CLIMATE CHANGE, COST OF PROVIDING WATER AND LIVELIHOOD DIVERSIFICATION BY ARABLE CROP FARMERS IN NIGERIA

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Abstract
The study showed the relationship between the cost of providing additional water on-farm and the movements to secondary livelihood activities to adjust to shock of climate change by farmers. The study undertook a cross-sectional survey of arable crop farmers in Nigeria. The study utilized the multi-stage random sampling to select representative samples. The sampling process involved an initial selection of two (2) agro-ecological zones, the Guinea Savanna and the Southern Rain Forest out of the four (4) broad agro - ecological zones namely: the Northern Sudan Savanna, Guinea Savanna, Derived Savanna and the Southern Rain Forest through the simple random technique. Consequently, two (2) states Osun and Niger were purposively selected from the Guinea Savannah and the Southern Rain Forest, respectively. At the last stage of sampling, two hundred (200) arable crop farmers from each of the 2 states making a total of 400 farmers. The field survey took place between December 2014 and February 2015. Information was collected on farmers' socio-economic, environmental, cultural and institutional variables. The data were subjected to descriptive analysis. The study revealed that the predominant movements by farmers induced by climate change were to other livelihood activities such as trading, artisanal jobs and farming of other agricultural crops. The common feature about the pattern of the movements is that they are rural-based and have capacity to generate additional incomes to support primary crop production. The study recommended increased investment on wells, boreholes and other infrastructure that can support provision of water by farmers and government at all levels, as well as increased investment on other non-farm income generating activities by farmers.

Keywords: Climate change, Livelihood diversification, Agriculture**.**

Introduction

Agriculture is a significant economic activity and has the highest contribution of 22.86% to Nigeria Gross Domestic Product (GDP) compared with other economic activities according to the 2018 Quarter 2 GDP report (NBS, 2018). It also provides employment for over 80% of the population who depends on it for rain-fed agriculture and fishing as their primary occupation. Significant of note is the fact that crop production represents 94 % of these agricultural activities (Ebele and Emordi, 2016) and any exposure of the sector to any unfavourable shock is capable of impacting heavily on the welfare of those whose livelihood depend on the sector, particularly if the personal and institutional capacities to adequately respond are lacking. In the last four decades, agriculture has been linked with shocks such as climate change, financial crisis, oil discovery etc. and of these shocks, climate change consequences seem to have lingered and its concern heightened, given the strong connection of agriculture with poverty (Ebele and Emordi, 2016).

Climate change is unarguably manifesting in Nigeria and evidences have shown that its effects are real. For instance, Odjugo (2010) analysed the trend in air temperature from year 1901 to 2005 and estimated a temperature increase of 1.7^{o}C during this period. He opined that if this trend continues Nigeria will fall within the low or medium scenario of global warming with not less than 2.5^{o}C temperature increase. This will be characterized by an increasing frequency and intensity of unusual and extreme events such as rainfall pattern, flood and sea level rise among others (Odjugo 2005, 2009; Molega 2006 and Umoh 2007). These studies have confirmed an increase in total rainfall in the coastal areas since the 1970s, which may have been linked to increased flooding in areas such as Lagos, Port Harcourt and Calabar. Likewise, there is increasing temperature and decreasing rainfall in the continental interior and semi-arid regions such as Sokoto, Katsina, Kano, Maiduguri which may have resulted in increasing evapotranspiration, drought and desertification as reported by Odjugo and Ikhouria (2003) and Adefolalu, (2007). Furthermore, NEST (2003) reported a constant reduction in forest cover and a sea level rise of 0.2m in the coastal region of Nigeria, which also is an indication of climate change and global warming. These evidences show that there is a little chance of success for Nigeria's heavily rain dependent agricultural production and implies that urgent necessary steps must be employed to adapt to this changing climate.

The Agriculture sector is one of the highly vulnerable to climate change in Nigeria and Africa (Mendelsohn and Tiwari, 2000, Parry *et. al.*, 2004). Meanwhile, available information shows that developing countries are more adversely affected by climate change than the industrialized economies. For instance, Houghton, *et al.*, (1997) projected a reduction in the Gross Domestic Product (GDP) of developing countries of between 2 – 9 % per year against 1 – 2 % for industrialized countries because of climate change. Consequently, crop production must increase by 40 % and meat products by 58 % in developing countries by 2020 to meet the expected demand that may arise by population growth and increased incomes (Sanchez, 2000). Furthermore, climate change have the potential to negatively impact African agriculture in a range of ways resulting to an overall reduction of productivity that could lead to a loss of GDP of between 2 – 7% in 2100 in the Sahara and 2 – 4% in Western Africa [Pan African Climate Justice Alliance (PACJA) (2009)]).

To underscore the significance of climate change to Nigeria's agriculture, Kehinde *et al.,* (2018) examined the trends in rainfall and temperature in Nigeria between 1970 and 2012 and their effects on maize and rice output in Nigeria. The average annual growth rate of rainfall for the period was 1.88 % though there was a degree of instability in the average annual rainfall. However, the average annual growth rate of temperature for the period covered by the study was 1.24 % and there was also a degree of instability in the average annual temperature. The study indicated obvious consequence of variation in climate on crop production for maize and rice and the need for appropriate farm level adaptation. Usman and Dije (2013) further corroborates these, that agriculture will be adversely impacted by increasing variation relating to the timing and amount of rainfall while, Wolfe *et al.,* (2005) asserted that the sustainability of agricultural production and yields in Africa depend on the quality of rains.

While controlling temperature may seem technologically difficult for farmers in developing countries, controlling water availability may seem an easier alternative. In underscoring the significance of water, World Bank (2017) and Organization for Economic Co-operation and Development (OECD, 2010) estimate that agriculture accounts for an estimated 70 % withdrawal of water globally. Also irrigated agriculture represent 20 % of the total cultivated land and contributes 40 % of the total food produced globally. By extension, an important response to climate change is diversification to other livelihoods and migration to other farm or non-farm locations. This can either reinforce or undermine food security. It can be deduced from the forgoing, that, responding adequately to provision of water by farmers will contribute significantly to reducing food insecurity and improved livelihood for those engaged in agriculture. It is to this extent that the study examined the interplay between cost of providing water and corresponding movements to alternative livelihood activities by arable crop farmers in Osun and Niger States of Nigeria.

Climate change induces in situ and ex situ adjustments (that is, on and off- farm adjustments) (Nawrotzki *et. al.,* 2015), As shown in Figure.1, this framework describes the farm level adjustment

induced by climate change which is the idea advanced by the authors of this study. The study argues further that climate change will ultimately result in livelihood adjustment by farmers resulting to on-farm and off- farm choices. Quite a lot of studies have already reported farm and non-farm adaptations to climate change (Apata *et al.*, Ellis 2000, Bryceson *et al*., 2000, and Cannon, 2014). This study will particularly focus on investment in wells as a source of providing alternative water to augment water from rains and the diversity of rural non-farm livelihoods activities farmers move to adapt to climate change. Selected socioeconomic characteristics that contribute to these climate adaptation movements will be analysed.

Methodology

Study Area:
The study area is Nigeria. It is located in the tropical zone of West Africa between latitude 4^{o} N to 14^{o} N; and longitude 3^{o} E to 15^{o} E. It has two distinct climate; the wet and dry seasons between April - November and November - March, respectively. The four broad agroecological zones are the the Northern Sudan Savanna (NSS), Guinea Savanna (GS), Derived Savanna (DS) and the Southern Rain Forest (SRF). It is bounded in the north by Niger Republic, in the West by Benin Republic and in the East by the Cameroun Republic. The Chad Republic is to the North-East and the Atlantic Ocean is to its South via the Gulf of Guinea. Prominent rivers in Nigeria include; Niger, Benue, Cross River, Ogun, Osun and Imo (all flowing directly into the Atlantic) as well as Rivers Kaduna, Hadejia and Gongola (all flowing into the Lake Chad). Furthermore, Nigeria has a land extent of about 923,769 km^2; a North-South length of about 1,450km^2 and a West-East breadth of about 800 km. It is a country with diverse biophysical characteristics ethnic nationalities, agro-ecological zones and vibrant socio-economy. (Federal Republic of Nigeria, https://www.britannica.com/place/Nigeria).

Sampling and Data Collection:
Nigeria has four broad agro-ecological zones namely; the NSS, GS, DS and the SRF. The multi-stage sampling was used to select representative sample of farmers for the study. The sampling process involved an initial selection of two (2) (SRF and GS) from the four (4) broad agro-ecological zones. Consequently, two (2) states, (Osun and Niger States) were purposively selected from the the GS and the SRF, respectively because they represent major vegetational ecologies which are very important food belts in the country. The two states are each divided into three (3) agricultural development zones (ADPs) while the ADPs in Osun comprises 30 and Niger 25 Local Government Areas (LGAs). Ten (10) and eight (8) LGAs, respectively were sampled from the ADPs in the 2 states. In the absence of a sampling frame, a sample of two hundred (200) arable crop farmers were selected in the farming communities in the selected LGAs from each of the 2 states making a total of 400 farmers. The field survey was conducted by well trained staff of the Agriculutural Development Project (ADP) in both states and took place between December 2014 and Februrary 2015. Information was collected on farmers' socioeconomic characteristics, environmental, cultural, institutional variables. After data cleaning, information on 367 respondents were found suitable for further analysis.

Analytical Techniques:
Descriptive statistics was the main tool employed. This involved the use of frequency count and percentages. Cross tabulation was used to examine the relationship between socioeconomic characteristics and cost required to dig wells which was a proxy for water availability.

Results and Discussion

Socioeconomic Characteristics of Respondents:
The socio-economic characteristics of respondents are presented in Table 1. The results show that majority of the farmers fall between 41 – 60 years with an average of 47.3years. Majority of the respondents (90.7%) are male and have formal education with just 28.6% without formal education. Most farmers have between 11 – 20 years farming experience and an average of 15.7years. The level of exposure to formal education and length of farming experience are two important factors that can

positively influence farmers' knowledge of and adaptation to climate change.
Most farmers have secondary occupation. While 7.6% have agriculture as their secondary occupation, 68.7% have agricultural related secondary occupations and 23.7% have no secondary occupation. This distribution implies that most farmers have opportunities to earn income from other sources and can utilize these to support their farm enterprises by helping to cushion the effects of adverse climatic conditions and other risks.

Access to land is mostly through inheritance (70.8%), followed by family land (17.2%) as shown in Table 1. These two tenurial arrangements encourage land fragmentation and is also a disincentive for investment in land improvement activities that can increase agricultural productivity. Furthermore, the result indicates that (61.3%) are members of cooperative societies and most of them do not source their farm input from these societies. Most farmers practice mixed cropping (66.7%) followed by mixed farming (10.9%). Most farmers (70.9%) cultivate their crops in the wet season while 28.6% cultivate in both wet and dry seasons. The prevalence of wet season farming can be explained by the dependence on rain as the main source of water by the farmers and possibly inadequate funds to invest in other sources of water. Finally, most farmers (97.0%) engage in competitive sale of their harvest by selling at the central food market rather than the farm gate. This is likely going to increase the net returns received by the farmers from their enterprises.

Secondary Livelihood Activities:
Table 2 shows the distribution of the respondents by their livelihood activities arising from the need to respond to climate change effects. The most prevalent secondary livelihood activity is trading (22.3%) and artisanal jobs (19.6%). The prevalence of these two may be related to their ability to generate huge returns that can sustain farm families as well as provide surplus funds that can be ploughed back into their farm enterprises. The least prevalent are hunting, clergy and private sector employment whose income generating potentials are usually low.

Relationship among Livelihood Activities, Cost of Providing Water and Age of Respondents:
Socioeconomic characteristics play a significant role in how farmers respond to production and economic shocks and this can inform the livelihood activities they move to in response to these shocks. From Table 3, the movements to other livelihood activities arising from the required cost of digging well to supply water on farms shows that farmers that moved to trading, artisanal jobs and other forms of farming have the greatest drive to invest more in well digging to provide irrigation water on their farms. These patterns are consistent across the different age groups namely; 18 – 40 years (youth), 41 – 60 years (active labour force) and > 60 (elderly).

The result further indicated that 45.0%, 34.6% and 9.1% of the age groups 18 – 40, 41 – 60 and > 60 years, respectively produced on their farms without digging wells, that is they practiced only rain fed agricultural production. This implies therefore that the preference for irrigation will increase with age, while the more experienced in agriculture or the older farmers are most likely to invest more in agriculture and more likely to plough back income from other secondary occupations into agriculture. These activities will ultimately serve to further boost agricultural output and farm incomes. It can also be assumed that movements from agriculture to other livelihood activities are more likely to be a catalyst for increase in agriculture output by the old compared with the young farmers.

Relationship among Livelihood Activities, Cost of Providing Water and Gender:
Table 5 reveals that there is a wide difference in the diversity of livelihood activities engaged in by male and female farmers. While the male farmers are involved in fourteen (14) livelihood activities, the females are involved in four (4). For male farmers, artisanal jobs, other types of farming and trading are the three (3) most important livelihood activities movement from agriculture arising from farmers' inability to invest in digging wells to provide water on their farms. This is consistent with the observations on age. In the case of female farmers, artisanal jobs and trading are the most important livelihood option as a result of movements from agriculture. More male farmers (36.6%) compared with their female counterpart (14.7%) are on farms without wells and depend solely on rain fed agriculture which implies that females are more inclined to invest in digging of well over their male counterpart.

Therefore, female farmers are more likely to contribute to food output and household incomes.
Relationship amongst Livelihood Activities, Cost of Providing Water and Household Size:
The size of household may be a major determinant for a movement from agriculture to other livelihood activities in peasant agriculture. Larger households are likely to have higher household expenditure over the small and the medium sized households. Therefore, the need to meet-up with this status will create the need to shift to other livelihood activities that will generate more income to augment incomes from agriculture arising from a climate shock. Table 7 suggests that for small households (1 – 5 persons), and medium (6 – 10 years), the movement from agriculture will be to artisanal jobs, farming and trading while for the large household the movement is to farming and trading. Furthermore, 16.7 %, 23.3 % and 64.9 % small, medium and large size household did not invest in digging wells and depend only on rain for water on their farms. This shows that the small size households have the highest preference for investment in digging well and as the household size increases this preference reduces. This implies that smaller households may likely muster more resources compared with the medium and large and will be better positioned to increase farm output farm and household incomes.

Relationship among Livelihood Activities, Cost of Providing Water and Household Size:
The land area (Ha) cultivated indicates farmers' ability to generate income from their crop enterprise. Land area cultivated categorized as 2 Ha, 2 – 5 Ha and > 5 Ha represent small, medium and large farms, respectively. The movements to livelihood activities arising from climate shock are from agriculture to artisanal jobs, produce merchandise and trading for large size farms. This shows a different mix compared with that of the other three (3) socioeconomic variables earlier discussed namely, age, sex and household size. There are movements toward activities that have potential to generate large amounts of resources that can possibly augment income from their farm enterprises. Table 9 shows that the proportion of large, small and medium farms that did not invest in wells and depend solely on rain on their farm are; 23.2 %, 36.5 % and 39.7 %, respectively. The result shows that large farm size owners have the greatest urge to invest in wells to provide irrigation water on their farms. This makes sense by virtue of their size and the consequent requirement of water on their farms.

Conclusion and Recommendations

The study showed the relationship between investment in digging wells occasioned by climate change and movement to secondary livelihood activities to adjust to the shock of climate change. The study revealed that the predominant movements were to other livelihood activities such as trading, artisanal jobs and farming of other agricultural crops. The common feature of the movements is that these activities are rural-based and have capacity to generate additional incomes to support their primary crop production (arable crops).

It is therefore recommended that:

i. Farmers should invest in more water infrastructure to bolster climate adaptation by sourcing for funds through their cooperative association and other rural lending institutions
ii. Government at all levels should complement farmers' efforts by investing more in rural infrastructure especially sinking of boreholes that would complement existing water sources provided by farmers
iii. Farmers should be educated by extension agents through their cooperative societies or farmers' associations to channel portions of their credit support to invest in additional non-farm income generating activities that will diversify there livelihood base and also strengthen there farm production.

References

Adefolalu, D. O. (2007). "Climate change and economic sustainability in Nigeria". Invited paper presented at the International Conference on *Climate Change and Economic Sustainabilit*y held at Nnamdi Azikiwe University, Enugu, Nigeria. 12-14 June, 2007.

Apata, T. G., Agboola, T. O., Kehinde, A. L. and R. A. Sanusi (2010). economic impacts of climate change on Nigerian agriculture and adaptation strategies response among farming households in Nigeria, *Journal of Agricultural Science and Technology*, 4 (6): 202 - 214.

Bryceson, D., Kay, C. and Mooij, J. (eds) (2000) *Disappearing peasantries? Rural labour in Africa, Asia and Latin America*, London: Intermediate Technology Publications.

Cannon, T. (2014). Rural livelihood diversification and adaptation to climate change, Chapter 4, In Jonathan Ensor, Rachel Berger and Saleemul Huq (eds), *Community based adaptation to climate change: Emerging lesson*s, 2013, Practical Action Publishing. file:///Users/mac/Downloads/PracticalActionBookCBAtoClimateChangeCannonChapterShared.pdf [Accessed 23/2/2021] DOI: 10.3362/9781780447902.004

Department for International Development (DFID) (2001), "Sustainable livelihoods guidance sheets," Sustainable livelihoods guidance sheets, London, UK. Available at: http://www.glopp.ch/B7/en/multimedia/B7_1_pdf2.pdf. [Accessed on 22/02/2021].

Ebele, N.K. and Emordi, N. V. (2016). Climate change and its impact in Nigerian economy, *Journal of Scientific Research & Reports* 10(6): 1-13.

Elasha, B. O., Elhassan, N.G. Ahmed, H. and Z. Sumaya (2005). "Sustainable livelihood approach for assessing community resilience to climate change: Case studies from Sudan," *AIACC Working Paper*, Vol. 17, no. 17, pp. 1–26

Ellis, F. (2000) *Rural livelihoods and diversity in developing countries,* Oxford: Oxford University Press.

FAO (2017). Migration, agriculture and climate change. http://www.fao.org/3/I8297EN/i8297en.pdf

Federal Republic of Nigeria, https://www.britannica.com/place/Nigeria) [Accessed 23/02/202].

Food and Agriculture Organization (2017) Agriculture and migration in the context of climate change. Available at: www.fao.org/migration [Accessed on 22/02/2021].

Hansen James W, Walter Baethgen, Dan Osgood, Pietro Ceccato1, Robinson Kinuthia Ngugi (2007). Innovations in climate risk management: Protecting and building rural livelihoods in a variable and changing climate ICRISAT 4 (1). *SAT eJournal* | www.ejournal.icrisat.org

Houghton, J.T., Gylvan Meira Filho, L. Griggs, D.J., Maskell, K., (1997). Stabilization of atmospheric greenhouse gases: physical, biological and socioeconomic implications. *IPCC Technical Paper III*, IPCC Secretariat, Geneva p48.

Kehinde, A.L., Busari, A.O., Layonu, L. D. and K. F. Adesanya (2018). Effects of climate change on rice and maize production in Nigeria from 1970 – 2012. *African Journal of Sustainable Development, 9 (1),*

Mendelsohn, R. and Tiwari, D. (2000). Two essays on climate change and agriculture: A developing country perspective. *FAO Economic and Social Development Paper* 145. Rome, Italy.

Molega, A.U., (2006). Rainfall anomalies in Nigeria. *Journal of Arid Environ.*, 5(1): 1-8.

National Bureau of Statistics (NBS) (2018) http://www.nigerianstat.gov.ng/

National Bureau of Statistics (NBS) *2017* www.nigerianstat.gov.ng/download/678

Nawrotzki R. J., Lori M. H., Daniel M. R. and Fernando R. (2015) Climate change as a migration driver from rural and urban Mexico, *Environmental Research Letters*, https://www.doi.org10.1088/1748-9326/10/11/114023 [Accessed on 26/06/2018].

Nigerian Environmental Study/Action Team (NEST), (2003). Climate change in Nigeria: A communication guide for reporters and educators, NEST, Ibadan.

Odjugo, P. A. O., and Ikhuoria A. I. (2003). "The impact of climate change and anthropogenic factors on desertification in the semi-arid region of Nigeria", *Global Journal of Environmental Science*, 2 (2):118-126.

.

Odjugo, P. A. O., (2005). "An analysis of rainfall pattern in Nigeria". *Global J. Environ. Sci.,* 4 (2): 139-145.

Odjugo, P.A.O., (2009). Quantifying the cost of climate change impact in Nigeria: Emphasis on wind and rainstorm**.** *Journal of Human Ecology,* 28 (2): 93-101.

Odjugo, P.A.O., (2010) Regional evidences of climate change. *Journal of Geography and Regional Change in Nigeria,* 6 (3) 142 -150.

OECD (2010), Sustainable management of water resources in agriculture, OECD studies on water, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264083578-en.

Pan African Climate Justice Alliance (PACJA) (2009)). The economic cost of climate change in Africa. Available at: https://www.preventionweb.net/files/12722_economiccostofclimatechangeinafrica.pdf [Accessed on 22/02/2021].

Parry, M.L., Rosenzweig, C, Iglesias, A., Livermore, M, and Fischer, G, (2004). Effects of climate change on global food production under SRES emission and socioeconomic senarios, *Global Environmental Change*, 14, 53 – 67.

Umoh, E. (2007). "Flooding problems in Rivers State", Journal of Environmental Science, 4(2): 44-60.

Usman, Y. D. and Dije, B. I. (2013). Potential challenges of climate change to the Nigeria economy. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 6 (2):07-12.

World Bank (2017). Water in Agriculture. https://www.worldbank.org/en/topic/water-in-agriculture Last Updated: Jul 12, 2017.

Wolfe, D.W., Schwartz, M. D., Lakso, A. N., Otsuki, Y., Pool, R. M., and N. J. Shaulis (2005). Climate change and shifts in spring phenology of three horticultural woody perennials In North-Eastern USA, *International Journal of Biometeorology,* 49: 303-309.

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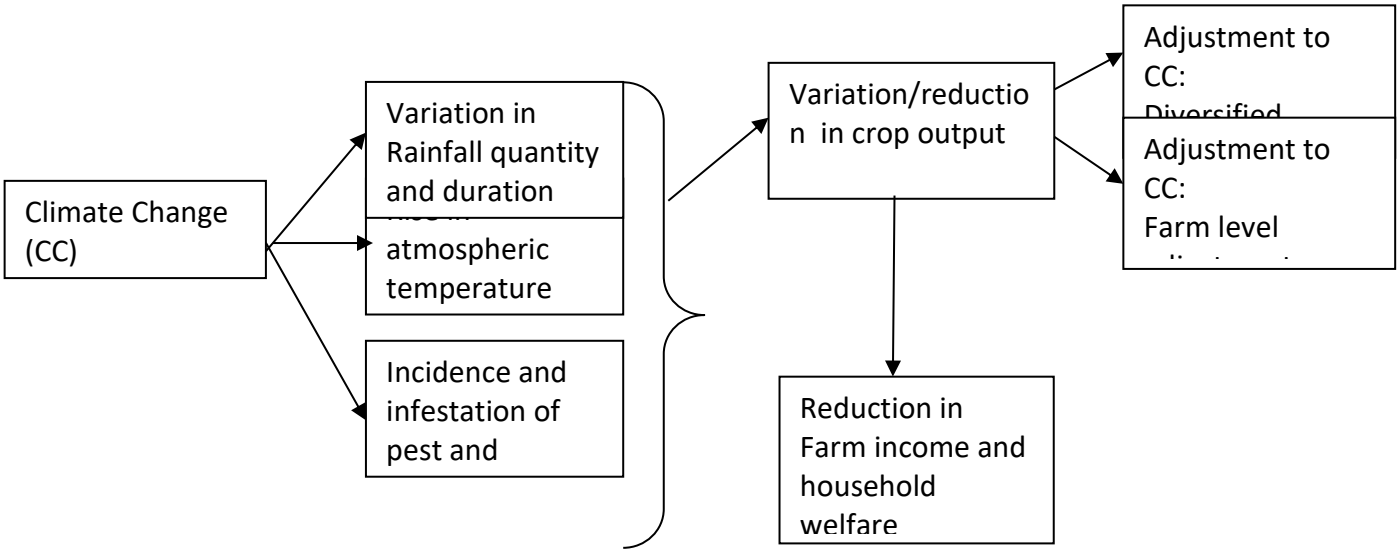

Figure 1: Schematic representation of the relationship between climate change and livelihood adjustment

Table 1: Socioeconomic characteristics of the respondents

Variables	Frequency	Percent (%)
Age (Years)		
18 – 40	109	29.70
41 – 60	228	62.13
> 60	30	8.17
Total	367	100.00
$\bar{X} = 47.43, SD = 11.51$		
Sex		
Male	333	90.74
Female	34	9.26
Total	367	100.00
Level of formal education		
None	105	28.61
Primary	103	28.07
Secondary	92	25.07
Tertiary	67	18.26
Total	367	100.00
Experience in farming (years)		
1 – 10	33	8.99
11 – 20	130	35.42
21 – 30	112	30.52
31 – 40	65	17.71
41 – 50	23	6.27
51 – 60	4	1.09
Total	367	100.00
$\bar{X} = 25.74, SD = 11.38$		
Secondary occupation		
Agriculture	28	7.63
Non-agriculture	252	68.66
None	87	23.71
Total	367	100.00
Sources of land		
Family land	63	17.17
Inheritance	260	70.85
Inheritance and outright purchase	2	0.54
Gift	7	1.91
Outright purchase	4	1.09
Outright purchase & Lease	2	0.54
Lease	27	7.36
Government	2	0.54
Total	367	100.00
Membership of cooperative societies		
Member	225	61.31
Non-member	142	38.69
Total	367	100.00
Sourcing farm input from cooperatives		
Source input	98	26.70
Do not source input	269	73.30
Total	367	100.00
Method of farming		
Mixed cropping	245	66.76
Mono cropping	82	10.63
Mixed farming	40	10.90
Total	367	100.00
System of farm cultivation		
Wet season	260	70.85
Dry season	2	0.54
Wet and dry seasons	105	28.61
Total	367	100.00
Sale of harvest		
Farm–gate	7	1.91
Central food market	356	97.00
Farm gate and central food market	4	1.09
Total	367	100.00

Table 2: Distribution of farmers by their secondary livelihood activities

Livelihood Activities	Frequency	Percent (%)
Animal husbandry	12	3.3
Artisan	72	19.6
Civil servant	26	7.1
Clergy	2	0.5
Craft	6	1.6
Farming (cash and other crops)	29	7.9
Food processing	18	4.9
Hired labour	2	0.5
Hunting	1	0.3
No secondary occupation	87	23.7
Private sector	3	0.8
Produce merchant	6	1.6
Retired civil servant	6	1.6
Trading	82	22.3
Transportation	15	4.1
Total	**367**	**100.0**

Source: Field survey 2014/2015.

Table 3: Relationship between livelihood activities and cost of digging wells by different age categories

			Cost of digging wells for irrigation water (₦)						
			No cost invested on well(s)	1001 – 50000	50001 – 100000	100001 - 150000	150001 – 200000	200001 – 250000	Total
< 18 years	Livelihood activities	Animal husbandry	3	0	0	0	0	0	3
		Artisan	9	8	1	0	0	0	18
		Civil servant	7	1	2	0	0	0	10
		Craft	0	0	4	0	0	0	4
		Farming	0	0	19	0	0	0	19
		Food processing	7	0	1	0	0	0	8
		Hired Labor	2	0	0	0			2
		No secondary occupation	12	9	1	0	0	0	22
		Private sector	1	0	0	0			1
		Produce merchant	0	1	0	0	0	0	1
		Trading	5	3	6	0	0	0	14
		Transportation	3	3	0	1	0	0	7
		Total	49 (45.0%)	25 (22.9%)	34 (31.2%)	1 (0.9%)	0 (0.0%)	0 (0.0%)	109 (100.0%)
18 – 40 years	Livelihood Activities	Animal husbandry	9	0	0	0	0	0	9
		Artisan	9	26	7	2	0	0	44
		Civil servant	10	1	2	2	0	0	15
		Clergy	0	1	0	0	0	0	1
		Craft	0	0	1	0		0	1
		Farming	1	2	6	0	0	0	9
		Food processing	8	2	0	0	0	0	10
		Hunting	0	1	0	0	0	0	1
		No secondary occupation	20	24	8	0	0	0	52
		Private sector	1	1	0	0	0	0	2
		Produce merchant	0	1	0	0		3	4

		Retired civil servant	0	0	1	0	0	0	1
		Trading	14	25	18	0	0	1	58
		Transportation	2	2	3	0	0	0	7
		Total	74 (34.6%)	86 (40.2%)	46 (21.5%)	4 (1.9%)	0 (0.0%)	4 (1.9%)	214 (100.0%)
> 41 years	Livelihood Activities	Artisan	0	8	2	0	0	0	10
		Civil servant	1	0	0	0	0	0	1
		Clergy	0	1	0	0			1
		Craft	0	1	0	0	0	0	1
		Farming	1	0	0	0	0	0	1
		No secondary occupation	1	10	2	0	0	0	13
		Produce merchant	0	1	0	0	0	0	1
		Retired civil servant	1	2	1	1	0	0	5
		Trading	0	9	1	0	0	0	10
		Transportation	0	0	0	1	0	0	1
		Total	4 (9.1%)	32 (72.7%)	6 (13.6%)	2 (4.5%)	0 (0.0%)	0 (0.0%)	44 (100%)
		Grand Total	127 (34.6%)	143 (39.0%)	86 (23.4%)	7 (1.9%)	0 (0.0%)	4 (1.1%)	367 (100.0%)

Source: Computed from field survey 2014/2015.

Table 4: Chi-Square test

Age	Value	Df	Sig.
< 18	104.592	33	0.000
18 – 40	206.174	52	0.000
> 41	50.75	27	0.004

Table 5: Relationship between livelihood activities and cost of digging wells by sex

			Cost of digging wells for irrigation water (₦)						
			No cost invested on well(s)	1001 - 50000	50001 – 100000	100001 – 150000	150001 - 200000	200001 - 250000	Total
Male	Livelihood activities	Animal husbandry	12	0	0	0	0	0	12
		Artisan	18	39	10	2	0	0	69
		Civil servant	17	2	4	2	0	0	25
		Clergy	0	2	0	0	0	0	2
		Craft	0	1	5	0	0	0	6
		Farming	2	2	25	0	0	0	29
		Food processing	15	2	1	0	0	0	18
		Hire labor	2	0	0	0	0	0	2
		Hunting	0	1	0	0	0	0	1
		No secondary occupation	31	42	10	0	0	0	83
		Private sector	2	1	0	0	0	0	3
		Produce merchant	0	3	0	0	0	3	6
		Retired civil servant	1	2	2	1	0	0	6
		Trading	17	21	18	0	0	0	56
		Transportation	5	5	3	2	0	0	15
		Total	122 (36.6%)	123 (36.9%)	78 (23.4%)	7 (2.1%)	0 (0.0%)	3 (0.9%)	333 (100.0%)
Female	Livelihood Activities	Artisan	0	3	0	0	0	0	3
		Civil servant	1	0	0	0	0	0	1
		No secondary occupation	2	1	1	0	0	0	4
		Trading	2	16	7	0	0	1	26
		Total	5 (14.7%)	20 (58.8%)	8 (23.5%)	0 (0.0%)	0 (0.0%)	1 (2.9%)	34 (100.0%)
		Grand Total	127 (34.6%)	143 (39.0%)	86 (23.4%)	7 (1.9%)	0 (0.0%)	4 (1.1%)	367 (100.0%)

Source: Computed from field survey 2014/2015.

Table 6: Chi-Square test

Sex	Value	Df	Sig
Male	13.289	9	0.150
Female	349.900	56	0.000

Table 7: Relationship between livelihood activities and cost of digging wells by different household sizes

			Cost of digging well2 for irrigation water (₦)						
			No cost invested on well(s)	1001 - 50000	50001 – 100000	100001 - 150000	150001 - 200000	200001 – 250000	Total
Small (1 – 5 Persons)	Livelihood activities	Artisan	4	12	5	0	0	0	21
		Civil servant	4	1	0	2	0	0	7
		Clergy	0	1	0	0			1
		Craft	0	1	0	0	0	0	1
		Farming	0	0	5	0	0	0	5
		Food processing	1	0	0	0	0	0	1
		No secondary occupation	5	26	5	0	0	0	36
		Produce merchant	0	1	0	0	0	0	1
		Retired civil servant	0	1	0	1	0	0	2
		Trading	1	8	4	0	0	0	13
		Transportation	0	0	1	1	0	0	2
		Total	15	51	20	4	0 (0.0%)	0 (0.0%)	90
Medium (6 – 10 Persons)	Livelihood Activities	Animal husbandry	5	0	0	0	0	0	5
		Artisan	9	30	4	1	0	0	44
		Civil servant	4	1	2	0	0	0	7
		Craft	0	0	2	0	0	0	2
		Farming	0	0	8	0	0	0	8
		Food processing	3	2	1	0	0	0	6
		Hired labor	1	0	0	0	0	0	1
		Hunting	0	1	0	0	0	0	1
		No secondary occupation	8	15	6	0	0	0	29
		Private sector	1	1	0	0	0	0	2
		Produce Merchant	0	1	0	0		3	4
		Retired civil servant	1	1	1	0	0	0	3
		Trading	4	27	12	0	0	1	44
		Transportation	2	2	2	1	0	0	7
		Total	38 (23.3%)	81 (49.7%)	38 (23.3%)	2 (1.2%)	0 (0.0%)	4 (2.5%)	163 (100%)
Large		Animal husbandry	7	0	0	0	0	0	7

	Artisan	5	0	1	1	0	0	7
	Civil servant	10	0	2	0	0	0	12
	Clergy	0	1	0	0			1
	Craft	0	0	3	0	0	0	3
	Farming	2	2	12	0	0	0	16
	Food processing	11	0	0	0	0	0	11
	Hired labor	1	0	0	0			1
	No secondary occupation	20	2	0	0	0	0	22
	Private sector	1	0	0	0			1
	Produce merchant	0	1	0	0	0	0	1
	Retired civil servant	0	0	1	0	0	0	1
	Trading	14	2	9	0	0	0	25
	Transportation	3	3	0	0	0	0	6
	Total	74 (64.9%)	11 (9.6%)	28 (24.6%)	1 (0.9%)	0 (0.0%)	0 (0.0%)	114 (100.0 %)
	Grand Total	127 (34.6%)	143 (39.0%)	86 (23.4%)	7 (1.9%)	0 (0.0%)	4 (1.1%)	367 (100.0%)

Source: Field survey 2014/2015

Table 8: Chi-Square test

Farm size	Value	Df	Sig
Small	73.396	30	0.000
Medium	177.984	52	0.000
Large	104.685	39	0.000

Table 9: Relationship between livelihood activities and cost of digging wells by different farm sizes

			Cost of digging wells for irrigation water (₦)						
			No cost invested on well(s)	1001 - 50000	50001 – 100000	100001 - 150000	150001 - 200000	200001 - 250000	Total
Small Farms (< 2Ha)	Livelihood activities	Animal husbandry	2	0	0	0	0	0	2
		Artisan	8	11	1	0	0	0	20
		Civil servant	4	2	0	1	0	0	7
		Craft	0	1	0	0	0	0	1
		Farming	0	0	1	0	0	0	1
		Food processing	4	0	0	0	0	0	4
		No secondary occupation	4	4	1	0	0	0	9
		Produce merchant	1	1	0	0	0	0	2
		Retired civil servant	0	2	0	0	0	0	2
		Trading	4	14	5	0	0	0	23
		Transportation	0	1	2	0	0	0	3
		Total	27 (36.5%)	36 (48.6%)	10 (13.5%)	1 (1.4%)	0 (0.0%)	0 (0.0%)	74 (100%)
Medium sized Farms (2- 5Ha)	Livelihood Activities	Animal husbandry	9	0	0	0	0	0	9
		Artisan	9	28	6	2	0	0	45
		Civil servant	14	0	1	0	0	0	15
		Clergy	0	2	0	0	0	0	2
		Farming	2	2	9	0	0	0	13
		Food processing	4	2	1	0	0	0	7
		Hired labour	2	0	0	0	0	0	2
		Hunting	0	1	0	0	0	0	1
		No secondary occupation	20	32	5	0	0	0	57
		Private sector	1	0	0	0	0	0	1
		Retired civil servant	0	1	1	0	0	0	2

		Trading	12	19	3	0	0	1	35
		Transportation	4	1	0	0	0	0	5
		Total	77 (39.7%)	88 (45.4%)	26 (13.4 %)	2 1.0%)	0 (0.0%)	1 (0.5%)	194 (100%)
Large sized Farms (>5Ha)	Livelihood Activities	Animal husbandry	1	0	0	0	0	0	1
		Artisan	1	3	3	0	0	0	7
		Civil servant	0	0	3	1	0	0	4
		Craft	0	0	5	0	0	0	5
		Farming	0	0	15	0	0	0	15
		Food processing	7	0	0	0	0	0	7
		No secondary occupation	9	7	5	0	0	0	21
		Produce merchant	0	1	0	0	0	3	4
		Retired civil servant	1	1	1	1	0	0	4
		Trading	3	4	17	0	0	0	24
		Transportation	1	3	1	2	0	0	7
		Total	23 (23.2%)	19 (19.2%)	50 (50.5 %)	4 (4.0%)	0 (0.0%)	3 (3.0%)	99 (100.0%)
		Grand Total	127 (34.6%)	143 (39.0%)	86 (23.4%)	7 (1.9%)	0 (0.0%)	4 (1.1%)	367 (100.0%)

Source: Computed from field survey 2014/2015

Table 10: Chi-Square test

Farm size	Value	Df	Sig
Small	332.296	30	0.000
Medium	161.939	48	0.000
Large	161.939	40	0.000