequently, causing a considerable burden on the environment especially because the country's population is very high which is currently projected to increase to 213, 312,387 by the end of 2019 (National Population commission, 2006). Towards this end, it has become of paramount importance for the pattern of energy sources used by households in Nigeria to be examined for efficient resource utilisation to curb CC.

A lot of research works have been conducted on household energy demand/ to mention but a few is a study by Olaleye and Akinbode (2012) which was on demand for alternative energy sources in Lagos. Onyekuru and Eboh (2011) looked at the determinants of rural household energy demand in Enugu, while Maina *et al*. (2017) looked at determinants of household energy demand in the north-eastern region of Nigeria. Each of these studies dwelt on energy use without categorising them as dirty or clean fuels. Also, the studies were on a particular region, state or local government. Therefore, this paper is limited to dirty energy sources only and will therefore, bridge a gap by assessing two objectives: The pattern of fuel use and their determinants in Nigeria's household sector.

METHODOLOGY

Study Area

The study area is Nigeria, it lies between latitudes4º 12′ 40.37″ N to 13º51′ 36.50 ″ N of the equator and longitudes 2º 45′ 47.735″ E to 14º42′ 55.123″ E of the Greenwich meridian. Located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa, Nigeria occupies an area of 923,768 sq. km (356,669 sq mi), extending 1,127 km (700 mi) East to West and 1,046 km (650 mi) North to South. The country is made up of 36 states and had a combined projected population of 214, 312, 387 as at the end of 2018 (NPC, 2006).The study area is characterized by widespread use of dirty energy sources with majority (86%) of the

rural households relying on fuelwood and dungs as their major sources of energy while the urban households use biomass, kerosene and petrol (Ogunniyi *et al.*, 2012 & Olaleye & Akinbode, 2012).

Data Type and Variables

Secondary data obtained from the database of the National Bureau of Statistics (NBS) on the General Household Survey, Panel 2015-2016 was used for the study. Secondary data set was used for the study, obtained from the database of the National Bureau of Statistics (NBS) on General Household Survey, Panel 2015-2016. A total of 5000 households were interviewed across the country. The relevant information collected in the survey include household socio-economic characteristics, information on farm, non-farm enterprise, income generating activities, food consumption expenditure, and other non-food expenditure. Table 1, presents how each of the variables is measured based on each household.

Table 1: Data Type and Variables Measurements

Variables	Measurement
Dependent Variable	Household monthly expenditure on dirty fuel types (₦)
Household monthly income	Household Monthly income is proxied by total household monthly expenditure (₦).
Household size	The variable is measured as the total number of individuals dwelling in the same house and sharing meals together.
Age	This variable is measured in years as the total number of years since the person was born.
Sex	Sex of respondent is a binary variable representing a value of 1 for male and 0 for female.
Educational level	The variable is measured by the total number of years spent in formal education

Model Specification and Method of Estimation

Multiple regression analysis

For this study (objective 2), only the four dirty energy sources used by households i.e. (Charcoal, Fuelwood, Kerosene and Petrol) were considered to capture the determinants of dirty energy sources, while diesel was dropped due to inadequate data. Also, LPG and electricity being clean energy sources were also excluded from the analysis. Hence, multiple regression analysis was used for households that record 100% expenditure share to the use of any of the fuels. The model is specified as:

$$Y = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + U_i \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Where:

Y = Household monthly expenditure on any of the dirty energy sources in (₦)
X_i = Household income(₦)
X_2 = Age of household head (years)
X_3 = Sex of respondent (Male (1), Female (0)

X_4 = Educational level (years)
X_5 = Household size (Numbers)
U = Error term.

A priori expectation

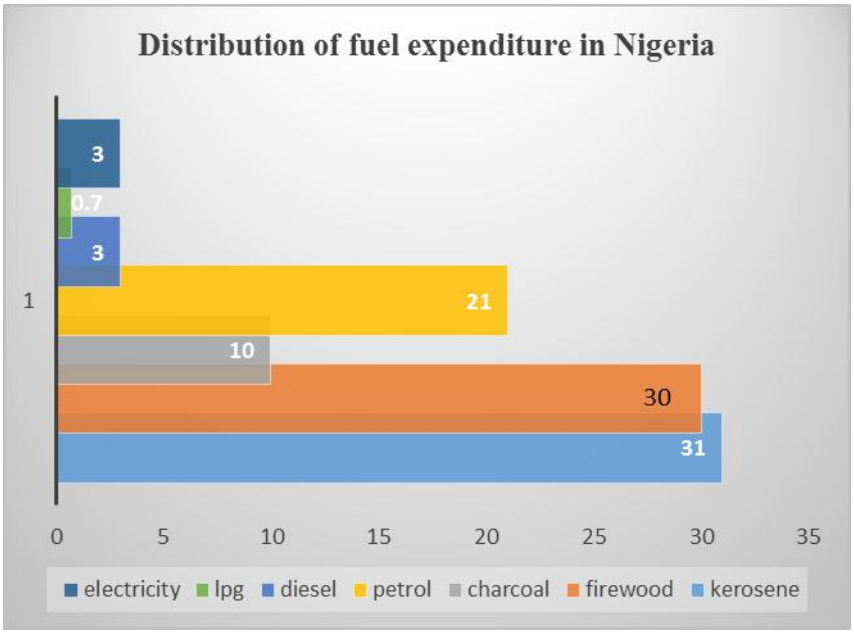
The coefficients of household income and area residence (rural/urban dichotomy) and sex would have negative effects. While the sex of household head, age and family size would have a positive effect.

RESULTS AND DISCUSSION

Pattern of Energy sources used Based on Expenditure

The pattern of energy sources used based on expenditure studied included all the common household's available fuels namely, charcoal, diesel, electricity, fuelwood, kerosene, LPG and petrol for lighting homes cooking and for other household uses. The results are presented in Figure1

Figure I: Distribution of Household Energy Expenditure in Nigeria (%)



Source: Generated by Stata 13 from the GHS BY NBS 2016 data

Figure 1 presents the percentage of expenditure on all the available energy used by the household sector. It can be virtually seen that kerosene has the highest percentage of expenditure with 31% budget share, making it the highest in terms of energy sources used for cooking. This is justified by the fact that it has been a traditional fuel especially in the urban areas. It is considered safer than LPG by most households with children and more convenient than fuel wood because it is less smokey and more convenient than fuelwood. This corresponds with the findings of Olaleye and Akinbode (2012). Petrol was the third most used energy source. With regard to energy for lighting homes however, it was found to be the most used because of the wide spread use of power generating plants as alternative source of electricity due to the acute shortage of power supply in the country. The reason for the high budget share could be due to the fact that petrol used for fuelling power generating plant is more expensive than either kerosene or fuelwood. This is in line with the findings of Maina *et al*. (2017).

The fuel with the expenditure share of 30% was fuel wood. Its use for food preservations and processing appeared as the third. However, in most household's energy consumption studies such as (Bello, 2011; Busola & Olaniyi, 2012; James & Alhaji, 2017) showed wood as the most used fuel. The reason could be because most of its quantities used are fetched from nearby bushes which usually end up not being captured in an effective demand study. This agrees with findings of Maina (2018). The next energy type with only 10% expenditure share is charcoal. The reason for such low demand could be because it was demanded by few geopolitical zones in the country such as north east where it is used for burning scent wood as room fresher as reported by Maina, *et al.* (2019).

However, electricity and diesel use were found to be as low as 3% in terms of budget share. The reason for this could be because electricity supply has been acute in the country. This has forced most of the household to resort to the use of power generating plants which uses petrol, hence the justification for its' high budget share, while the use of diesel is low because it is used by bigger power plants mostly found in urban areas and among higher income households. Hence its low use as a household fuel for lighting. Similarly, the expenditure share for LPG appears to be the lowest in Nigeria. This is not surprising as most energy studies have reported the same results**.** This corresponds with the findings of Bello (2011), Maina *et al.* (2017) and Maina & Kyari (2019). LPG use is low, this could be due to high installation cost, it is often scarce and its level of awareness by households as an environmental sustainable fuel is low.

In general, the demand for dirty energy sources is found to be the highest in Nigeria. The implications of these on the environment is that the use of more fossil fuels such as kerosene, petrol and diesel for lighting or cooking at home as shown by Maina (2018) emit high rate of carbon-dioxide thereby causing high concentration of greenhouse gases in the atmosphere. This does not only pose health risk on members of households as opined by Ogunniyi *et al.* (2012) but also affects the ozone layer and consequently results in climate change in the long term as found by (Kavi & Brinda, 2005). In addition, the demand for solid fuels like fuelwood is also found to be high. This could result in indiscriminate cutting down of trees to meet the increasing demand for fuelwood. All these deplete the ozone layer thereby exposing the atmosphere to dangerous gases this is in line with the findings of (James & Alhajji, 2017).

Determinants of Energy Expenditure in Nigeria

OLS regression technique was employed to determine the socio-economic factors influencing fuel use in Nigeria. The data set used contains all the information of the various households' interviewed based on their socio-economic factors and food and non-food expenditure (energy shares).The coefficients and the significant levels are presented in Table 2.

Table 2: Socio-economic Factors Determining Nigeria's Energy Expenditure

Variable	Coefficient	Standard error	T value	p>[t]	R^2
Constant	3.425445	.208205	16.45	0.000***	**0.623**
Educational level	-.1881203	.01219	-15.43	0.000***	
Monthly Income	- .5865661	- .010649	-55.08	0.001***	
Household size	.1182682	.0246805	4.79	0.000***	
Sex	- .0529781	-.0773088	- 0.69	0.493	
Age	.1850243	.0288777	6.41	0.000***	

Source: Generated by Stata 13: GHS by NBS's2016 data. ***(1%) ^{NS} (Not significant)

Household monthly income was found to be a significant determinant of dirty energy sources used at 1% level but negatively related. This agrees with findings of Maina (2018). Also, the finding agrees with the *a priori* expectation which assumes that the higher the income the lesser the expenditure on dirty fuels. *Ceteris paribus*, income is one of the major determinants of expenditure allocation. However, the negativity implies that the higher the income level, the lower the use of dirty fuels. This indicates that when household incomes increase, household heads would use more clean energy sources such as LPG and less dirty energy sources such as kerosene, charcoal and fuelwood. This is in line with environmental Kuznets hypothesis; which states that when income levels keep increasing, environment status also changes from a worsen situation to an improved stage (Kuznets, 1955).

Household size showed positive and significant relationship with the expenditure on dirty energy. This implies that *ceteris paribus* the larger the unit, the more dirty energy use. This is in line with the *a priori* expectation and contrary to the findings of Olufemi *et al* (2012). It was assumed that the coefficient of family size would have positive effect on dirty fuel use. This is because increase in household size without a corresponding increase in income would increase household expenses. Thus, households would be forced to resort copping strategies which includes resorting to the use of dirty fuels which are cheaper sources of domestic energy than clean energy sources.

Household size showed positive and significant relationship with the expenditure on dirty energy. This implies that *ceteris paribus* the larger a household, the dirtier energy the household will use. This is in line with the *a priori* expectation, and contradicts the findings of Olufemi *et al.* (2012). It was assumed that the coefficient of family size would have positive effect on dirty fuel use. This is because increase in household size without a corresponding increase in income would increase household expenses. Thus, households would be forced to resort copping strategies which includes resorting to the use of dirty fuels which are cheaper sources of domestic energy than clean energy sources.

Educational level of the household head was found to be significant and negatively related to the expenditure on dirty fuels. This could imply that higher level of education is synonymous with higher level of income and awareness. This agrees with the *a priori* expectation which assumed that higher educational level would result to less use of dirty fuels. Thus, the more educated a household head is, the more the person is well informed about the implications of the use of dirty energy sources on his/her health and the environment. It could also be linked with having the opportunity to be employed. So the higher the level of education the better the opportunity to be employed and consequently better income level, and the more he demands for clean energy sources and the less the use of dirty fuels.

CONCLUSION

This study examined the pattern of fuel use in Nigeria. The results revealed that most of the energy used by households whether for cooking or lighting homes were dirty. The most common energy sources used were Kerosene, Petrol, Fuelwood and Charcoal. These fuels have direct negative impact on the environment and are thus considered dirty energy source. The use of dirty energy is determined by socioeconomic characteristics of households including low levels of education and income of household heads as well as large family sizes and older family heads.

RECOMMENDATIONS

The following policies are recommended to government/policymakers based on the findings of the study;

- Making the environmentally sustainable energy sources more affordable to the Nigerian households by subsidizing the price of such fuels especially for low income households that cannot afford them.

- There is there is the need to reinforce the policy of planting trees that is already in existence in order to conserve the environment. Since Nigeria is one of the countries that acceded to emission reduction, it can achieve this target by adopting the United Nations policy of Reducing Emissions from Deforestation and Forest Degradation (REDD) which rewards people to plant more trees.

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A Review of Agricultural Intervention Programs and their Extension Delivery System in Nigeria

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ABSTRACT

This paper reviewed the agricultural development interventions programs and their extension approaches. Agricultural intervention program is a plan by a country to support its agricultural development, increase food production and welfare among smallholder farmer in collaboration with concerned stakeholders. The review indicated that there were a number of agricultural development intervention programs in Nigeria with the objective of improving the level of agricultural production and productivity. However, records reveal that some of the programs have achieved little or no progress. The first period of agricultural intervention program dated back to the colonial era in which the agricultural policy of the colonial administration was primarily focused on encouraging only export crops at the detriment of the nation towards agricultural production and productivity and the extension approach was by demonstration approach to farmers. The second period was when several institutions performed agricultural extension services. Among such institutions where the River Basin Development Authorities (RBDA), Green Revolution (GR), Operation Feed the Nation (OFN), Directorate for Food, Roads and Rural Infrastructure (DFRRI) and Agricultural Development Programs (ADPs), among others, yet, the sector's performance was far below expectation. The extension approach was Training and visit (T&V) system of extension which Nigeria operates until early nineties when Unified Agricultural Extension System (UAES) was introduced. This approach required that the frontline extension agents of the ADP take messages to farmers in all the sectors of agriculture. The major stakeholders include the states ADPs, National Agricultural Research System, private sectors and the Research Extension Farmer-Input Linkage System (REFILS). Based on this review, it is recommended that the agricultural extension system should be detached from its dependence on the civil service agencies and regulations.

Keywords: *Agriculture, Intervention, Program, Extension, delivery system.*

INTRODUCTION

Historically, the beginning of agricultural extension systems in Europe has been traced to the mid-19th century potato famine in Ireland, where agricultural advisors from the United Kingdom taught farmers how to grow alternative food crops. A few years later, in (1867), Oxford and Cambridge Universities in England started sharing the practical knowledge generated by their faculties with neighboring communities (Swanson and Claar, 1984). The European potato famine in 1845-51 highlighted the need for institutionalizing agricultural extension. Agricultural extension is fundamental in the transformation process of agricultural production activities in many parts of the world and the extension function is crucial for

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sustainable agricultural development (Ani, 2007). Thus, agricultural extension is most important which serve as the foundation in the transfiguration process of agricultural development .Agricultural extension and advisory systems in Oxford and Cambridge universities in the United Kingdom firstly used extension as a term to explain adult education programs in 1867. These programs assisted in expanding the message of the universities outside of campus's boarders and entering into the nearby communities. Extension as a term was officially adopted in the United States in the 1860's. Later on, research activities were included in 1887 with extension activities moreover started in the 1890's.Elsewhere, Japan created the first agricultural extension service in Asia in 1899 (Swanson and Rajalahti, 2010).Agricultural extension activities were officially called advisory services in the United Kingdom in the beginning of the 20th century. The majority of the European countries also used this same term. Nevertheless, in the United States and Canada, agricultural extension operations or activities were called extension services. The term that the donor agency used was commonly carried to the developing countries where the donor agencies played a part of building public agricultural extension institutions. For instance, in the 1960s and 1970s the United States Agency for International Development (USAID) was involved in setting up agricultural universities in addition to research and extension systems in many developing countries.

Agricultural intervention program is a plan by a country to support its agricultural development, increase food production and welfare among smallholder farmer in collaboration with concerned stakeholders (Koyenikan, 2008). Agricultural intervention program is a support for agricultural policy and regulatory frameworks to deliver on government expectation, contributing to increasing food security, as well as serving as a vehicle for rural employment, depends on robust evidence-based policies, capable of repositioning the agricultural sector to contribute effectively to economic development in collaboration with the key stakeholders including agricultural extension among others (FAO, 2019).

According to Gwyn and Chris (1999), the history agricultural extension service in Nigeria is intertwined with political history, the services is a significant social innovation, an important force in agricultural change, which has been created and recreated, adapted and developed over the centuries. Anaeto *et al*. (2001) opined that the organizations and personnel engaged in agricultural extension encompass various ranges of social control and legitimate activities which seek to improve the activities of farm people to adopt more appropriate and new practices and to adjust to changing conditions. Nevertheless, the near collapse of extension service institutional framework is evident. Agricultural extension is a business which flourishes when an enabling environment is provided for its growth and development (Agbamu, 2016). It is important to note that the sector presents a degrading state of neglect in spite of its potentials and contributions to the national economy. Moreover, under development with ever increasing cases of population growth, incessant rural urban migration of exuberant youth, malnutrition, lack of basic human needs and poor road network prevail(Anaeto*et al.*,2001).,It is against this background that this paper reviewed agricultural intervention programs and extension delivery system based on the following titles: Overview of agricultural extension intervention programs and their extension service delivery; the stages of agricultural extension system; the present agricultural extension intervention Programs; and Major Stakeholders in Extension Delivery System.

Overview of Agricultural Intervention Programs and their Extension Approaches in Nigeria

According to Atala (2001), the first period of extension system dates back to the colonial era when regional governments offered extension using the demonstration approach to farmers. Akubuilo (2008) the second period was in the post-independence era when several institutions provided agricultural extension services. These include the Farm Settlement Scheme (FSS) of the 1960s which were operated in the former Western and Eastern Nigeria aimed at providing young school leavers with practical training in agriculture. It was also intended that farmers in the neighboring villages will learn new ideas from the settlers. The National Accelerated Food Production Program (NAFPP) was launched in 1972 by the federal government to accelerate the production of six major crops in Nigeria, rice, Maize, Cassava, Sorghum, Millet and Wheat. Perez (1976) the aim is to increase the farm yields of small-scale farmers by their adoption of improved varieties which are responsive to nitrogen and improved management, by developing well organized and well trained extension workers and farmers and by developing effective support agencies to supply all the production inputs, arrange storage and marketing. The Operation Feed the Nation (OFN) was launched in 1976 with the aim of encouraging massive food production across the country. With little attention to a well-articulated extension system, the program ended by marketing a little impact. River Basin Development Authority (RBDA) (1973) charged with the development of irrigated agriculture in identified river basins in different parts of the country. The river basins employed different extension approaches. Their mandate was however later redefined to exclude extension services. Green Revolution (GR) (1979) which sought to bring about radical changes in Nigerian agricultural production and eliminate inherited food problems of successive government. Large, medium and small-scale farmers received a number of incentives to boost their production level during the implementation of the program. (Jibowo and Ajayi, 2011). It is also a period in which extension workers were involved in input supplies and credit procurement. In mid-seventies, World Bank assisted Agricultural Development Project (ADP) was introduced and with them the progressive target of contact farmers became standard. The approach metamorphosed by mid-eighties to the full introduction of Training and visit (T&V) system of extension. T&V extension was vigorously promoted by the World Bank in more than 50 countries, and religiously adopted in Nigeria. More than ninety-five percent (95%) of the agricultural extension services delivery in Nigeria is provided by the government through the state agricultural development project (ADPs) using the T&V approach (Madukwe, 2004). According to Hamisu*et al.* (2007). T and V extension approach was finally abandoned in the late 1990s by its promoters, and this led to the introduction of the Unified Agricultural Extension System (UAES). This approach or system required that the frontline extension agent of ADP takes message to the farmer in all the sectors of agriculture. Consequently, the agents should be knowledgeable enough to be able to disseminate message in the various field of agriculture. Auta and Dafwang (2010) opined that ADPs were first launched in 1972 to increase food production and to raise the income of small-scale farmers. The success of the pilot schemes led to its expansion nationwide by 1984. Today the ADPs in majority of the states stand just as symbols of past glory because ADPs have very weak funding status. Despite the funding problems, 89% of the state ADPs paid visits to farmers, 68% established Small Plot Adoption Technique (SPAT),while 54% established On-Farm-Adaptive Research (OFAR). The benefits of the ADPs according to Auta and Dafwang (2010) were to be realized through: A re-organized and revitalized agricultural extension system that integrates extension workers training and farm visits and ensure two-way communication between farmers and research; An effective farm inputs distribution system which operates through a network of farmer service centers

(FSC) ensuring that supplying the needed farm inputs are reliable and are in close proximity to their farms; Network of rural feeder roads to assist with farm produce evacuation as well as cost effective farm input distribution. An autonomous ADP Management Unit that is stripped of the usual civil service bureaucratic procedures and therefore possess flexibility to promptly take management decisions in line with the demands for timeliness in agricultural operation. A rigorous monitoring and management system that provides needed management information and ensures that errors in one project are not perpetuated there or in another project.

Development of Agricultural Extension Delivery System in Nigeria

Jibowo (1992) traced the historical background to agricultural extension service delivery in Nigeria. According to him, the Nigeria's national agricultural extension system come forth gradually into being over four centuries from a basic export crops that attract demand in more developed nations which have export value to what can be described as a professional service even if its effectiveness and efficiency remains average. The stages of development of the Nigeria's extension systems can be grouped in to three major periods namely: the colonial and immediate post-independence period between 1893-1968; the oil boom period of 1970-1979; and the state wide Agricultural Development Project (ADP) from 1980-present. The colonial and immediate post-independence period of development of agricultural extension system, the early part of this period 1893-1921 marked the beginning of scientific agriculture in Nigeria and the beginning of direct government involvement in agricultural development. The policy of the colonial government was primarily focused on encouraging only export crops such as cocoa, rubber, palm oil, cotton and groundnut to support the agro-industries in Europe. The extension system strategy was apparently a commodity approach with some enforcement component (Akubuilo, 2008). Extension delivery at that stage was at embryonic level and has dual but conflicting roles of education and law enforcement. The period is characterized by the following extension strategies and approaches: The colonial commodity extension approach; the ministry of agriculture approach; and the revitalized commodity extension strategy and the colonial commodity extension approach. The second stage was oil boom era of 1970-1979 which was near absence of a dynamic research and an effective extension strategy for food crop production in the earlier era was worsened by the oil boom, which turned out to be an "oil doom" for agriculture. The second stage is characterized by the following extension approaches which include: The National Accelerated Food Production Program (NAFPP); Operation Feed the Nation (OFN); the River Basin Development Authority (RBDA) strategies; The Green Revolution; and The Pilot (Enclave) Agricultural Development Projects (ADPs). The third stage is state-wide ADP Era of 1984. This stage of the extension service was characterized by the rapid growth of the ADP concept and reached national coverage by 1989 and had full responsibility for extension delivery at the grassroots Auta and Dafwang (2010). Common to all were an autonomous project management unit, on adaptive research component input delivery system, rural infrastructure component for rural feeder roads and water supply and a systematic extension delivery using basically the Training and Visit Extension approach as propounded by Benor and Baxter (1996) and Promoted by the world Bank in Nigeria and other developing countries (Musa *et al*., 2013). Apart from the "one-size fits all concept" of the strategy, it has proved to be very regimented, and expensive hence the serious management problems after the withdrawal of the world Bank support to the projects. It has never the less helped to professionalized extension delivery in the country (Buba, 2016). Although the strategy was crop-biased on introduction, this major defect was corrected in 1989 with the introduction of the Unified Agricultural Extension Services (UAES) which made provision for the inclusion to the other sectors such

as livestock, fisheries, forestry, natural resource management etc. Thus, one village extension agent (VEA) is expected to deliver extension messages in all agricultural disciplines (sub-sectors) to the beneficiaries. This was informed by the need to remove the problems of conflicting messages to the clientele by multiple agents. It was also expected to make the system move cost-effective by eliminating duplication of efforts. This extension strategy remains basically top-down in approach and the farmer also still basically remains a passive receptor of information, which may not necessary meet his needs. His involvement and participation in technology development remains low (Agbamu, 2016).

The Current Agricultural Extension Delivery System in Nigeria

This agricultural development programs (ADPs) nationwide remain the main agencies responsible for public extension service delivery at the grassroots Gambo *et al.*, (2016). A recent trend especially since the new democratic dispensation, is the involvement of the local governments in extension delivery, in collaboration with the ADPs. The quality of staff and the resources of the local government are such that they have only been able to make minimal impact Anaeto *et al.*, (2001). While the various modified forms of the training and visit (T&V) extension system remain the basic strategy for public extension delivery, the Research Extension-Farmer-Input-Linkage System (REFILS) is the management mechanism that has been used to identify and bring together the stakeholders in agricultural development as equal partners in development. It provides the structure and mechanisms for collaboration in technology generation, adaptation, dissemination and utilization with clear roles and responsibilities for all partners. Although the REFILS has strengthened the traditionally weak research-extension linkage, private sector participation still remains low just as the farmer's involvement, especially in the research agenda and planning for technology development (Agbamu, 2016).

The Major Stakeholders in Agricultural Extension Delivery System in Nigeria

The major stakeholders include the states ADPs, National Agricultural Research System, private sectors and The Research Extension Farmer-Input Linkage System (REFILS). ADPs in collaboration with the LGAs in some states who are responsible for grassroots extension delivery nationwide, the National Agricultural Research System is responsible primarily for technology development and the private sector is made up of both the commercial organization and Non-Governmental organization. Commercial organizations are responsible for the provision of essential inputs and services including credit and marketing while and the Non-Governmental organizations, are the latest participants in agricultural extension services delivery. Although approaches used by most of the NGOs are generally more participatory, their linkage with both NARS and the public extension service remain weak (Arokoyo *et al*., 2002). A major feature of the Nigeria agricultural Extension Service in the recent past is the participation of NGOs in extension delivery in Nigeria. These NGOs are divided into two major categories: The charity based NGOs and private commercial organizations. The charity based NGOs are non-profit oriented organizations while private commercial organizations have profit motive associated with their activities. These NGOs in the agricultural and rural development sector, provide a wide range of extension education and technical support services including micro-credit financing and supply of essential inputs in several communities in the country (Wahab, 2011).

Examples of the non-profit NGOs include: the Development Education Centre (DEC) which provides extension support to women to organize themselves into grassroots level self-help association in South-Eastern Nigeria; the women's Advancement Network (WOFAN) in the

North-West, promoting income generation activities among rural women; the farmer Development Union (FADU) and the faith-based Diocesan Agricultural Development Project (DADP) in South-Western Nigeria which aims at poverty alleviation among small- scale farmers (Arokoye *et al.,* 2000). Unique in this group is the international NGO, Sasakawa-Global 2000 which not only work in very close collaboration with the ADPs, but actually uses the already established structures of the ADPs including selected staff who are seconded to the organization. Examples of the private commercial organizations providing extension services include: the shell petroleum company (shell petroleum extension project), the British American Tobacco (BAT), and African cotton (AFCOT) Niger Delta Oil exploratory areas are community-development oriented, public relations outfits, those of BAT and AFCOT are principally commodity-targeted out growers schemes to ensure adequate raw materials for their companies source?

The Research Extension Farmer-Input Linkage System (REFILS) is an organization of Research Extension and input agencies to improve productivity of farmers, which has linked the ADPs staff with the universities and the research institutes and also created easy access to farmers acquiring farm inputs (Nnadozie *et al.,* 2015) also include the government for policy direction even though the policies over the past several decades have neither been friendly nor consistent to sufficiently encourage significant private-sector involvement in meaningful sustainable agricultural development. There are two partners in REFILS-the National Agricultural Extension and Research Liaison Services (NAERLS) of Ahmadu Bello University and the projects coordination Unit (PCU) of the Federal Ministry of Agriculture and Rural Development. While the NAERLS is responsible for the provision of extension specialist support service to the ADPs, the PCU is responsible for the co-ordination, Monitoring and evaluation of their extension delivery activities. The PCU, it must be mentioned is an amalgam of the former Federal Agricultural Coordinating Unit and the Agricultural Project Monitoring and Evaluation Unit (APMEU), both in the Federal Department of Agriculture. Of course, the farmer remains the most important stakeholder and centre piece of REFILS Arokoyo *el al.,* (2002).

CONCLUSION AND RECOMMENDATIONS

It is concluded that there are several agricultural intervention programs that have been developed and executed by governments in Nigeria and that these intervention programs have contributed conspicuously to agricultural development in the country. However, several noticeable limitations were also evident as a result of passive involvement of target beneficiaries of the intervention programs and extension activities. Also in most of the ADPs, the number of extension workers has been reduced drastically due to a number of reasons; notable among them is poor funding. The problem of funding has resulted in reduced extension activities, and that, in turn, has pushed some staff to voluntarily leave the ADPs. As a result, the high numbers of agricultural development intervention programs in Nigeria that have the objective of improving the level of agricultural productivity in the country have made little or no progress in recent years. The performance of agricultural intervention programs/projects which sought to improve food production using the integrated approach to agricultural development in Nigeria is still far below expectation. In the state-wide ADP, the extension strategy remains basically top-down in approach and the farmers also still basically remain passive receptors of information, which may not necessarily meet the needs of the farmers. The present situation where ADPs are left to the unsteady policies of governments both at Federal and State levels is very bad for Nigerian Agriculture if not tackled. The regrettable state of the ADPs is a reflection of the unreliability and frequent changes in the

policies of Governments. If these challenges are not addressed the overall aim of agricultural development programs would not be achieved. In that regard it is recommended that the target beneficiaries (farmers) should be integrated and be seen as active participants in agricultural development programs. In addition, extension service should be seriously involved. Agricultural extension system should be detached from being dependent on civil service rules and regulations to make for their efficiency. Furthermore, Agricultural extension service should be mandated to collaborate with NGOs and international development agencies to keep them abreast with happenings in the sector. The funding of agricultural development projects should be by direct deduction from source from the three tiers of government. All concerned stakeholders should be involved in policy formulation so that decisions are bottom-top in order to meet the needs of the farmers.

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Socio–economic Factors Influencing Accessibility to Agricultural Credits among Crop Farmers in Sabon Gari Local Government Area, Kaduna State, Nigeria

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ABSTRACT

Poor access to agricultural credit by peasant farmers has been an age long problem posing serious threat to the nation's food security programme. Hence, the study was aimed at examining the Socio–economic Factors influencing Accessibility to Agricultural Credits among Crop Farmers in Sabon Gari Local Government Area, Kaduna State, Nigeria. Data were obtained from 65 farmers through structured questionnaire. Descriptive statistic and step wise linear regression model were used to analyze the data. The study revealed that Farmers in the area used multiple sources of credit to aid their production and 20% of the variations in accessibility of farmers to agricultural credits were explained by the nine variables in the model used. It was recommended that among other things, government should make credit facility more effective and available in the study area.

Keywords: *Accessibility, Agricultural, Credits, farmers, Nigeria.*

INTRODUCTION

Nigerian agricultural sector has been an important component of the economy with small holder farmers producing over 90% of available food in the country and 70% of the labour force relying on these sectors for their livelihood. Majority of these farmers cultivate less than five hectares of land. Although these lands look insignificant individually, collectively they form the foundation on which the nation's economy rests (Afolabi, 2010).

The decline in the Nigerian economy, particularly in the area of agricultural productivity, has often been blamed on lack of credit facilities. This has prevented many farmers from adopting improved practices. This is worsened by the fact that small scale farmers often lack the collateral to secure credit from financial institutions. The acquisition and utilization of credit for agricultural purposes promote productivity and consequently improve the food security status of communities (Aribaba, 2013). Agricultural credit has long been identified as a major input in the development of the agricultural sector of the Nigerian economy. Farmers have a large demand for different production inputs among which is credit. Despite the almost indispensable need for credit among farmers, providing the sector with adequate credit has remained a problem in Nigeria (Asogwa, Abu1, and Ochoche, 2014).

Most farmers in Nigeria who often reside in the rural areas are credit constrained as they cannot access credit facilities for agricultural production. Improved technologies in

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agriculture entails the use of modern implements and inputs, but this is not possible as most farmers are poor (Rahji and Adeoti, 2010).. Changes in the agricultural sector which have gone beyond the use of hoe and cutlass to the use of animal traction, use of improved seeds varieties, better transport facilities, storage and marketing of farm produce, uses of herbicides and pesticides have necessitated the farmers to require more capital, increase volume of savings to accommodate their new trend of input (Aribaba, 2013). There is virtually little or no financial sources to cater for these farming inputs and eventually the farmers have to borrow from friends and relations where collateral is not often demanded to meet their input demand. These sources of credit are however, often inadequate to meet the farmers farm needs.

METHODOLOGY

Study Area

The study was conducted in Sabon-Gari Local Government Area of Kaduna State and is located in the northern zone of Kaduna State. It lies between Latitude 11^{o} and 23^{o} N of the equator and Longitude 7^{o} and 8^{o} E of the green wich meridian. The area is characterized by alternating dry (October-May) and wet (May-October) seasons with mean annual rainfall of 1099.3mm, temperature of 27^{o}c-35^{o} c in April, with guinea savanna vegetation zone, clay-loamy soil type. (Ibrahim, 2015).The major source of livelihood in the area is agriculture and trading. The bulk of agricultural production is done by small scale farmers (Ibrahim, 2015).

Sampling techniques

Multistage sampling technique was used for the sampling. In the first stage, five villages were selected out of eleven villages. In the second stage, fifteen (15) crop farmers who obtained credits for their crop production were purposively selected from each village. A total of sixty five (65) crop farmers which constitute the working population for the study were sampled. Primary data which were obtained with the aid of structured questionnaire were used for the study. Descriptive statistics such as frequency distribution and linear regression model were the tools used.

Stepwise Linear Regression Model.

In this method one would proceeds by introducing the explanatory variables one at a time (Gujarati, 2007). The regression model in its general form is expressed as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, U)$$

Where Y = rate of accessibility to credit to be measured in percentage as:

$$Y = \frac{amount\ of\ credit\ obtained}{amount\ of\ credit\ needed}\ X\ 100$$

X_1=sex (dummy, male=1, female=0), X_2= age (years), X_3= farm size (ha), X_4= income per annum (N), X_5= education (years of schooling), X_6= marital status (dummy, married=1, otherwise=0), X_7= farming experience (years), X_8= family size (number), X_9= source of credit dummy, formal=1 informal=0, U = error term.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

The Result in Table 1 indicated that 63% of the farmers were within the active age, with mean age of 45 years for the farmers, implying that age can influence the purchase and adoption of modern agricultural technologies which requires credits. The average household size was 12 persons implying that there is a source of family labour for crop production in households.

Table 1 Distribution of farmers based on socio-economic characteristics

Age (years)	frequency	Percentage
≤ 30	5	7.692
31 - 40	22	33.846
41 – 50	19	29.231
51 – 60	12	18.462
≥ 61	7	10.769
Farm size (ha)		
0.1 – 1.0	17	26.154
1.1 – 2.0	33	50.769
2.1 – 3.0	9	13.846
3.1 - 4.0	2	3.077
≥ 4.1	4	6.154
Household size		
≤ 5	15	23.077
6 – 11	21	32.308
12 – 17	13	20.000
18 – 23	12	18.462
≥ 24	4	6.154
Farming experience (years)		
≤ 10	19	29.231
11 – 20	18	27.692
21 – 30	16	24.615
31 – 40	8	12.308
41 – 50	3	4.615
≥ 51	1	1.539
Years in cooperative		
0	16	24.615
1 - 5	8	12.308
6 – 10	21	32.308
11 – 15	6	9.231
16 – 20	4	6.154
≥ 21	10	15.385
Annual income (₦)		
≤ 90000	12	18.462
100000 – 290000	22	33.846
300000 – 490000	17	26.154
500000 – 690000	7	10.769
700000 – 890000	5	7.692
≥ 900000	2	3.077

Source: *Field Survey, 2014.*

The mean years of farming experience was over 21 years, implying that there is managerial experience among the farmers. About 77% of the crop farmers had farms ranging from 0.1 hectares to 2.0 hectares, while 6% had farm holding greater than 4.0 hectares, which shows

that crop production in the study area is practiced mainly by small-scale farmers who are small because of their inability to afford more. About 25% did not join any farmers' cooperative while about 42% had spent 6-15 years in farmers' cooperative societies. Membership of cooperatives can ease access to credit and money lenders. Over 33.9% of the farmers were within the range of annual gross income of ₦100,000 – 290,000 while only 3% had income exceeding N 890,000 annually. This implies that most farm households are small income earners who would earn better if they had access to credit.

Socio–economic factors affecting the accessibility of farmers to agricultural credits

Results in table 2 revealed that 20% of the variation in accessibility of farmers to agricultural credits was explained by the nine socioeconomic variables in the model.

Table 2: Socio–economic factors affecting the accessibility of farmers to agricultural credit

Regression coefficient												
X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	constant	F-value	R^2	R^2 change
-14.334 (-1.745)*									92.347 (9.154)***	3.044	0.046	-
-15.521 (-1.916)*	-0.490 (-1.806)*								115.735 (7.071)***	3.207	0.094	0.048
-15.208 (-1.883)*	-0.365 (-1.259)	-2.569 (-1.200)							114.994 (7.071)***	2.633	0.115	0.021
-11.118 (-1.350)	-0.427 (-1.491)	-2.817 (-1.338)	0.000 (1.827)*						105.708 (6.311)***	2.885	0.161	0.046
-13.042 (-1.541)	-0.387 (-1.340)	-2.674 (-1.267)	0.000 (1.806)*	0.333 (0.986)					104.406 (6.213)***	2.502	0.175	0.014
-11.813 (-1.398)	-0.302 (-1.027)	-2.672 (-1.271)	0.000. (1.851)*	0.360 (1.072)	19.922 (1.377)				78.001 (3.069)***	2.432	0.201	0.026
-11.411 (-1.265)	-0.246 (-0.783)	2.691 (-1.271)	0.000 (1.837)*	0.360 (1.062)	19.897 (1.363)	0.054 (0.136)			78.445 (3.035)***	2.052	0.201	0.000
-10.474 (-1.075)	-0.335 (-0.747)	-2.385 (-0.984)	0.000 (1.831)*	0.352 (1.028)	20.015 (1.359)	0.082 (0.197)	-0.137 (-0.267)		76.907 (2.882)***	1.776	0.202	0.001
-10.200 (-1.029)	-0.350 (-0.764)	-2.485 (-0.998)	0.000 (1.761)*	0.349 (1.010)	19.857 (1.335)	0.090 (-0.181)	0.010 (0.215)	-2.932 (-0.211)	77.325 (2.865)***	1.556	0.203	0.001

Source: Field Survey, 2014.

Age induced the highest variation in the accessibility to the credit with about 5%, followed by annual income and marital status with 5% and 3% respectively. This agrees with the finding of Adebayo and Adeola (2008), that older farmers were not collecting and using credit to finance their production activities. And this could also mean that annual income of a farmer determines his loan repayment capacity and invariably increases the agricultural credit accessibility. Education was positively and significantly related to the rate of credit accessibility at 5% level. Ideally, educated farmers are likely to understand the benefits of credit in modern production and comprehend extension information on sources and utilization of credits.

Level of credit rationing in the study area

The result revealed the maximum credits needed and the one obtained by the farmers in the area.

Table 3: Level of Credit Rationing in Sabon Gari

Estimate	Credit needed	Credits obtained
Max	550,000.00	665000.00
Min	20000.00	0
Average	112,000.00	79,800.00
SD	106753502	93245.84
Coefficient of variation	0. 95	1.17
Differential	32200	
Standard Error	24806.87	
t-Value	1.298^{NS}	

Source: *Field Survey Data, 2014.*

There is no statistical difference between the minimum credits obtained and the one apply for, as the relationship was found to be Non-significant. Characteristic of the farmers that can help illuminate the nature of credit rationing among crop farmers is the availability of potential collateral (Rahji and Adeoti 2010).

Usually, access to loans from various lending institutions that issue credits to farmers depends on provision of collateral and loans often attract high interest rate. Thus, in the absence of suitable collateral or a collateral substitute, credit rationing will continue to remain an obstacle to rural farmers (IFPRI, 2014).

CONCLUSION AND RECOMMENDATIONS

There is recognition of the crucial role played by financial institutions in economic growth and productivity. Limited access to agricultural credit facilities is one of the major problem confronting crop farmers, resulting in declining agricultural productivity in the study area. The study therefore concluded that age, annual income, marital status and education of the farmers were the significant determinants of farmers' accessibility to agricultural credit in the study area

It was recommended that more credit facilities should be made available and accessible by reviewing borrowing conditions in the favour of small farmers to farmers in the study area. Enabling environment should be created to improve farmers' accessibility to educational facilities and rural farmers should be encouraged to join co-operative associations as this can increase their chances of accessing formal agricultural credit facilities.

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A Review of the Effect of Crude Oil Exploration on Agriculture: A Case Study of the Niger Delta Region

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ABSTRACT

Agriculture is the backbone of Africa's economy. About 70% of Africans especially, Nigerians, and roughly 80% of Africa's poor live in the rural areas and depend mainly on agriculture for their livelihood. Agriculture in Nigeria is the most important sector of the economy from the standpoint rural employment, sufficiency in food and fiber, and export earning prior to the discovery of oil. The oil industry has risen to the unassailable loftiness of the Nigerian economy, contributing the lion share to gross domestic product and accounting for the bulk of federal government revenue and foreign exchange earnings since early 1970. This Paper examines the effect of crude oil exploration on agricultural productivity and those that depend on it. Despite the various polices and strategies adopted by various governments in Nigeria to address agriculture and rural underdevelopment problem, the story remains the same. Oil spills have shown significant negative impact on crop yield and land productivity which further impoverish the already poor farmers in these oil producing areas. With increasing soil infertility as a result of the destruction of soil micro-organisms and dwindling agricultural productivity, farmers have been forced to abandon their land to seek non-existent alternative means of livelihood. This paper finally submits that regulatory agencies and policies should be restructured to tame the tide of environmental destruction perpetrated by oil multinational companies. This is in order to give agriculture the pride of place it deserves in serving as a catalyst for peace, income, employment and pollution-free environment in the Niger Delta.

Keywords: *Agriculture, Niger Delta, Oil Exploration, Environmental Pollution.*

INTRODUCTION

Agriculture is the cultivation of plants and husbandry of animals, that is, the management of living things and ecosystems to produce goods and services for the people. Agriculture includes farming; ranching; aquaculture; apiculture; horticulture; viticulture; animal husbandry, including, but not limited to, the care and raising of livestock, equine, and fur-bearing animals; poultry husbandry and the production of poultry and poultry products; dairy production. It includes the production of field crops, tobacco, fruits, vegetables, nursery stock, ornamental shrubs, ornamental trees, flowers, sod, or mushrooms; timber; pasturage, and the processing, drying, storage, and marketing of agricultural products (Nchuchuwe and Adejuwon, 2012).

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Agriculture is the backbone of Africa's economy. About 70% of Africans and roughly 80% of the Africa's poor live in the rural areas and depend mainly on agriculture for their livelihood.

It has a massive social and economic foot print. More than 60% of the population of sub-Saharan Africa is smallholder farmers, and about 23% of the GDP of Africa comes from agriculture (Goedde, et al, 2019).

Agriculture is faced with fundamental changes. Human population growth, improved incomes and shifting dietary patterns are increasing the demand for food and other agricultural products. At the same time, however, the natural resource base under-pinning agricultural production is under threat, with growing threats to genetic diversity and the degradation of land and water resources. It improves food security in many ways, most fundamentally by increasing the amount of food but also by providing the means to purchase food. Through growth in agricultural productivity and higher farm profits, the rural poor can generate additional income to purchase more food, including more diverse kinds of food. The sustainability of agriculture in African region cannot be isolated from the sustainability of development in the region and beyond.

Agricultural development, a subset of economic development, implies a sustained increase in the level of production and productivity over a reasonable length of time and the subsequent improved wellbeing of farmers as reflected in their higher per capita income and standard of living.

Rural Development in Nigeria

Rural development relates not only to a sustained increase in the level of production and productivity of all rural dwellers, including farmers, and a sustained improvement in their wellbeing, manifested by increasing per capita income and standard of living, but also leads to a sustained physical, social and economic improvement of rural communities.

Olayide *et al.* (1981) stated that rural development is a process whereby concerted efforts are made in order to facilitate significant increase in rural resources productivity with the central objective of enhancing rural income and creating employment opportunity in rural communities for rural dwellers to remain in the area. It is also an integrated approach to food production, provision of physical, social and institutional infrastructures with an ultimate goal of bringing about good healthcare delivery system, affordable and quality education, improved and sustainable agriculture etc. Rural development is reconstructing the eroded economic base of both the rural economy and the farm enterprise. Van der Ploeg et al. (2000).

The bedrock of agriculture and agricultural development in developing countries of sub- Saharan Africa is rural development, without which all efforts at agricultural development will be futile. A large majority of the farmers operate at the subsistence, smallholder level, with intensive agriculture being uncommon. A characteristic feature of the agricultural production system in such countries, Nigeria inclusive, is that a disproportionately large fraction of the agricultural output is in the hands of these smallholder farmers whose average holding is about 1-3 hectares. Also, there is very limited access to modern improved technologies and their general circumstance does not always merit tangible investments in capital, inputs and labor (Ogunlela and Mukhtar, 2009).

Agriculture in Nigeria is the most important sector of the economy from the standpoint of rural employment, sufficiency in food and fiber, and export earning prior to the discovery of oil. The above assertion is based on the fact that as at independence in 1960, little was known of petroleum as a source of revenue for the Nigerian economy. There was sustained emphasis on agriculture to the extent that Nigeria was a major exporter of such agricultural products as palm produce, cocoa, groundnut, cotton and rubber. In addition to these cash crops, the national agricultural system was able to produce enough of food crops like yam, cassava, maize, millet, sorghum and soya beans to the extent that there was almost no need for food importation. Hitherto, agriculture accounted for over 60% of the Nation's Gross Domestic Product (GDP). However, with the advent of petroleum in the early 1970s, petroleum became the country's major foreign exchange earner and agriculture became grossly neglected (Oni, 2008).

Crude Oil

Crude oil is naturally occurring oily, bituminous liquid composed of various organic chemicals. It is found in large quantities below the surface of Earth and is used as a fuel and as a raw material in the chemical industry. Modern industrial societies use it primarily to achieve a degree of mobility; on land, at sea, and in the air. In addition, petroleum and its derivatives are used in the manufacture of medicines and fertilizers, foodstuffs, plastics, building materials, paints, and cloth and to generate electricity.

According to Doscher (2009), the chemical composition of all crude oil is principally hydrocarbons, although a few sulfur-containing and oxygen-containing compounds are usually present; the sulfur content varies from about 0.1 to 5 percent. Petroleum contains gaseous, liquid, and solid elements. The consistency of petroleum varies from liquid as thin as gasoline to liquid so thick that it will barely pour. Small quantities of gaseous compounds are usually dissolved in the liquid; when larger quantities of these compounds are present, the petroleum deposit is associated with a deposit of natural gas.

Oil exploration in Nigeria using Niger Delta Region as a case Study.

The Niger Delta region has been in existence long before the British discovery of Nigeria in 1840. In 1380, the Portuguese passed through the Niger Delta and met the Izons who are the aborigines of the Niger Delta (Etekpe, 2007). The geographical landmark of the area covers 70,000km^2. It is described by the World Bank in 1995, as the World's largest Wetland and "Africa's largest delta."

Over the years, the determination and definition of the Niger Delta region has taken different dimension. In the 1954 constitution of J. W. Robertson and for the purposes of the establishment of the Niger Delta Development Board (NDDB) defined the Niger Delta region to cover, the Western Ijaw Division of Delta Province, the Yenagoa Province, Degema Province and the Ogoni Division of Port Harcourt Province. These provinces as at today include the Southern Delta State, Bayelsa State, and Rivers State. However, the region was redefined by the NDDB Act of 1960 to include areas like Akwa Ibom and Cross River States. The establishment of the defunct Oil Mineral Producing Areas Development Commission (OMPADEC) and the Niger Delta Development Commission (NDDC) have redefined the area to include Ondo State, Edo State, Imo State and Abia State. This definition covers oil producing States and not the Niger Delta Region of the South-South geo-political zone which includes the Izons, Urhobo, Isoko, Ikwere, Ika, Ukwuani, Abua, Itsekiri, Ogoni, Efik, Ibibio, and Bini (Etekpe, 2007 and Tamuno and Samuel, 2012).

According to Azaiki (2003), "the search for crude oil in Nigeria began as far back as 1908 when a German company, the Nigerian Bitumen Corporation, started exploration in the Araromi area of western Nigeria". The pioneering effort of this company was aborted by the outbreak of the First World War in 1914. Shell Petroleum Development Company continued with oil exploration in the Niger Delta region. The company made its first oil discovery in 1956 at Oloibiri in the Niger Delta region after about half a century of exploration. Nigeria joined the ranks of oil producers in 1958 when the company discovered oil in commercial.

Today, the oil industry is highly visible in the Niger Delta and has control over a large expanse of land. Shell Petroleum Development Corporation operates over 31,000 square kilometers (Aworawo, 2000). The area is crisscrossed by thousands of kilometers of pipelines, punctuated by well and flow stations. Much of the oil infrastructure is located close to the homes, farms and water sources of communities in the Niger Delta region (Taiwo, 1991).

After Shell British Petroleum, which discovered and drilled the oil at Oloibiri, joined the ranks of oil producers in 1958, exploration rights in onshore and offshore areas adjoining the Niger Delta were later extended to other foreign companies such as Mobil, Chevron, Total etc. Further exploration and production activities, according were hampered between 1967 and 1970 by the Nigerian civil war. Total production from Nigeria's oil fields in the Niger Delta region increased from 308 million barrels in 1970 to 703,455 million barrels in 1991. The peak of its production came in the 1980s when the total output was 753.5 million barrels per annum (bpa), out of which 93 percent was exported overseas (Azaiki, 2003).

Despite its major problems of civil unrest, political instability, corruption and poor governance, international oil companies have always seen Nigeria as an attractive area of upstream investment. Oil exploration has taken place in five major sedimentary basins, namely, the Niger Delta, the Anambra Basin, the Benue Trough, the Chad Basin and the Benin Basin. The most prospective basin is the Niger Delta which includes the continental shelf and which makes up most of the proven and possible reserves.

Omofonman and Odia (2009), and Apata (2012), observed that the petroleum industry in Nigeria has brought exceptional changes to the Nigerian economy, particularly in the past five decades when it replaced agriculture as the basis of the Nigeria economy. The oil industry has risen to the unassailable loftiness of the Nigerian economy, contributing the lion share to gross domestic product and accounting for the bulk of federal government revenue and foreign exchange earnings since early 1970. Prior to the advent of Crude-Oil exploration and exploitation in the crude-oil producing zones of Nigeria, the people in the area had a thriving economy with about 90% of the population engaged productively in economic activities, such as artisanal fishing, mat weaving, local gin production, boat building, palm wine tapping among others (Omofonmwan & Odia, 2009). However, Nigeria's considerable abundance in fossil fuel has not translated into a desirable economic performance or a positive change in the standard of living of the people.

Sustainable Agricultural Development in the Niger Delta Region

The idea that development must be proactive of future development prospects was brought to the fore by the Brundtland Report (1984). According to the report, for development to be sustainable, the "process of change in which exploitation of resources, direction of investment, orientation of technological development, and institutional changes are made

consistent with future as well as present needs. It is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

To this end, scholars urge for a sustainable agriculture that "focuses attention on the spatial dimensions of ecologically sustainable development in the context of regional resource use affecting land use. The concept of sustainable agriculture discusses the issue of regional sustainable development in relation to land use in such a way that the future generations would not be worse off" (Adeyemo, 2002). Thus, for agricultural development to be sustainable, it must meet three goals, as noted by Adeyemo (2002) viz:

a) An acceptable level of welfare for the regional population that can be sustained in the future;

b) Non-conflict with the focus of agricultural development at national or supra-regional level;

c) Development of human factor (HF) in agriculture.

It is expected that a holistic adoption and application of these goals be the cardinal objectives of the Nigerian state in the Niger Delta. The exploration and exploitation of crude petroleum must not jeopardize agriculture in the Niger Delta region, national development policies and their implementation must not be skewed against a region such as the Niger Delta, etc.

Petroleum Resources and the Nigerian Economy

Aniefiok, *et al.* (2013), opined that the dominance of the Nigeria's economy by the petroleum sector in the early 1970s resulted in declined economic contribution of agricultural sector in the country's economy and there was an overwhelming prominence of petroleum resources in the Nigerian economy, especially from 1973 onwards. According to Graf (1998), there is evidence to indicate that crude oil sales income as a proportion of foreign exchange earnings escalated from 2.5% to 58.1% in 1970, to 93.6% in 1975 greater than 98% through the first half of the 1980s.Production of oil and gas resources, which have been on–going for the past five decades, account for over 85 % of the Nigeria's gross domestic product (GDP), represents over 95 % of nation's foreign exchange revenues and contributes over 80 % of the government revenues. Overall, oil and gas production from the Niger Delta region by the Nigerian government and multinational oil companies has generated an estimated $600 billion since the 1960s. Therefore, effective understanding of unsustainable exploitation of natural resources has helped shape our views of economic development from narrow economic interest to one that comprehensively embraces human, social and environmental factors in recent years.

Government and Oil Multi-national companies ultimate desire in the Niger Delta is petroleum and therefore considers livelihood sources derivable from agriculture and the physical environment as inconsequential (Thomas, 1992). In spite of the negligence, agriculture is still a major source of employment in the Niger Delta; See table below.

Table 1: Distribution of Employed Working Population by activity and Region

State	Agriculture	Fish	Manufacturing	Construction	Trade	Transport	Public Admin	Educ.
Abia	44	0	4	3	25	4	4	4
A/Ibom	35	2	2	2	26	5	4	3
Bayelsa	34	19	3	4	16	2	7	8
C/River	68	0	1	1	9	2	5	5
Delta	38	6	4	4	21	5	5	4
Edo	41	1	6	3	22	5	3	5
Imo	50	0	3	3	20	4	3	3
Ondo	42	2	3	3	27	4	5	5
Rivers	49	4	4	5	13	3	6	7
Niger Delta	44	4	3	3	20	4	5	5

Source: *World Bank, 2008.*

Some Agricultural and Environmental Policies in Nigeria:

In order to tame the effects of petroleum on agriculture and those that depend on it, The New Nigerian Agricultural Policy (1988)/Agriculture in Nigeria: The New Policy Thrust (2001) and The National Policy on the Environment (1998) were set up as guiding policy documents. These policy guidelines are expected to provide regulatory framework on agriculture and the environment in Nigeria devoid of selective administration in any part of Nigeria. However, discriminatory administration of these policies is noticed in the Niger Delta. Crude petroleum discovery in the late 1960s and the subsequent avidity for the proceeds arising from crude petroleum by successive Nigerian governments are identified as the culprits precipitating the selective policy implementation from the Nigerian state, especially with respect to communities in the Niger Delta (Berry 1984; Diouf 1989; Adedipe 2004 in Egbe, 2012).

Agricultural Policies:

Nigeria never lacks policies. Agriculture and environmental sectors are not exceptions. The bane of Nigeria's policy environment has always been the lack of will-power to carry out the policies.

Nigerian governments had evolved several agricultural policies. The New Nigerian Agricultural Policy (1988), Agriculture in Nigeria: The New Policy Thrust (2001), etc., are policies launched by successive administrations in Nigeria. The policy goals were specific, stating inter alia: "agriculture accounts for 88% of the non-oil foreign exchange earnings and employs about 70% of the active labour force of the population.

The sector is a catalyst and major source of raw materials for the industrial sector and provides most of the staple food consumed by the 120 million Nigerians". In recognition of this importance, the 1988 agricultural policy specified a set of broad policy objectives, which include among others, the following:

a) "increase in production of agricultural raw materials to meet the growth of an expanding industrial sector;

b) creation of more agricultural and rural employment opportunities to increase the income of farmers and rural dwellers and to productively absorb an increasing

labour force in the nation;

c) protection and improvement of agricultural land resources and preservation of the environment for sustainable agricultural production" (Egbe, 2012).

The Obasanjo administration, upon a review of previous policies, came up with the New Policy Thrust (2001), which intended to transform Nigerian agriculture. These include:

i. Creating the conducive macro-environment to stimulate greater private sector investment in agriculture so that the private sector can assume its appropriate role as the lead and main actor in agriculture;

ii. Rationalizing the roles of the tiers of government in their promotional and supportive activities to stimulate growth;

iii. Reorganizing the institutional framework for government intervention in the sector to facilitate smooth and integrated development of agricultural potentials;

iv. Articulating and implementing integrated rural development as a priority national programme to raise the quality of life of the rural people;

v. Increasing agricultural production through increased budgetary allocation and promotion of the necessary developmental, supportive and service-oriented activities to enhance production and productivity and marketing opportunities;

vi. Increasing fiscal incentives to agriculture, among other sectors, and reviewing import waiver anomalies with appropriate tariffication of agricultural imports;

vii. Promoting increased use of agricultural machinery and inputs through favourable tariff policy".

Table 2: Effectiveness of Policies, Regulations and Institutions on Nigerian Agriculture

Policies and Regulations	Rank	Position
Agricultural input supply to farmers	2.83	4
Agricultural input demand farmers	2.17	2
Foreign investment in agriculture	8.83	20
Domestic investment in agriculture	4.00	5
Commercialization of agriculture	6.17	14
Agricultural production for domestic market	1.83	1
Agricultural production for export market	5.33	8
Agricultural commodity storage	7.17	18
Agricultural commodity processing	6.17	15
Agricultural commodity transport, distribution and information	6.50	16
Domestic agricultural commodity trade	2.67	3
Agricultural commodity export	5.83	11
Agricultural commodity utilization	5.50	9
Agricultural research and technology development	4.33	7
Agricultural technology adoption	4.00	5
Food security	5.50	9
Poverty reduction	5.83	11
Closing gender gap	6.00	13
Protection/welfare of vulnerable groups	6.67	17
Sustainable environmental management	7.5	19

Source: *Olawumi (2009), (the lower the value, the better) in Egbe, (2012).*

Environmental effects of oil Exploration and Exploitation in the Niger Delta includes:

Table 3: Showing the Number of Spills in the Niger Delta between 1979 and 2005

Episode	Year	State	Quantity Spilt in Barrels
Forcados terminal oil spills	1979	Delta	570,000
Funiwa no.5 well blow out	1980	Rivers	400,000
Oyakama oil spillage	1980	Rivers	10,000
System 2c Warri, Kaduna pipe line rupture at Abudu	1982	Edo	18,000
Sohika oil spill	1983	Rivers	10,000
Idoho oil spill	1983	Akwa Ibom	40,000
Jones creek oil spill	1998	Delta	21,000
Jesse oil spill	1998	Delta	10,000
Etiama oil spill	2000	Bayelsa	11,000
Ughelli oil spill	2005	Delta	10,000
Total	**-**	**-**	**700,000**

Source: *United Nations Development Programme (UNDP) (2006) in Oyinloye and Olamiji (2013)*

The discharges of petroleum–derived waste streams from oil and gas exploration and productions are toxic to the coastal waters, soils and sediments near the discharge points. In the marine environment, contaminants with petroleum–contaminated produced water are toxic to a wide variety of aquatic organisms or estuarine organisms, therefore, there is no justification for the continuous disposal of produced water into ecologically sensitive areas in the Niger Delta.

Petroleum Contamination of Soil, Sediment and Groundwater

Petroleum hydrocarbon contamination of soil can occur in several ways, from natural seepage of hydrocarbons in areas where petroleum is found in shallow reservoirs, to accidental spillage of crude oil on the ground. In the Niger Delta, activities associated with petroleum exploration and production and subsequent discharges of hydrocarbon–derived chemical wastes have caused contamination of soils, groundwater pollution and ecosystem degradation. Ageing oil and gas production facilities often discharge significant volumes of petroleum hydrocarbon into the agricultural land.

Table 4: Farmers' Perception of the Effect of Gas Flaring on their Crops

Crop	Nature of problem attributed to gas flaring by farmers at
Yam (D. rotundata)	Gas flare (GF) continuously emitting heat radiation, light and unburnt gas drastically reduces yield, both quantitatively and qualitatively. GF attracts insects, such as variegated grasshopper (Zonocerus variegates) that eats up vines, and yam beetle (Heteroligus spp.) that attacks yam tubers.
Cassava (M. esculenta)	Gas flare attracts grasshoppers, which eat up the plants
Rice (O. sativa)	No gas flare effect on rice was reported.
Mango (M. indica)	Gas flare causes premature ripening of fruits, especially during the dry season months of December-March each year.
Sweet orange (C. sinensis)	Gas flare effect is similar to that of mango. In addition farmers believe that toxic effluents dispersed by flood water to homes and farms adversely affect the crop.

Source: *Daniel-Kalio and Braide (2006).*

Human Health Risks

Discharges of petroleum hydrocarbon into the environment often expose human population around the contaminated area to potentially dangerous toxic substances. Acute exposures to aromatic hydrocarbons, which are common constituents of oil, are known to cause respiratory disorder in humans.

CONCLUSION

Agriculture remains a potent catalyst for peace in the Niger Delta. Policy documents such as the National Policy on Environment and Agriculture in Nigeria: the New Policy Thrust intended to enthrone sustainable exploitation of agricultural and natural resources in Nigeria and indeed the Niger Delta have not yielded the expected outcomes. This abysmal failure is attributable to the pursuit of oil profit to the detriment of the localitiesand dwellers of the Niger Delta region and their agriculture, where crude oil is explored.

The Nigeria state has often used violence as a means for solving company-community conflicts. Violence and military options for solving the Niger Delta crisis has never worked. Regulatory agencies and policies should be restructured to tame the tide of environmental destruction perpetrated by oil multinational companies. This is in order to give agriculture the pride of place it deserves in serving as a catalyst for peace, income, and employment in the Niger delta. The peace of the region has been affected by the unabated environmental devastation against agricultural land, and consequently the loss of livelihood sources of the Niger delta people.

RECOMMENDATIONS

- Multinational oil companies operating in the Niger Delta should cease all harmful and wasteful practices, and engage in immediate clean-up of affected areas.
- They must compensate communities for the resources lost as a consequence of oil exploration and production activities, as well as for any other social and economic damages.
- The Nigeria Sat-1 would help in monitoring oil spill by providing the spill position which would serve as input data into the oil spill model. It would also give the extent of coastal water and coastal areas polluted. These information are vital for

quick clean-up of oil impacted areas. In order to reduce the response time and quality decision-making. In this case the application of Geographic Information Systems (GIS) as an operational tool would come handy. Information on the exact position and size of the oil spill can be plotted on maps in GIS and a priority of the combat efforts and means according to the identified coastal sensitive areas can be carried out, (Oyinlola and Olamiju, 2013).

- The creation of Regional Spill Response Centres along coastlines would help in managing oil spill problems. The centres will use oil spill models for combating oil spill problems. Data collected with an airborne system could serve as inputs in the model.

- The petroleum industry should work closely with government agencies, universities and research centers to combat the adverse effect of oil spill incidents in the region.

- Government should develop a new and expanded policy agenda for agricultural extension and communication for rural development, focusing national attenstion on food security and income.

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Short Communication

Survey of Weeds on Irrigated Farmlands in Bakolori-Area of Sudan Savanna-Nigeria

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ABSTRACT

High water table combined with increase in evaporation rate has caused serious weeds infestation which has already ruined our irrigable lands. In view of this, field survey was carried out during 2014 cropping season at the Bakolori irrigation project site Talata Mafara, Nigeria with the aim of assessing weeds infestation and farmers' perception on weed and weed management in the area. Thirty farmers were randomly selected from four sampled farms where irrigation farming is practiced. Questionnaires were administrated; in addition to oral interview. Data were collected on socioeconomic characteristics of the farmers, methods of weed control and checklist on weed abundance. Findings revealed that, majority of the farmers are between the ages of 20-45 years (56%), 77. 14% were males while 22.86% were females. About 25.71% of the farmers had Qur'an education only and 60.57% of them are operating subsistence kind of farming with just 0-10 ha as their farm size. The weed species observed were mostly annuals, constituting about 73.68% of the total weed species. Morphological classification has shown that majority of the weed species are broad leaved Acacia nilotica, Amaranthus spinosus, Boerhavia diffusa, Cassia mimosoides, Euphorbia convolvuloides, Ipomoea triloba, Mitracar pushirtus, Pennisetum hordeoides, Sennatora and Ziziphusspina) constituting 57.89%, 31.58% for grasses (Cynodon dactylon, Oryza longistaminata, Digitaria horizontali, Digitaria singuinalia, Eleusine indica, Imperata cylindrical) and 10.58% were sedges (Cyperus tuberosus and Cyprus esculentus. Majority of the respondents (51.42%) use both hand weeding and herbicide application.

Keywords: *Weeds, Irrigated farms and Bakolori.*

INTRODUCTION

Weeds are plants growing simultaneously in a managed ecosystem such as irrigated farm lands that have negative impacts on human activities (IWSS, 1997). Weeds compete favourably with crops for soil nutrient, soil moisture, space, light and considerably reduce the quality and value of the crops through production and harvesting costs (Hussain, 1983). Yakubu *et al.* (2006) reported that *fadama* soils are highly variable with respect to fertility level and other physical properties such as texture and structure, all of which can affect the growth and distribution of weeds flora. Losses caused by weeds have been estimated to be much higher than those caused by insect pests and diseases where a yield loss of up to 90% and 50% in onions and rice respectively were recorded (Okafor and Datta, 1976; Baltazar *et al*., 2000). Vegetables in general exhibit a greater susceptibility to weeds than many other crops. For example, Sinha and Lagoke (1983) reported 49-86% loss due to weed competition while reported 96% yield loss was observed in the United Kingdom. In Nigeria, weeds in irrigated crops such as tomatoes, pepper, sugarcane and onion has been reported to cause

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between l2 and 78% reduction in yield, which varied with the weed species, intensity of weed infestation and the crop life cycle (Yohanna *et al*., 2014). The area of land cultivated by farmers greatly depends on their ability to have better understanding of weeds and their control measures (Akobundu, 1987). In this respect, effort to identify the predominant weed species in Bakolori irrigation site can be invaluable for effective weed management. Therefore, this study was conducted with the aim of studying socioeconomic characteristics of the farmers as well as identifyingdominant weed species as well as farmers perception in the irrigated farms, which could serve as a guide to farmers, researchers as well as policy makers.

METHODOLOGY

The study was conducted in 2014 at the Bakolori Irrigation Project Site, Talata-Mafara, Nigeria. Talata-Mafara lies on Latitude 12° 30′ 43'N and Longitude 6° 11′ 0' E with an estimated land area of 924, 000km^2 and population of about 39, 045 (NPC, 2006). The major occupation of people leaving in the area is agriculture, particularly dry season farming and fishing. The dominant ethnic group is Hausa, however, a sizeable number of Fulani, Igbo, Yoruba and other tribes are coexisting peacefully in the area. Vegetation of the area is semi-arid with mainly grasses, shrubs and few trees. The area experiences long dry season (October-April/May), short rainy season (June-September/October) and a dry cold Harmattan winds (December-February). Annual rainfall ranges from 450-600 mm with an average temperature range of 25-40 ^{0}C. Relative humidity ranges between 40-80% during the rainy season. Monthly evapotranspiration reaches its peak in March (155.2 mm) and begins to drop reaching its minimum (88.1 mm) at the height of rainy season. Major arable crops grown are cereals like maize, millet, wheat, sorghum and rice and legumes like cowpea, groundnuts coupled with vegetables that include tomato, potatoes, onions, watermelon, okra, roselle and pumpkins are also grown. Sandy loam soils are dominant on the slopes while the flood plains are dominated by black soils originally laterized (USAID, 2010).

The sample for the study was drawn based on the various areas around the Bakolori Irrigation Project site. Weeds were sampled from the experimental sites using a quadrant with a dimension of 2 × 2(4 m^2). This was used to determine the general classification, life cycle, morphology and frequency of occurrence of the weed species. A total of fifty (50) questionnaires were administered but thirty-five were returned valid. Data were collected on socioeconomic characteristics, farm size, weed abundance and control methods and data were analysed using descriptive statistics.

RESULTS AND DISCUSSION

Table 1 shows the demographic information of the respondents by age and gender. Gender and age are two important demographic factors that contribute to knowledge, attitude and practices of farmers (Ghorbani and Hamraz, 2009; Sarker*et al*., 2010; Sayed *et al*., 2010). Majority (77.14%) of the respondents are male, reflecting a male dominated occupation, while 22.86% are females. Farming in Nigeria is characterized by energy sapping operations. Therefore, it is not surprising to note that an overwhelming percentage of farmers in the study area are male. It is also recorded that majority (85.71%) of the farmers fall within the age bracket of 20-40 years; this age bracket is considered to be energetic enough to engage in farming activities, while a small percentage of 14.29 fall within the age category of 41-60 years.

However, it is interesting to note that majority (57.14%) of the farmers are married while only 22.86% are single. The large number of the male farmers and small number of females is an indication of northern Nigerian culture where the male is the farmer (sole provider) who brings the produce from the farm. It was observed that the little percentage (20.00) of the divorced females may explain why they went into farming business to sustain themselves and their families. Also, 42.86%, 25.71% and 14.29% had no formal education; primary/secondary education and Quranic education attained, respectively. This has a great implication for technology adoption. Fadayomi (1991) and Akobundu (1987) observed that majority of the rural farmers in Nigeria has no formal education.

Table 1. Socioeconomic Characteristics of the Farmers

	Category	Frequency	Percentage
Sex	Male	27	77.14
	Female	08	22.86
Age	20-40	30	85.71
	41-60	05	14.29
Marital Status	Single	08	22.86
	Married	20	57.14
	Divorced	07	20.00
	Widower	00	100
Level of Education	Quranic	11	25.71
	Primary	09	14.29
	No formal	15	17.14
House Hold Size	≤5	05	14.29
	0-6	07	20.00
	≥10	23	65.71

Table 2 revealed that all farmers still use manual method of operation. The size of the land owned by majority (60%) of the farmers ranges from as small as 0-10 ha. While 60% of the farmers spend not less than 20 years in farming; others (15%) are relatively new in the business with just about five years of experience. This is in line with the fact that the Nigerian population is dominated by small scale farmers. This was corroborated with Babalola, (2002). The trend in household size in the study area indicated that majority (65.71%) of the respondents have more than 15 persons per household. This could serve as a motivation to adopt as well as comprehend new farming techniques where prospect for hired labour is low (Ikuenobe *et al*., 2005).

Results showed that majority of the farmers adopt both herbicide and hand weeding techniques, where 20.00% of the respondents use herbicide. The use of herbicides requires expertise which might be difficult to understand by farmers as a result of high level of illiteracy recorded among them. In consequence, they find it difficult to read instructional labels on herbicide containers and understand the functionality of herbicides Ali *et al*. (2005). About 28.57% use manual (hand weeding) method of weed control. Integrated use of herbicide and manual hand weeding is seen as the most effective immediate solution to most weed problems. This was also corroborated by Ali *et al*. (2005).

Table 2: Showing Farms Size, Methods of Farming and Weed Control

	Category	Frequency	Percentage
Methods of farming	Hand	35	100
	Mechanical	00	00
Farm Size(ha)	1-10	21	60.57
	11-20	08	22.85
	21-30	06	17.14
Weed Control Methods	No control	00	00
	Hand weeding	10	07
	Use of herbicide	28.57	18
	Both	20	51.42

Table 3 showed the distribution of weeds based on life cycle and morphology. The dominance of these species is characteristics of Nigerian savannah agro ecological zones. Similar observation was made by Ishaya *et al*. (2012) who reported that in the Nigerian savannah agro-ecological zone, grasses and sedges are often the most dominant weed species. Yakubu *et al*. (2006) and Yohanna *et al*. (2014) reported that could be attributed to regular flooding in area which increases the rate of weed seeds in weed bank.

Table 3. Showing Distribution, Morphology and Frequency of Weeds in the Study Area

S/No.	**Name of Weed species (Genus and species)**	**Classification**	**Morphology**	**Frequency of occurrence**
1.	*Acacia nilotica*	A	B	**
2.	*Amaranthusspinosus*	A	B	***
3.	*Boerhaviadiffusa*	A	B	**
4.	*Cassia mimosoides*	A	B	*
5.	*Cyperustuberosus*	P	S	*
6.	*Cynodondactylon*	P	G	***
7.	*Cyperus esculentus*	P	S	***
8.	*Oryzalongistaminata*	A	G	***
9.	*Digitariahorizontalis*	A	G	*
10.	*Digitariasinguinalia*	A	G	**
11.	*Eleusineindica*	A	G	*
12.	*Euphorbia convolvuloides*	A	B	*
13.	*Ipomoea triloba*	A	B	*
14.	*Mitracarpushirtus*	A	B	*
15.	*Pennisetumhordeoides*	A	B	*
16.	*Portulacaoleracea*	A	B	**
17.	*Imperata cylindrical*	P	G	***
18.	*Sennatora*	A	B	***
19.	*Ziziphusspina*	P	B	***

Field survey, 2012

A = Annuals: B = Broad leaved: S = Sedge: P = Perennials: G = grass

CONCLUSION

In conclusion, the weed species associated with irrigable land of Bakolori irrigation area included broad leaved (57.89%), grasses (31.58%) and sedges (10.58%). The dormant weed species were; *Cyperus spp, Oryza spp, Cynodon spp, Digitaria singuinalia,* and *Portulaca*

oleracae. Majority of the farmers were subsistence whom has little or no knowledge of western education and adopted both hand weeding and herbicide application for controlling weeds in the farm.

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