
ADVERSE EFFECTS OF CLIMATE CHANGE ON SMALL-SCALE AGRO-INDUSTRIES IN SOUTH-WESTERN, NIGERIA

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ABSTRACT: *Climate change impacts on agriculture are alarming despite several recommendations from research to tackle its effects. There is need for sustainable agriculture to meet the increasing demand of agro-industries for raw materials and food for the growing population in Nigeria. This study evaluated the adverse effects of climate change on small-scale agro-industries in Southwestern, Nigeria. Specifically, the study described the socio-economic characteristics of the agro-processors, identified subsectors of agriculture adversely affected by climate change, determined the perception of agro-processors towards the effects of climate change on small-scale agro-industries. A multistage sampling procedure was employed to select 238 agro-processors, while a structured interview schedule was used to collect data. The collected data were analyzed with frequency counts and percentages as the main statistical tools and PPMC was used to make inferences between the variables. The study revealed different types of agro-processing industries in the zone and subsector of agriculture adversely affected by climate change, as well as the agro-processors perception of the adverse effects of climate change on agriculture, environment and agro-industries. The study further revealed that age ($r=0.457^{**}$; $p\leq 0.000$), educational status ($r=0.744^{**}$; $p\leq 0.000$), level of operation ($r=0.219^{*}$; $p\leq 0.026$) and awareness of climate change ($r=0.249^{*}$; $p\leq 0.011$) respectively exhibited significant relationship with their perception of adverse effects of climate change on agriculture and agro-processing industries in the zone. The study, therefore, recommends that government at the Federal, State and Local levels should exercise greater responsibilities in providing policy measures that will reduce the effects of climate change on the subsectors of agriculture and most importantly agro-industries and develop specific policies for implementation to enhance sustainable agro-industrialization in South-west, Nigeria.*

KEYWORDS: climate change, agro-industries, agro-processors

INTRODUCTION

The challenges of climate change are enormous which are reflected majorly in agricultural production leading to poor harvest, low income and food shortage. Agro-industries suffers inadequate raw materials as a result of the adverse effect of climate change on agriculture, hence there is competition for the available raw materials required for the production of different agro-industrial products. A decrease in the level of production of agro-industries is inevitable and invariably increase the prices of available products. Butt et al. (2005) went further to predict future

economic losses and increase the risk of hunger due to climate change. Smith and Skinner (2002) asserted that climate plays a dominant role in agriculture having a direct impact on the productivity of physical production factors, for example, the soil's moisture and fertility. Adverse climate effects can influence farming outputs at any stage from cultivation through the final harvest. Even if there is sufficient rain, its irregularity can affect yields adversely if rains fail to arrive during the crucial growing stage of the crops (Rudolf and Hermann, 2009).

The vulnerability of the Nigerian agricultural sector to climate change is of particular interest to policymakers because agriculture is a key sector in the economy accounting for between 60-70% of the labour force and contributing between 30-40% of the nation's GDP. The sector is also the source of raw materials used in several processing industries as well as a source of foreign exchange earnings for the country. How much one can hold climate responsible for changes in agricultural productivity in Nigeria will, for a long time, remain a subject of research as long as other factors are at interplay in determining agricultural productivity. The production of major export crops in the country such as groundnut, rubber, coffee, cocoa and palm produce in the country has declined in magnitude since the drought of 1972/73 which is the first real evidence of climate change in Nigeria (Ajetomobi et al., 2011). Climate change is a threat to agriculture and non-agricultural socio-economic development, agricultural production activities are generally more vulnerable to climate change than other sectors, (Kurukulasuriya, et. al., 2006). This is because agricultural production in most sub-Saharan African countries (Nigeria inclusive) is dependent on weather and climate.

METHODOLOGY

The study was carried out in the Southwest zone of Nigeria. The zone has six States; Ekiti, Lagos, Ogun, Ondo, Osun and Oyo. It is majorly a Yoruba speaking area, although there are different dialects even within the same state. The weather conditions vary between the two distinct seasons in Nigeria; the rainy season (March - November) and the dry season (November - February). The dry season is also the bringer of the Harmattan dust; cold dry winds from the northern deserts blow into the southern regions around this time (www.myguidenigeria.com). A multistage sampling technique was used to select respondents within the zone. Firstly, the purposive sampling technique was used to select Oyo, Osun, Ondo, Ogun and Ekiti State because of the high concentration of small-scale agro-allied industries and entrepreneurs in the five States. Thereafter, simple random sampling techniques were used to select rural-based Local Governments from a list of rural-based Local Government Councils in each State. Then purposive sampling technique was used to select Agro-entrepreneurs involved in crop processing. Food and fruit juice canning, manufacturing of soft drinks as "Zobo", cocoa drink, cashew and orange juice drink, wood processing and furniture making, paper milling and tissues paper manufacturing, cassava cottage factory for processing cassava into "garri", "fufu", tapioca" and flour, yam flakes and flour procession, food processing such as cornflakes, milk, yoghurt, palm and groundnut oil, soap and detergent making, fish processing, fish drying and packaging and grain milling e.g. maize, rice, soybean and guineacorn as at the time of data collection.

Fifty (50) respondents were purposively chosen in Oyo, Osun and Ekiti States while thirty-eight (38) respondents were chosen from Ogun State due to accessibility to the location of operations and availability of Agro-entrepreneurs in each State. Therefore the total sample for the study was two hundred thirty-eight (238). A structured interview schedule was used to collect relevant data from the respondents. Also, relevant secondary data were collected through a desk review of relevant literature on climate change and its effects on agricultural and agro-industrial development in Nigeria. Data were collated, organized and subjected to both descriptive and inferential statistics. Data collected include socio-economic characteristics, a subsector of agriculture adversely affected by climate change, perceived adverse effects of climate change on agriculture; environment; agro-based processing business and agro-industries. The descriptive statistical tools used include frequency counts, percentages, while Pearson Product Moment Correlation was used as an inferential tool to test for significant relationship between variables.

RESULTS AND DISCUSSION

Socio-economic characteristics of selected Agro-processors in South-West Nigeria

Table 1 reveals the socio-economic characteristics of the agro-processors included in the study. The majority of the agro-processors (65.5%) were male while 34.5% were female. This shows that both males and females were involved in agro-processing activities in Southwest, Nigeria. However, male agro-processors were dominant in the subsector. It was also revealed that about 81.5% of the agro-processors were between the ages of 30 and 59 years. This shows that they are very active, agile and mature enough to face the challenges and rigour involved in agro-processing activities such as transporting raw materials, processing, packaging and marketing. The data in Table 1 further reveals that about 82.2% of the agro-processors were literate with abilities to read and write. They possessed West African Examination Council (WAEC), Senior Secondary School Certificate (SSCE), National Certificate in Education (NCE), Ordinary National Diploma (OND), Higher National Diploma (HND) and B.sc Degree Certificates. This shows that they are capable of running their agro-business ventures and processing activities with knowledge and acquired skills to improve their productivity and income. This implies that efforts can be made to build their capacities their capacity to manage agro-allied ventures to encourage them to expand their scale of operations and employ more labourers in their businesses. Table 1 also reveals that the majority of the agro-processors had been involved in agro-processing and agro-business activities for more than five years as at the time of the study. About 87% of the agro-processors had between 5 and 30 years of experience in agro-based enterprises. This shows that their practical experiences in the sub-sector can be tapped to develop well-articulated and robust policies for agro-industrial development in Southwest, Nigeria. In terms of the scale of operation, it was revealed that the majority of the agro-processors (80.7%) were operating on a small-scale while 17.6% and 1.7% were on medium-scale and large scale operations respectively. It shows that agro-based enterprises need to be stepped up to increase their scale of operations to generate more employment opportunities for Nigeria youth, and improve the contribution of small- medium -large scale enterprises to the Gross- Domestic Products (GDP) and national economic development. Table 1 further shows that the majority of agro-processors (68.9%) secured the majority of their raw materials from contractors/suppliers while 21.8% agro-processors secured their raw materials from

the open market. Only 7.6% of the sampled agro-processors secured their raw materials from their farms. This shows that the processing activities of the agro-processors will be determined by the availability of raw materials as at when due and this will eventually determine the continuous operations of the agro-processors.

The above implies that the profitability of agro-ventures will be largely determined by the cost of raw materials from other sources and transaction costs associated with raw material procurement. The agro-processors were asked about their level of awareness of climate change as it affected their activities. 85.7% of agro-processors confirmed their awareness of climate change while only 14.3% said they did not aware. This shows that there is increasing awareness of the local manifestations of the global problem of climate change, hence it will be easier to develop community-level and policy-based climate change adaptation strategies that will engender sustained agro-industrial development.

Table 1: Distribution of Agro- Processors by their Socio-economic Characteristics South-West Nigeria n = 238

Socio-economic Characteristics	Frequency	Percentage	Cumulative Percentage
Sex:			
(i) Male	152	65.5	65.5
(ii)Female	82	34.5	100.0
Age- group (years)			
(i) 20-29	8	3.8	3.4
(ii) 30-39	38	16.0	19.3
(iii) 40-49	100	42.0	61.3
(iv) 50-59	56	23.5	84.9
(v) 60-69	34	14.3	99.2
(vi) 70 and above	2	0.8	100.0
Highest Level of Education attainment			
(i) No formal education	8	3.4	3.4
(ii) Primary school certificate	20	8.4	11.8
(iii) Secondary school certificate WAEC/SSCE	64	26.9	38.7
(iv) Tertiary Education Certificate NCE/OND/HND/First Degree	146	61.3	100.0
Years of experience in agro-based enterprises			
(i) Less than 5years	24	10.1	10.1
(ii) 5-10 years	142	59.6	69.7
(iii) 11-20years	64	26.9	96.6
(iv) 21-30years	6	2.5	99.2
(v) 31 and above years	2	0.8	100.00
Level of operation			
(i) Small- Scale	192	80.7	80.7
(ii) Medium Scale	42	17.6	98.3
(iii) Large scale	4	1.7	100.0
The major source of raw materials			
(i) Farmgate	4	1.7	1.7
(ii) Open market	52	21.8	23.5
(iii) Contractor/supplies	164	68.9	92.4
(iv) Personal farm	18	7.6	100.00
Awareness of climate change			
(i) No	34	14.3	14.3
(ii) Yes	104	85.7	100.0

Source: Field Survey, 2018

Types of Agro-processing industries in South-West, Nigeria

Table 2 reveals different types of agro-processing industries in the study area. It was revealed that palm and groundnut oils, soap, detergent making (23.9%); yam flakes and flour processing (23.9%); cassava cottage factory for processing cassava into “garri” “fufu” “tapioca” and chips (36.9%), and food and fruit juice canning manufacturing of soft drinks e.g fruits and “Zobo” drink (22.7%) are major types of agro-processing industries in the study area. It was also revealed that many agro-processing industries are of low magnitude in the Southwest. These include production of confectionaries e.g sugar, sweet, cassava cakes and biscuits,(18.9%), paper milling and tissue paper manufacturing (17.2%); fish processing, drying and packaging (13.4%) grain milling e.g maize, soybean and Guinea corn (13.5%), and textiles and beads and apparels making “Aso-oke and Adire” (14.3%). This implies that agro-processors are operating on a small scale level and are these potential areas of generating employment opportunities for Nigeria youth. Efforts should therefore be made to increase the scale of operations and magnitude to generate employment opportunities for youth and increase their contributions to Gross Domestic Products (GDP) in Nigeria.

Table 2: Distribution of Agro- Processors by their types of Agro-processing industries in the zone

	Types of Agro-Processing Industries	Frequency	Percentage
(i)	Food and fruit juice canning	54	22.7
(ii)	Manufacturing of soft drink such as “Zobo”, cocoa drink, cashew juice drink	18	7.6
(iii)	Production of confectionaries e.g sugar, sweet, cassava cakes biscuits	45	18.91
(iv)	Wood processing and furniture making	22	9.2
(v)	Paper milling and tissues paper manufacturing	41	17.2
(vi)	Cassava cottage factory for processing cassava into “garri” “fufu” “tapioca” and flavor processing	88	36.9
(vii)	Yam flakes and flavour processing	57	23.9
(viii)	Food processing such as cornflakes, jam, milk, yoghurt	12	5.0
(ix)	Palm and groundnut oils, soap and detergent making	57	23.9
(x)	Fish processing, fish drying and packaging	32	13.4
(xi)	Grain milling e.g. maize, soybean and Guinean corn	24	13.5
(xii)	Dairy production	0	0.0
(xiii)	Textiles beads and apparels making (Aso-oke, Adire)	24	14.3

Source: Field Survey, 2018

*:Multiple responses

Subsectors of agriculture adversely affected by climate change in the zone

Table3 reveals different subsectors of agriculture being adversely affected by climate change. It was revealed that agro-processing industries (78.2%); Forestry and Agroforestry products e.g woods (73.9%); food crops (e.g cereals, legumes, root and tubers) production (73.9%); industrial crop e.g cocoa, cashew, sugarcane, oil palm, orange and mango production (58.8%); farm produce marketing (57.1%) and livestock (e.g poultry, piggery and cattle) production subsectors were being adversely affected by climate change. The impacts of climate change on agriculture are projected to manifest through changes in land and water regimes, especially, changes in the frequency and intensity of droughts, flooding, water shortages, worsening soil conditions, desertification, disease and pest outbreaks on crops and livestock. (IPCC, 2001). The Nigerian’s

agricultural activities are rain-fed and the farmers are engaged in crop production, livestock rearing, fisheries and post-harvest activities. Also, reductions in crop yield are imminent due to decreased water availability and changed insect pest incidence. Agriculture in the Southwest is rainfall dependent, and rain led crops yields are likely to fall sharply for even a small climate change. Richards (2003) projected a fall in agricultural productivity of up to 30% over the 21st century

Table 3: Distribution of subsectors of agriculture being adversely affected by climate change in South West, Nigeria

	Subsectors of agriculture	Frequency	Percentage
i.	Industrial crop e.g cocoa, cashew, sugarcane, oil palm, orange and mango production	140	58.8
ii.	Food crops (e.g cereals, legumes, root and tubers) production	176	73.9
iii.	Horticulture (e.g flowers and high value fruits and vegetable) production	62	26.1
iv.	Livestock (e.g poultry, piggery and cattle) production	102	51.3
v.	Forestry and Agroforestry products (e.g woods)	176	73.9
vi.	Farm produce marketing	136	57.1
vii.	Agro-processing industries	186	78.2

Source: Field Survey, 2018

Perceived adverse effects of climate change on Agriculture, Environment, Agro-based processing business and agro-industrial development in South-West Nigeria

Table4 reveals the perceived adverse effects of climate change on agriculture, environment, agro-based processing business and agro-industrial development in South West, Nigeria. On agriculture, the majority of the agro-processors mentioned that irregular patterns of rainfall adversely affect crop production (87.4%); caused low/ reduction in farm income (78.2%); increased pest and disease of crops (73.9%) and unpredictable/epileptic rainfall reduced crop yield (57.1%). These are major adverse effects of climate change on agriculture in Southwest, Nigeria. These findings agreed with Idowu *et al.* (2011) which reported that climate change affects crop production in several ways as a result of uncertainties and variation in the pattern of rainfall; floods and devastated farmlands.

On the environment, many agro-processor mentioned that high temperature has increased heat (83.2%); increased desertification (58.2%); caused high soil erosion due to increased precipitation (58.0%) and high occurrence of periodic flooding (58.0%). These findings agreed with IPCC (2001) which remarked that the projected impact on the Earth's environmental stability and hence changes in global climate would include; disruption of temperature distribution, precipitations, evapotranspiration, clouds, air, currents and consequential shifts in the vegetation belts, melting of polar ice-caps, rise in sea level that could adversely affect low-lying areas and the synergy among these discrete effects. All of these have grave implications for freshwater resources, agriculture and food supply, natural ecosystems, biodiversity and human health (IPCC, 2001).

In the agro-based processing business, the majority of agro-processor mentioned the high cost of agricultural raw materials (63.0%); insufficient/inadequate production inputs (raw materials) (58.8%); high cost of transportation of raw materials (58.0%) and reduced production capacity (57.1%) as perceived adverse effects of climate change on agro-based processing businesses in the study area. Handling and process of agricultural produce are usually influenced by climate change, processing of agricultural products like cassava into “garri”, starch and cassava flour, yam into yam flour, oil palm seed into palm oil and palm kernel, paddy rice into processed parboiled rice, cocoa into dried seeds and processing of fish and livestock products are usually influenced by rainfall and temperature pattern in a local environment. Several studies have reported that climate change affects both the livelihoods of the farmers as well as sustaining the support activities (NEST, 2004 and IPCC, 2011).

Food security and food availability are consequences not only of food production but of food processing. Food processing and distribution are major sources of employment and income. According to the World Bank (2008), agribusinesses account for approximately the 30percent of the GDP in transforming and urbanized countries. In low-income counties, industries and services linked to agriculture amount to 50 percent of the total manufacturing value added (World Bank, 2008). The transformation, storage and transport of raw agricultural products involve activities that cut across the agricultural, manufacturing and transport sectors.

On agro-industrial development, the majority of the sampled agro-processors mentioned reduction in agricultural raw materials (93.3%) high cost of production inputs (63.0%); and inadequate production inputs has forced some agro-industries to stop production (58.0%). These are the major perceived adverse effects of climate change on agro-industrial development in Southwest, Nigeria. The impacts of climate change on the population and livelihoods of Nigeria’s farming communities are manifesting in the areas of farm investments, resources availability, food crops abundance, decline livestock production and consequent losses of income. There is a need for government intervention to reduce these perceived effects to encourage agro-industrial development to create employment opportunities for youth in Nigeria.

Table 4: Distribution of the perceived adverse effect of climate change on Agriculture, Environment, agro-based processing business and agro-industrial development as mentioned by the selected agro-processors and agro-industrialists in Southwest, Nigeria.

Perceived Adverse effect of climate change	Frequency	Percentage
Agriculture		
(i) The irregular pattern of rainfall adversely affect crop production	208	87.4
(ii) Unpredictable/Epileptic rainfall reduces crop yield	136	57.1
(iii) High-temperature causes stunted crop growth and low yield	82	34.5
(iv) Increased pests and diseases of crops	166	73.9
(v) Low/reduction in farm income	186	78.2
(vi) Unpredicted weather disrupt farm operations	82	34.5
(vii) Crop failure resulting in low productivity	196	80.7
Environment		
(i) increased desertification	140	58.8
(ii) high soil erosion due to increased precipitation	138	58.0
(iii) high temperature has increased heat	198	83.2
(iv) High occurrence of periodic flooding	138	58.0
(v) Increase in weather fluctuation	82	34.5
(vi) Loss in genetic diversity of natural resource	62	26.1
Agro-based processing business		
(i) Insufficient/inadequate production inputs (raw materials)	140	58.8
(ii) High cost of transportation of raw materials	138	58.01
(iii) High cost of Agricultural raw materials	150	63.0
(iv) Reduced production capacity	136	57.1
Agro-Industrial Development		
(i) Inadequate production inputs have forced some Agro industries to stop production	138	58.0
(ii) Reduction in agricultural raw materials	222	93.3
(iii) High cost of production inputs	150	63.0
(iv) Some agro-industries are producing below actual capacity	52	21.8
(v) Retirement of workers as a way of reducing the cost of production	82	34.5
(vi) Reduction in profit level of agro-industries	102	42.9

Source: Field Survey, 2018

Test of the significant relationship between selected socio-economic characteristics of the respondents and their perception of adverse effects of climate change on agriculture and agro-processing industries in South-western Nigeria

For this hypothesis, Pearson Product Moment Correlation (PPMC) was used to test for the relationship between the independent and dependent variables. The result of the analysis revealed that some of the selected socio-economic characteristics of the respondents such as age ($r=0.457^{**}$; $p\leq 0.000$), educational status ($r=0.744^{**}$; $p\leq 0.000$), level of operation ($r=0.219^*$; $p\leq 0.026$) and awareness of climate change ($r=0.249^*$; $p\leq 0.011$) respectively exhibited significant relationship with their perception of adverse effects of climate change on agriculture and agro-processing industries in the area (Table5). The above results imply that all the aforementioned socio-economic variables (age, educational status, level of operation and awareness of climate change) have a decisive influence on the perception of respondents on adverse effects of climate change on agriculture and agro-processing industries. The results also suggest that the impact of climate change on the agriculture and agro-processing industries are already registered in the mind of the sampled agro-processors in this region, hence attention is required to salvage the situation to encourage agricultural production and the growth of agro-processing industries.

Table5: Test of the significant relationship between the selected socio-economic characteristics of the respondents and their perception of adverse effects of climate change on agriculture and agro-processing industries in South-western Nigeria

Socio-economic variables	Correlation Coefficient	P-value	Decision	Remark
Sex	0.087	0.184	NS	Accept H_0
Age	0.457**	0.000	S	Reject H_0
Educational status	0.744**	0.000	S	Reject H_0
Years of experience	0.030	0.761	NS	Accept H_0
Level of operation	0.219*	0.026	S	Reject H_0
The major source of raw material	0.052 0.602	NS	Accept H_0	
Awareness of climate change	0.249*	0.011	S	Reject H_0

Source: Data Analysis, 2018.

***Correlation is significant at 0.05 level (2-tailed)**

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

H_0 : Null hypothesis

CONCLUSION AND RECOMMENDATIONS

Based on major findings, the paper concludes that climate change had adverse effects on small-scale agro-industries and had created major challenges to agro-industrialization in South-west, Nigeria. It is therefore recommended that the government at the Federal, State and Local levels should exercise greater responsibilities in providing policy measures that will reduce the effects of climate change on the subsectors of agriculture and most importantly agro-industries and develop

specific policies for implementation to enhance sustainable agro-industrialization in South-west, Nigeria.

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