

EFFECT OF CLIMATE CHANGE ON FOOD CROPS PRODUCTION IN OGUN STATE

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Abstract

The study was carried out to assess the effect of climate change on food crop production in Ogun State, Nigeria. Multistage sampling was used to select 240 farm households from two ADP zones (Ilaro and Abeokuta) in Ogun State. Data were analyzed using descriptive statistics and Stochastic Production Frontier (SPF) at $\alpha 0.01$. The result reveals that the majority (62.0%) of the respondents were married with mean age and household size of 44 years and 6 persons, respectively. Also, majority (95.83%) were aware of climate change, sourced information about climate change from radio (95.83%) and local Newspaper/Magazine/Flyer (55.00%), while 25.00% sourced from extension agents. Climatic parameters perceived to have changed were sunshine (60.00%), rainfall (19.17%), temperature (8.33%) and wind speed (4.17%) while 81.67%, 75.00% and 54.17% of the respondents claimed that decrease in numbers of rainy days, many days of high temperature and low humidity, respectively, indicated trends in climate change. Cost of agrochemicals ($\beta=0.0740$), number hired labour ($\beta=0.0142$), farm size ($\beta=0.3101$), perceived amount of rainfall ($\beta=-0.0752$) and perceived rate of sunshine ($\beta=-0.1183$) had significant influence on food crop production. It is concluded that the major parameter that influence climate change in the study area is sunshine which have significant effect on food crop production. It was recommended that government should provide necessary resources such as information needs and capital resources that would help the farmers to cope with adverse effects of climate change.

Key words: Climate change; humidity; food crops; stochastic production frontier

Introduction

There is a serious declined in agricultural sector in meeting ever increasing domestic food requirement, inadequate raw material supply for industries and ever demanding foreign exchange inform of exportation due to various problems associated to economic, political, social and environmental problems: among which was climate change (Food and Agriculture, Organisation (FAO), 2019) This concept called "climate change" is a universal environmental phenomenon being experienced by mankind across the globe (Edward, 2019). By implication, climate change cut across areas of life ranging from health sector, economic sector to agricultural sectors. Climate change and agriculture (food and nutrition) are two entities that cannot be separated which can result into negative impact on food availability, accessibility and security if not well managed. Climate change impacts are associated with unforeseen natural catastrophe causing great loss, upset or unpleasantness through flooding, droughtness, hurricanes which at long run leads to reduction in smallholders' productivity as a result of shortage in food crop output and animal lead to livestock production (Anderson, 2018).

According to World Bank (2019a), there are global temperature changes as a result of high continually changing of greenhouse gas emissions into the atmosphere. In this case, there is an interrelation between climate change and agriculture. Amare *et al.* (2018) reported that overall food production and general agricultural related activities in recent years are been negatively affected by climate change. Over time, the resultant effect of climate change on food crop production, availability and security across various countries and region will intensified (Food and Agricultural Organization of the United Nations (FAO), 2018a). The new highlights report of FAO (2018b) has observed that climate change would negatively put food production, availability and security of households, whose livelihood depends on rain-fed agriculture, at risk. Furthermore, it is difficult to planned for climate change and this may become more frequent on farming systems. Until our approach towards agricultural growth and development in terms of planning and investment, there is high tendency of improper allocation of available resources such as human and financial resources to agricultural system which are incapable of improving the food security status of the farming and at long run, having a negative

influence on climate change (Edward, 2019). Globally, there are visible changes in atmospheric and climatic conditions, and thus have a severe implication on food availability and accessibility, as seen in most countries in the Africa especially Nigeria which are suffering from total dryness. Constant temperature rising have negatively affected crop production, water bodies, likewise perpetual rainfall have resulted into floods. Climate change threatens various economic developments such as, agriculture and natural resource, food crop production accessibility and food security as well as tourism, health and manufacturing companies (Mary, 2019)

Statements of problem

Global climate conditions and patterns have recently been changing and thus have a severe implication on food availability and accessibility. As seen in most countries in the Sub-Saharan Africa region and beyond suffering from perpetual droughts. Increasing temperatures have taken their toll on crops, water bodies and in some instances led to perpetual rains that have resulted in floods. This has compounded the fate of a continent suffering from a myriad of development challenges where for example, malnutrition is responsible for several deaths every year. Growths in average global temperature will have several effects on agricultural production, principal being variations in growing seasons, the length of time that soil temperature and soil moisture conditions are appropriate for crop evolution (Darwin, 2011). The Earth's oceans will expand, raising sea levels and reducing the amount of land available for agriculture. Extreme weather events, such as storms and floods, may also increase in frequency (Darwin, 2011).

Developing countries are more susceptible to climate change due to their low adaptive capacity and growing dependence on resources sensitive to changes in climate. Climate change will weaken development efforts in Africa and the rest of the developing world. This will hit the poorest and most vulnerable sections of society hard (Madzwamuse, 2010). Madzwamuse (2010) also argued that climate change will further deepen the development crisis faced by developing countries as climate changes "threaten to reverse the gains of sustainable development and put additional pressure on already overstretched human and financial resources in developing countries". The perennial challenges faced by the Sub-Saharan African countries (poverty, burden of diseases, conflict, environmental degradation, malnutrition among others), risk getting aggravated by climate change (O'Brien, 2010). In short, the implications of climate change are serious IPCC, 2007b; UNDP, 2007; Stern,

2017). According to O'Brien (2010), "Climate change can be considered as the biggest environmental threat in human history, and as the defining human development challenge for the 21st century". The majority of Sub-Saharan Africa's population (96%) is dependent on rain-fed agriculture and in some countries, predictions forecast a 50% yield deficit by 2050 while arable land will decline by 6% (Madzwamuse, 2011).

The problem haunting small-scale farmers in Nigeria lays in a changing climate that has adversely affected crop production. There has been a noted decline in seasonal rainfall, as well as an increase in temperatures, conditions not favourable to crop production. Therefore, low rainfall amounts, increased temperatures have drastically reduced food production capacity resulting in an increase in the incidence of household food insecurity. Food insecurity in Nigeria have placed conflict, policy, and resource management as insinuating factors (FAO, 2016). Alternatively, Rahim (2017) argues that "hunger results, not from a decline in cumulative food accessibility, but from a lack of clear political commitment to social security provisions due to an alienation of rural land, loss of labour power, a loss of employment, and a fall in wages". A vicious cycle of conflict and food insecurity makes alleviation of poverty in rural areas of the most vulnerable countries especially intractable. Having more people to feed, with less land and water, more variable climate, and greater food price volatility increases stress on livelihoods (World Bank, 2016). It is against this background that an in-depth qualitative study was conducted to establish relationship between climate change and food crop production in Nigeria. Hence, the effect of climate change on food crop production in Ogun State was examined, while the specific objectives were to identify the sources of agricultural information on climate change, examine the perceived indicators of climate change and investigate the effects of climate change on food crops production in the study area.

Justification for the study

Climate change has already compromised food security and access to food in poor rural communities. This has condemned poor countries with the least financial, institutional and technological capacity to adapt to climate change to being the worst affected and most vulnerable. The implication is that, with agriculture facing harsh climate vulnerability, food production in countries and even at the household level has to keep up with internal demand (World Bank, 2014). Therefore, small-scale farmers face the

task of either adapting or falling casualty to the effects of climate change, taking into account that small-scale subsistence agriculture is essential to growth and to reducing mass poverty and food insecurity (World Bank, 2014). The capacity of small-scale farmers to adapt to climate change is enabled by some form of state intervention. Government has an increasing role to build capacity of small-scale farmers so that they manage to adapt to climate change. This is based on the understanding that in South Africa an estimated 2.2 million households are food insecure, 14 million people are vulnerable to food insecurity and cannot adapt with some form of state assistance (HSRC, 2012; DAFF, 2006). Some attempts have been made to estimate the impact of climate variability on food

production at the country, regional or global scale (Stern, 2017). However, these attempts failed to provide critical insight into the impacts on farmers' output. In this study therefore, an attempt was made to fill the gap in the literature by assessing the effects of climate change on food production in Ogun state.

Methodology

Ogun State, in southwestern Nigeria was selected as the study area. The state has a land size of 16409.26 km². It has an estimated population of 3,751,140 (Nigeria Population Census 2006). The state was carved out of the old western region in by the Military Government of the Federation in 1976 and its name is derived from the Ogun River.

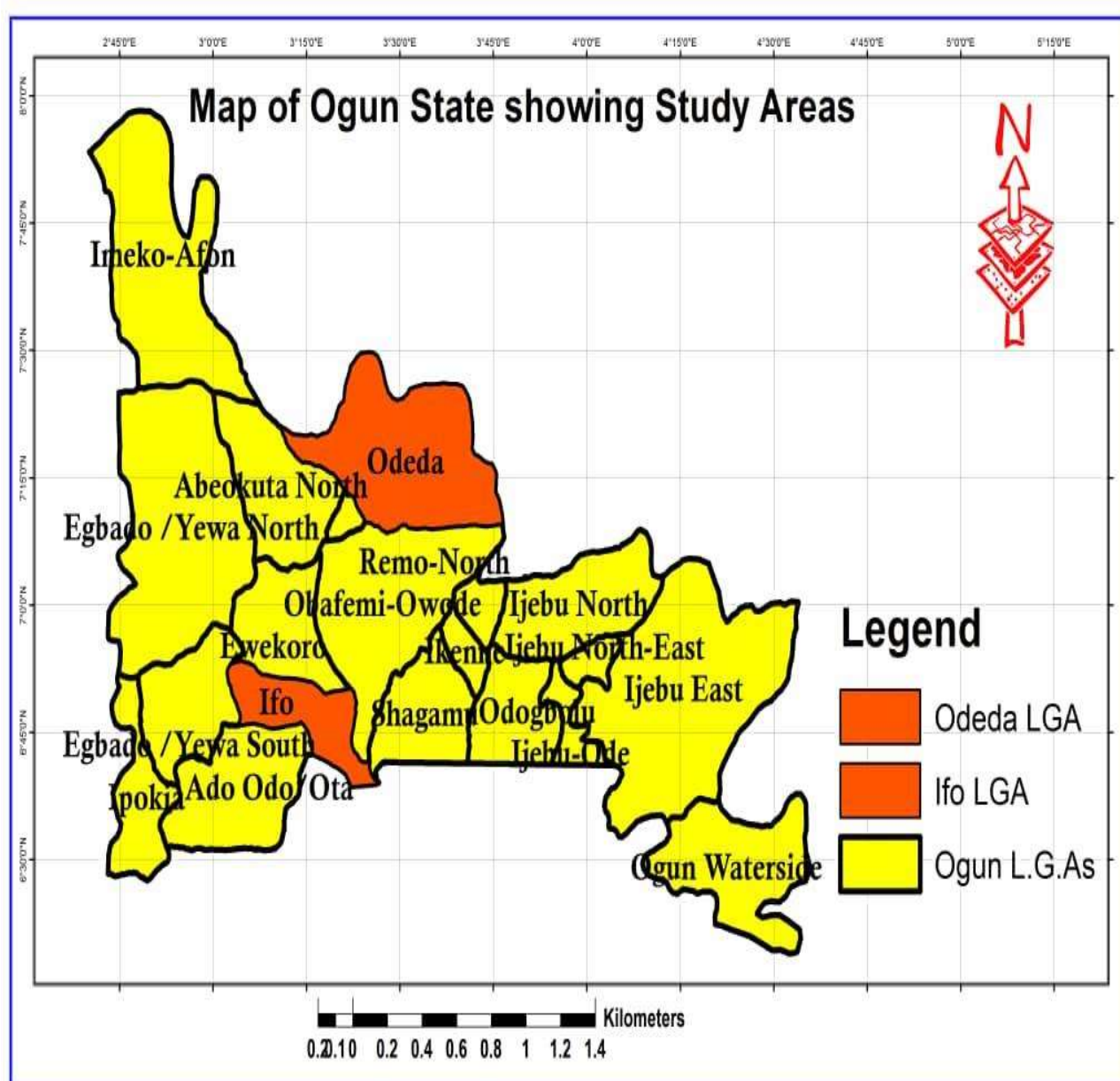


Figure 1: Map of Ogun state showing Selected LGAs study areas

Sampling technique and sample size

The population of the study comprised food crops farming households in Ogun state, Nigeria. A multistage sampling technique was used to select 240 rural farming households in the study area. Stage one involved purposive selection of 2 zones (Abeokuta and Ilaro) from 4 zones of the Agricultural Development Programme of the state because they are major food crop producing zones in the State. Stage 2 involved random selection of 3 blocks each, from Abeokuta and Ilaro. Stage 3 comprised the random selection of 4 cells from the selected 6 blocks, making 24 cells. The fourth stage involved random selection of 10 respondents from each of the 24 cells, giving us a total of 240 respondents. Primary data were collected using structured questionnaire. Data collected were subjected to various analytical techniques such as descriptive statistics, budgeting analysis and Stochastic Production Function (SPF) regression analysis.

Results and discussion

Demographic distributions of the respondents

The demographic distribution showed background information of the sampled respondents. The distribution of age of the food crop farmers in Table 1 revealed that 91.83% of food crop farmers were aged

below 50 years with an average age of 44 years. This result was in conformity with the finding of Omotayo and Oladejo (2016) who pointed out that individuals are more active under the age of 50 years. This pinpointed that majority of the household heads were still at their active productive age. In addition, the food crop farmers in the study area had an average of 6 persons in their household with about 63.0% of them married. This large family size points to the need for the knowledge of family planning in rural households (Omotayo and Oladejo 2016).

The distribution of the respondents according to belief revealed that the majority (55.0%) are Muslims. In terms of distribution of food crop farmers by educational status, the majority (79.17%) had formal education as against 20.83% with no formal education, with the mean farming experience estimated at 13 years. This is contrary to Dipeolu et al. (2009) who reported that many rural farming households lack basic elementary education. Furthermore, the mean farm size was estimated at 4.3 hectares. Also, a high proportion (88.1%) of the farm size fell between 0.1 and 5.0 hectares for the food crop farmers, clearly showing the subsistence nature of farming in the state. This was in line with Arimi (2014) who reported that the majority of Nigeria's farmers are still subsistence in nature

Table 1: Socioeconomic distribution of Food Crop Farmers

Variable	Frequency	Percentage	Mean
Age			
25	22	9.17	
26-30	44	18.33	
31-37	18	7.50	
38-45	124	51.66	44
46-50	10	4.17	
Over 50	22	9.17	
Marital status			
Single	42	17.50	
Married	150	62.50	
Widowed	44	18.33	
Divorced	4	1.67	
Sex			
Male	140	58.33	
Female	100	41.67	
Educational level			
Primary	112	46.67	
Secondary	46	19.17	
Tertiary	32	13.33	
No formal	50	20.83	
Household size			
Less than 5	30	12.50	
5 – 9	150	62.50	6
Above 9	60	25.00	



Farm size			
Less than 5	150	62.50	4.3
5-10	60	25.00	
Above 10	30	12.50	
Farm experience			
Less than 6	10	4.17	13
6-10	104	43.33	
Above 10	126	52.50	
Religion			
Christianity	94	39.17	
Islam	132	55.00	
Traditional	14	5.83	
Others			
Total	240	100.00	

4.2 Distribution of respondents according to awareness about climate change in the study area

Table 2 shows the distribution of respondents according to awareness about climate change in the study area. Majority (95.83 percent) of the respondents were aware of climate change while only 4.17 percent of the respondents claimed not to be aware. This indicates that farmers had perceived climate change which enhances their awareness. This

is not surprising because different sources pertaining climate change information, awareness and practices are being shared among the farmers in the recent years. This is confirmed by Idrisa *et al.* (2012), who reported in a study conducted in Sahel Savannah agro-ecological zone of Borno State, Nigeria, that the majority of farmers were aware of climate change and its consequences.

Table 2: Distribution of respondents according to awareness about climate change in the study area

Awareness	Frequency	Percentage
Yes	230	95.83
No	10	4.17
Total	240	100.00

Distribution of the respondents according to source of information on climate change

The source of information on climate change as presented in Table 3 reveals that most of the respondents (95.83 percent) sourced information on the radio. Respondents who sourced information from local Newspaper/Magazine/Flyer and extension

agents were 55.00 percent and 25.50 percent respectively, while 4.17 percent of the respondents received or had no source of information on climate change. These findings are supported by Maponya (2012), who reported that local radio is the major source of information received by small-scale farmers in Africa.

Table 3: Distribution of the respondents according to source of information on climate change

Information Source*	Frequency	Percentage
Extension Agent	60	25.50
Friends/Neighbour	112	46.67
Radio	230	95.83
Television	30	12.50
Worship centers	150	62.50
Mobile phones	60	25.00
Local Newspaper/Magazine/Flyer	130	55.00
No response	10	4.17

* Multiple response



Distribution of respondents according to the Perceived Climatic Parameters that Influence Climate Change in the Study area

Table 4 showed the perceived climatic parameters that influence climate change in the study area by the respondents. The result revealed that majority (60.00 percent) of the respondents perceived sunshine as the climatic parameter that influence climate change while 19.17 percent, 8.33 percent, 4.17 percent of the respondents reported that rainfall, temperature and wind

respectively were the climatic parameters that brought about climate change in the area respectively. This claim was supported by Bareja (2011) that climatic factors such as rainfall and water, light and temperature are the factors that influence plant growth and development. It was also in line with the claim that climate variability is a long-term shift in weather conditions identified by changes in temperature, precipitation, wind and other indicators (climate change.canada.ca 2015).

Table 4: Distribution of Respondents according to the perceived Climatic Parameters that Influence Climate Change in the Study area

Climatic Parameters	Frequency	percentage
Rainfall	46	19.17
Temperature	20	8.33
Wind	10	4.17
Sunshine	144	60.00
Humidity	10	4.17
None	10	4.17
Total	240	100.00

Perceived Trends in Climate Change among farmers in the study area

The distribution of the respondents according to perceived trends in climate change in the study area was presented in Table 5. The result showed that majority (81.67 percent) of the respondents claimed that decrease in numbers of rainy days as a trend in

climate change. Also, 75.00 percent, 63.33 percent and 54.17 percent of the respondents claimed to perceived late arrival of rainfall, high temperature causes wilting of crops and many days of high temperature coupled with low humidity as a trends of climate.

Table 5: Perceived Trends in Climate Change among farmers in the study area

Trends in climate change*	Frequency	Percentage
Increase in temperature	46	19.17
Many days of high temperature and low humidity	130	54.17
High temperature causes wilting	14	5.83
Decrease in number of rainy days	196	81.67
Inadequate rainfall leads to crop failure	88	36.67
Unstable rainfall pattern reduces yield	152	63.33
Late arrival of rain delays planting	180	75.00
Destructive wind is common	42	17.50
Wind causes damages to crop	30	12.50
Increase in temperature	14	5.83
Many days of high temp.	20	8.33
None	10	4.17

* Multiple responses

Maximum Likelihood Estimates of the Stochastic Production Function of food crop farmers

Table 6 presents the maximum likelihood estimates (MLE) of the production function of food crop farmers in Ogun State. The variance parameter for sigma-square for food crop farmers was estimated at 0.512. The sigma-square attests to the goodness of fit and correctness of the distributional form of the model

while the gamma value (0.601) which was significant at 1% revealed the systematic influences that were unexplained by the production function and the dominant sources of random error. It implies that about 60% percent of the variance in output of food crop farmers in Ogun State was due to the differences in their technical efficiencies.

The result showed that cost of agrochemicals ($\beta=0.0740$), hired labour ($\beta=0.0142$) and farm size ($\beta=0.3101$) in hectares had positive significant influence on food crop production at 1 percent level of significance. However, the finding showed that other variables such as fertilizer and cost of planting materials/input didn't exert any significant influence on food crop farmers in the study area. The contribution of farmers' personal characteristics such as age, years of education, farming experience,

household size and sex, perceived rainfall, perceived sunshine and perceived humidity were also examined. However, all the variables examined in the inefficiency model are not significant except perceived rainfall ($\beta=-0.0752$) and perceived sunshine ($\beta=-0.1183$) that had negative influence on farmers' inefficiency model. It implies that rainfall and sunshine are predominant factors in food crop production in the study area.

Table 6: Stochastic Frontier Production Function Model result of Food Crop Farmers

Variables	Coefficient	Standard error	t-value
Constant	0.5531***	0.2221	
Farm size	0.3101***	0.0982	
Number of Labour (Man days)	0.0142***	0.0099	
Fertilizer (Kg)	0.5981	0.4421	
Agrochemicals (Kg)	0.0740***	0.0289	
Planting material/input (₦)	0.1120	0.3211	
Inefficiency Model			
Constant	1.1321**	0.9736	
Sex	0.1176	0.1123	
Age	0.1023	0.1132	
Education	0.1721	0.2721	
Farm Experience	-0.2217	0.4439	
Household size	-0.1974	0.2310	
Perceived change in rainfall	-0.0752***	0.0522	
Perceived change in sunshine	-0.1183***	0.2316	
Perceived change in humidity	0.3210	0.4321	
Diagnostic Statistics			
Stigma-square (δ^2)	0.512	0.286	0.467
Gamma (γ)	0.601**	0.311	2.061
Log Likelihood	-92.32		
Chi Square	18.11***		

Conclusion and recommendation

It can be concluded from the findings that majority of the farmers are young and expected to be productive. Also, majority of the rural farmers obtained information about climate change from extension agents, radio and local newspapers. The climate parameters influencing climate change as perceived by the respondents are rainfall, sunshine and temperature. The SPF analysis shows that farming output in the study area is a function of farm size, number of labour, agrochemicals used, amount of rainfall and sunshine. Moreover, the stochastic production function reveals that inefficiency exists among the food crop farmers.

Therefore, it is recommended as follows:

1. The role of government is necessary to supply the resources needed such as infrastructural, structural, and capital resources. This can help

the farmers to cope with an event of climate variability.

2. In addition, the government can put in place, agricultural disaster insurance system or policy to compensate in the case of losses.
3. In the same vein, provision of government subsidies should be encouraged and distribute uniformly among the rural farming households.
4. Information on climate change impact and various adaptation measures should be translated from a scientific point of view to simple languages that the farmers can understand. Different sources of information on a platform that the farmers can understand should be made available.

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