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EFFECTS OF CLIMATE CHANGE ON IRISH POTATOES FARMING IN PLATEAU: A STUDY OF NORTH AND CENTRAL ZONES OF PLATEAU STATE, NIGERIA

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Abstract

Despite efforts by the Government and the Irish Potato Programme in Kuru, Jos to improve farming of Irish potato in Plateau, decreasing level of production indicated that there are constraints associated with the small and medium enterprises farmers of Irish potato in North and Central Zones of plateau State. The study examines effects of climatic change on Irish potatoes farming in Plateau State. The study adopted a survey design. Regression and correlation analyses were employed in testing the hypotheses. Findings revealed that frequent changes in climatic conditions have a significant impact on Irish potato farming and temperate weather conditions improved the quality of Irish Potato farming. The effect of these changes is posing threat to food security in Plateau State. Lastly, it was discovered that there is no relationship between low level of technology and Irish potato farming in Plateau North and Central zones of Plateau State. It shows that low level of technology leads to wrong weather predictions which could impact negatively on Irish potato farming. The study suggests that there is need for an explicit national agricultural research policy framework to provide conducive environment for continuity and effectiveness in agricultural programmers' projects for increased Irish potato farming. The Nigerian government should take a bold step to establish better-

equipped weather stations and high technological machines as against the scanty and ill-equipped ones. With this, accurate weather forecast and predictions will be possible and this will help to prevent weather-related disasters through early warning and effective response or adaptation system.

Keywords: Climate Change, Irish Potatoes, SMEs Farmers, Quality and Level of Technology

INTRODUCTION

The process of global warming/temperature shows no signs of abating and is expected to bring about long-term changes in weather conditions. These changes will have serious impacts on the four dimensions of food security; food availability, food accessibility, food utilization and food system stability. However, the effects are already being felt in the production of Irish Potatoes. The Irish potato is one of the most common food crops found in North and Central Zones of plateau State. It is also an important source of revenue, employing more than 20,000 people in Irish potatoes farming activities across the entire production chain in Plateau. The new efforts to address improved potatoes productions from multiple angles, ranging from public policy to better seed production and increased resistance to Irish potato disease. Scientists along with other researchers and administrators are focusing on designing a proper potato policy in Plateau State. Irish Potato fields in Plateau have remained stagnant over the past decade due to factors such as price hikes, climate change, and policy deficiencies as well as farmers' use of poor quality seed and improper post-harvest practices. Addressing issues regarding seed quality and access, Plateau State government led an effort to conduct an extensive seed market survey that involved gathering information regarding seed demand and availability from growers of all the major Irish potato-production areas in Nigeria. The government has also been working with both private and public sector partners to introduce a new technology that produces substantially higher numbers of Irish potato seed, or the mini-tubers from which new Irish potatoes are grown, and helps to ensure that they are disease free. The technology is know as aeroponics, and involves growing the seed tubers in mid-air, with much higher multiplication rates than conventional methods. In close collaboration Plateau Agricultural Development Programme (PADP) office and the ministry of Agriculture have been working to test and release varieties of Irish potatoes for smallholder farmers that are resistant to late blight, the most serious disease threatening potatoes worldwide. Late blight, which led to the famous Irish Potato famine, is caused by the fungus-like oomycete, Phytophthora infestans, and spreads through spores transported in the wind or the use of infected tubers. The government of Plateau

State has committed to supplying disease-free planting material to farmers along with subsidizing farm inputs, organizing markets, and strengthening farmers association. All these efforts have not yielded any significant change due to inadequate literature.

Statement of the Problem

Despite efforts by the Government and the Irish Potato Programme in Kuru, Jos to improve the farming of Irish potato in Plateau, decreasing level of production indicated that there are constraints associated with the small and medium enterprises farmers of Irish potato in North and Central Zones of plateau State. Major factors contributing to the low level of Irish Potato farming in these areas includes: climate change, poor quality of Irish Potato farming, low level of technology, inadequate capital, poor economic infrastructure, lack of adequate incentives and the likes. However, this revelation led to this study which has also created a literature gap. Consequently, this study seeks to fill the literature gap through examining the effects of climate change on Irish Potato Farming in North and Central Zones of Plateau State. The questions for this study include: what relationship exists between climate change and Irish Potato Farming in North and Central Zones of Plateau State? To what extent has climate changes enhanced quality of Irish Potato farming in North and Central Zones of Plateau State? Has use of new technology improved SMEs farmers of Irish potato in North and Central Zones of Plateau State? The main objective of this study is to examine the effects of climate change on Irish Potato farming in North and Central Zones of Plateau State. Other specific objectives are to: Examine relationship that between climate change and Irish Potato Farming in North and Central zones of Plateau State; investigate the level of Irish Potato production that encouraged the quality of Irish Potato farming in North and Central Zones of Plateau State and evaluates the extent to which climate change enhances the use of low technology equipment by SMEs farmers of Irish potato in North and Central Zones of Plateau State.

Statement of Hypotheses

H_{01}: There is no significant relationship between climate changes and Irish Potato Farming in North and Central Zones of Plateau State.

H_{02}: There is no significant relationship between climate changes and quality of Irish Potato farming in North and Central Zones of Plateau State.

H_{03}: There is no significant relationship between climate changes and use of low technology equipment by SMEs farmers of Irish potato in North and Central Zones of Plateau State.

CONCEPTUAL FRAMEWORK

Concept of Climate Change

There is still uncertainty about what causes climate variations, with some of the factors being changes in ocean circulation, changes in land cover types, the production of greenhouse grasses by mankind's burning of fossil fuels, and the role of man – made aerosols on cloud formation (Spencer, 2007). Climate change refers to an increase in average global temperatures (Olaniyi, Funmilayo and Olutimehin, 2014). Natural events and human activities are believed to be contributing to an increase in average global temperatures. This is caused primarily by increases in greenhouse gases such as Carbon Dioxide (CO2). Nigeria is experiencing adverse climate conditions with negative impacts on the welfare of millions of people. Persistent droughts and flooding, off season rains and dry spells have sent growing seasons out of orbit, on a country dependent on a rain fed agriculture. Alarm bells are ringing with lakes drying up and a reduction in river flow in the arid and semi arid region. The result is fewer water supplies for use in agriculture, hydro power generation and other users. The main suspect for all this havoc is Climate Change. Scientific studies show snows are disappearing rapidly. Ifeanyi-obi, Etuk and Jike-wai (2012) contributed that climate Change has been confirmed following release of the 4th IPCC Assessment report. Africa will be worst hit by the effects of Climate Change which Nigeria is part of it. Climate change refers to all changes in climate be it as a result of human activities or natural variations. The earth is surrounded by a layer of gases that act like the glass wall (earth's blanket) and ceiling of a green house. These so-called green house gases are necessary to sustain life on earth. They let the sun's rays enter but stop much of the heat from escaping, keeping the planet warm enough to allow life. The agricultural sector contributes some percentage of the Nigerian Gross National Product and majority of the rural populace are employed in this sector. The dominant role of agriculture makes it obvious that even minor climate deteriorations can cause devastating socioeconomic consequences. Policies to curb the climate change by reducing the consumption of fossil fuels like oil, gas or carbon, have significant economical impacts on the producers or rather the International Journal of Environment and Pollution Research suppliers of these fuels. Nigeria is the eighth largest oil supplier in the world and the ninth largest deposits of gas. The Nigerian national economy would be massively affected by a sustainable reduction of fossil energy consumption. Nigeria is practically a monoculture: about 80% of the government income, 90-95% of the export earnings and more than 90% of the foreign exchange revenues evolve from the oil sector. Therefore the nation should be proactive in her response to the phenomenon and its challenges and should not wait until much damage is done which will be very costly to correct. Developing nations like Nigeria should not fold their arms and wait for international

donor agencies and Research Institutes to provide wholesale solutions their global warming issues Chioma (2015). They must take up the challenge and seek cooperation and collaboration with International Agencies in other to create opportunities for technology transfer. There are a number of adaptation and mitigation options that the country can embark upon using the existing government institutions, which do not require any elaborate capital outlay but the right political will to ensure enforcement and compliance.

Historical Development of Irish Potato Farming in Plateau State

Irish potato was introduced into Nigeria as far back as later part of the 19th Century and early 20th Century by Europeans, notably the tin miners (Jwanya, Dawang, Zarmai and Mashat, 2014). The establishment of Irish potato programme in Kuru by NRCRI IN 1976, improved varieties were imported and bred. These were screened and those found adaptable to the temperate regions of the country were released to farmers. Irish potato requires an optimum temperature of 15^{oC} for tuber formation. Jos Plateau met this condition in both rainy and dry seasons. In the dry season, potato is planted in late October or early November to take advantage of the low December and January temperatures for tuberization. Time of planting potato in the rainy season depends on the onset of rains. Generally, it is planted between the last week of April and end of May each year, off season productions occurs between August-November (OKonkwo, Ene, and Okoli, 1995). Potato performs best on soils rich in ferrallitic combiosol, Clayic soils (NRCRI, 1976). The soils are shallow, molttled and poorly drained clay loam soil on weathered basit. Similarly, for optimal commercial yields, potato needs relatively high levels of chemical fertilizer and organic matter (Tewodros, 2014).

Empirical Review

An empirical study conducted by Nancy and John (2014) on Market Structure and Price: An empirical analysis of Irish potato markets in Kenya showed that the Irish potato markets in the country are not functioning properly, mainly due to their structure, the market is oligopolistic in nature, i.e. there are few market participants in the form of rural brokers, urban brokers and transporters who have the market power. There are barriers to entry at the urban market centres where the brokers provide the link between wholesalers and retailers. In many cases the brokers and transporters determine the market price for each potato consignment delivered after accounting for their assembly and transportation costs. A study conducted by Apronius, Georgina and Vivian (2013) on the effects of climate change on small scale farmer in Tanzania in the past decade; explore the environmental management that are being used and adaptation measures and policies to cope with climate change. Eight geographical regions were selected

and from these regions interviews were conducted from 12 districts and 20 villages. The findings from the study confirmed that farmers of both crop farming and livestock keeping have been affected negatively by climate change. There has been an increase in the frequency of extreme events such as drought and flooding which has reduced soil fertility and yields from crop production and livestock keeping. There has also been disappearance of major crops in some areas as farmers are trying to farm crops that are able to survive short or no rainfall. These changes in turn has resulted into socio economic challenges such as spread of diseases such as malaria in areas where there was no malaria before, reduced income, lack of employment (which in turn affect people's health, access to education and food) and conflict between livestock keepers and crop farmers among many other problems. Mostly children, women and the elderly are mostly affected by the resulting impact of climate change as they have limited resources and mean to cope with the changes. Men would migrate to urban centres and look for casual employment and women, children and elderly remain in the village facing the problems alone with no support. A study on economic efficiency of rainy season Irish potato production in Jos South Area of Plateau State by Asumugha and Okwonkwo (1992) revealed that the variable cost of production per hectare was ₦9,899.54, while the gross return per hectare was ₦10, 191.38. The findings also confirmed that capital efficiency was ₦2.03, which is the earning power per ₦1.00 expenditure on capital input. The labour efficiency was economic efficiency of rainy season Irish potato production in Jos South Area of Plateau State by Asumugha and Okwonkwo (1992) revealed that the variable cost of production per hectare was ₦9,899.54, while the gross return per hectare was ₦10, 191.38. The findings also confirmed that capital efficiency was ₦25.87 implying that ₦1.00 spent on labour earned ₦25.87. Similarly, land efficiency or productivity was 10,045,36kg, while the price or allocative efficiency was ₦0.99k implying that the cost of producing 1kg of potato was ₦0.99k. the study indicated that some aspects of economics production of potato, are silent on the socio-economic characteristics of Irish potato farmers, optimization of potato production and production constraints. Similarly, Nancy and John (2014) reported that efforts should be made to facilitate arbitrage through the development of storage and physical infrastructure. Lack of proper storage at farm level necessitates that farmers sell in order to avoid losses, and this tends to accelerate intra-seasonal price instability. At the market centres the focus should be on initiatives such as building the capacities of local councils and local communities to sustainably manage their marketing infrastructure, and building and/or rehabilitating identified marketing infrastructure. There is need to improve the efficiency of food markets through improvement of infrastructure including storage, transportation, information and communication technology (ICT) and market information at national and local levels, in addition to empowering the producers,

facilitating market linkages and expanding/developing agricultural market information systems. However, most studies did not give attention to the effects of climate change on Irish potato farming in North and Central zones of Plateau State which have created an existing gap.

Theoretical Framework/Model

Simulation Model

This study was based on the LINTUL potato simulation model as described by Robert (2003) who used in calculating potential yield. The model has a temperature-dependent development of the canopy (green ground cover). Biomass production is the product of the fraction green ground cover, incident solar radiation and radiation use efficiency. The estimated tuber yield as a temperature dependent percentage of the total biomass accumulated during the growing season. In this study, however, the relative allocation of biomass to tubers was calculated on a daily basis. Relative allocation to the tubers is initially 0%. After a thermal time threshold is reached, relative allocation starts increasing linearly with thermal time until the next threshold after which 1Wh of new bio mass goes to the tubers. The values of these parameters were estimated so that harvest index of a mature crop is 80% under normal circumstances (no frost or heat sires), as in the original model. This procedure avoids overestimating yield for a crop with prematurely killed foliage due to frost, or for a crop for which the end of the growing season is very warm, and hence has a lower best index than would be expected h month e average temperature during the growing season. The absolute allocation of biomass to the tubers is also dependent on daily average temperature: it decreases above 15 C and becomes zero at an average temperature above 28 C (Stol et al. 1991). A heat-tolerant potato cultivar was defined by shifting these curve two degrees. In the adapted model, radiation use efficiency (RUE) was made dependent on daily average temperature. RUE is highest (2.9 g MJ (PAR) between 15 and 21 C md zero below 2 C and above 34 C, with intermediate value in between. Decrease of RUE at high temperatures is duel to increasing respiration. Radiation (PAR) above 12 MJ (PAR) m2 days' was not considered, to account for light saturation (Kooman and Haverkort 1995). For each grid cell, the model was run for 12 planting times (with planting at the first day of each month) and for five maturity classes of potato, representing different cultivars with early to late senescence. This was repeated for the heat-tolerant Irish potato. Maturity classes used were 1000, 1200, 1400, 1600, or 1800 Cd, expressed as the temperature sum (thermal time) between emergence and harvest, with a base temperature of 2C. The optimal planting time for a location grid cell) was determined after the simulations, selecting the Mont-cultivar combination that led to the highest yield. Average temperature during the optimal planting time was calculated for each grid cell. To distinguish between the effect of changes in radiation and in

temperature, the model was also run for the projected climate, while using radiation data for the current climate. Current and projected potential yield were compared for two cases: with and without adaptation. Adaptation is narrowly defined as changes in the month of planting or in the maturity class of the cultivar. This is sometimes referred to as "autonomous adaptation" in the sense that these are inexpensive and can be carried out at the farm level (McCarthy, Canziani, Leary, Dokken, and White, 2001). In the case of "without adaptation," potential yield for projected conditions is calculated for the combination of cultivar and month of planting that gave the highest yield for the current climate. In the case of "with adaptation," the highest yield is taken from the 60 (5 cultivars x 12 months) months of planting cultivar combinations for the projected climate scenarios. Hence, in this latter case, the month of planting and cultivar type in a location (grid cell) can be different for current and future climates for economic development.

METHODOLOGY

The study adopted a survey research design to investigate the effect of climate change on Irish Potato small scale farmers in plateau: A Study of North and Central zones of Plateau State. The population of this study total 668 drawn from PADP office records consisting of selected individuals small scale farmers of Irish potato in Jos-South, Barkinladi, Rom, Bukkos, Mangu and Pankshin LGAs. The study used a purposive sampling method to select the respondents. The sample size was determined using smith sampling formula. Primary methods of data collection have been used; data collected include information on trends in Irish Potato Quality production, changes in new technology, effects of changes in rainfall, temperature and, socio economic data such as income generating activities, employment and information on adaptation strategies farmers are using to cope with climatic changes. Data were obtained from the rural farmers through a structured questionnaire which was also based on a five point likert scale (agreed, disagree, neutral, strongly agreed and strongly disagreed). Data analyses were further presented using frequency tables, charts and simple percentage while OLS regression and product moment Pearson correlation coefficient (r) method was used in testing the three hypotheses through the Statistical Package for Social Sciences (SPSS) and E-views.

The OLS regression result was express as follow:

$$Y_i = \beta_0 + \beta_i X_i + \mu_t \qquad (1)$$

Where:

B_0 = Constant Intercept

B_i = Coefficient of Independent Variable

x_i = Dependent Variable

Y_i = Independent Variable

μ_i = Error Term

The product moment Pearson correlation coefficient(r) is given by the formulae:

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n(\sum X^2) - (\sum X)^2][n(\sum Y^2) - (\sum Y)^2]}} \qquad (2)$$

Where:

r = product moment Pearson correlation coefficient

X=are the independent variables of our observation and;

Y= are the dependent variables of our observations

RESULTS AND DISCUSSIONS

The results obtained were generated using frequency tables, charts and simple percentage. The first and second hypotheses formulated in the study was tested using rho value of the product moment correlation analysis; while the second hypothesis was however tested using t-test statistical tool.

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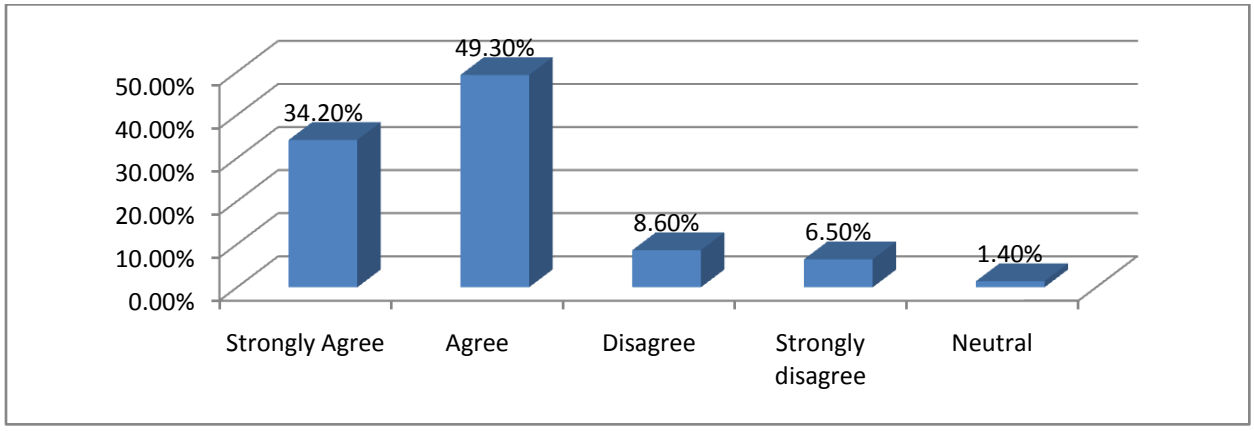
Descriptive Statistics

Section A: Climate Change and Irish Potatoes Farming in North and Central Zones of Plateau State

Figure 1: Climate Changes did not Encouraged Irish Potato Varieties to grow very well in North and Central Zones of Plateau State



From figure 1, it could be observed that 49.30% majority agreed that climate changes did not encouraged Irish potato varieties to grow very well in North and Central Zones of Plateau

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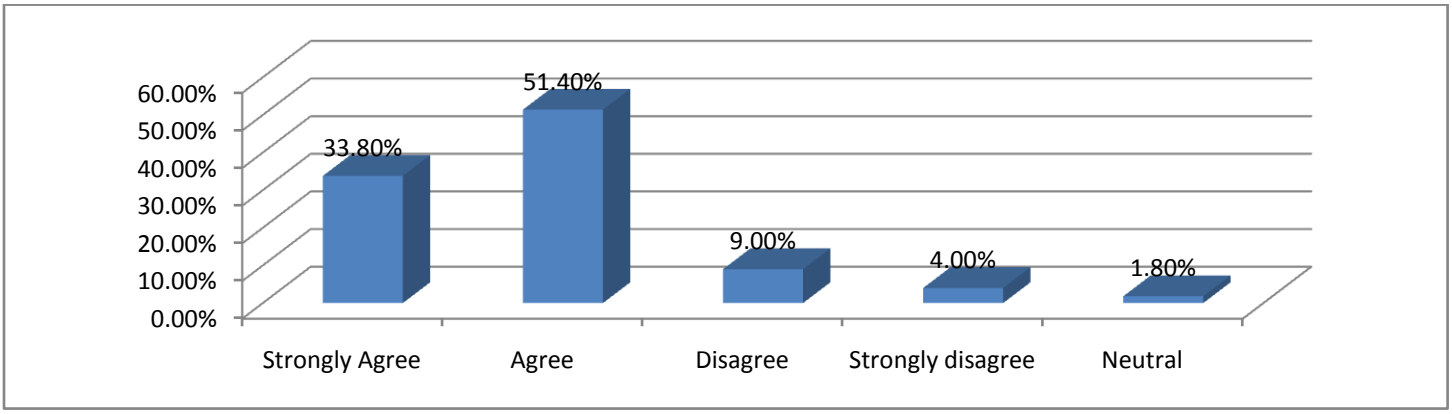
State.34.20% strongly agreed to that, while just very few of them comprising of 8.6% disagreed. 1.4% of the respondents remained neutral on whether Climate changes has not encouraged Irish potato varieties to grow very well in North Central Zones of Plateau State.

Figure 2: The Variation of Weather (Rainfall, Temperature, Extreme Events) has negatively Affected Irish Potato Quality Production in North and Central Zones of Plateau State



From figure 2, it was observed that 51.4% of respondents agreed that the variation of weather (rainfall, temperature, extreme events) has negatively affected Irish Potato quality production in Central Area of Plateau State. However, 9% of the respondents disagreed that variation of weather (rainfall, temperature, extreme events) has negatively affected Irish Potato quality production in North and Central Zones of Plateau State, while 1.8% are undecided on the issue.

Figure 3: Irish Potato Farming has Improved Small Scale Farmers Revenue Drive in North and Central Zones of Plateau State

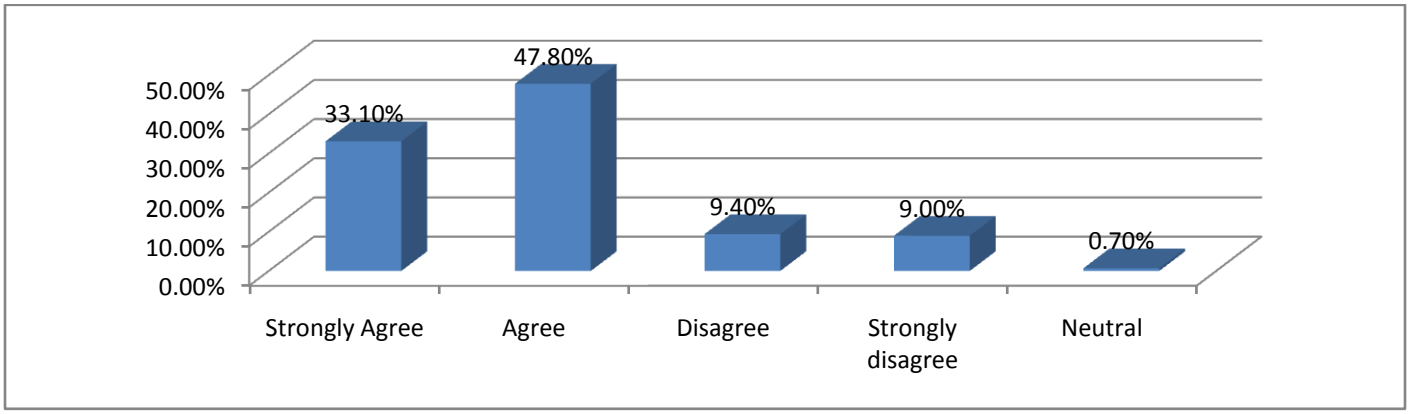
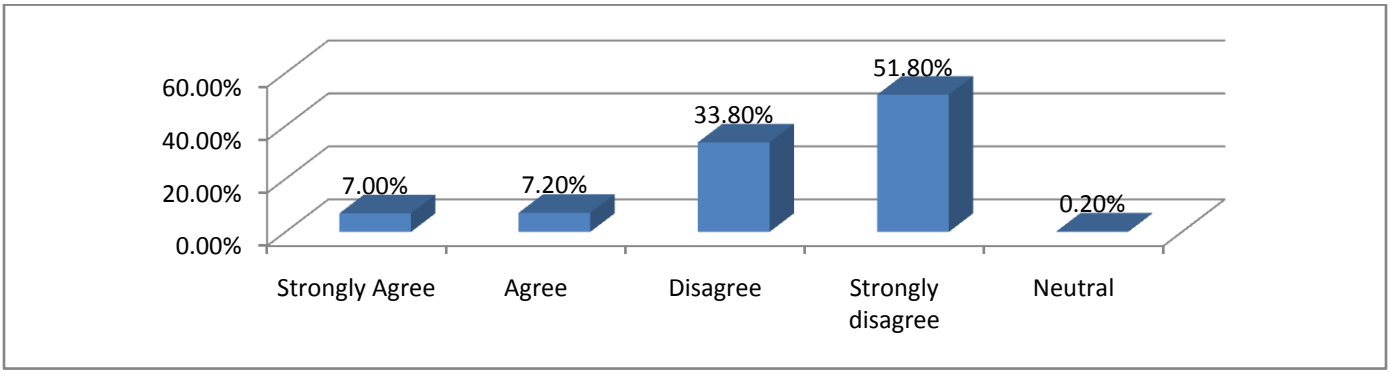


Figure 3, confirmed that 47.8% of the respondents were in agreement that Irish Potato farming has improved small scale farmers revenue drive in North and Central Zones of Plateau State.

This is an indication that Irish potato farming can have positive implication on revenue generation in North and Central Zones of Plateau State as captured in figure 3.

Figure 4: Government Institutions have provided Mitigation or Adaptation Measures to Assists Small Scale Irish Potato Farmers Cope with Climate Change in North and Central Zones of Plateau State



From figure 4, it could be observed that majority (51.80%) of the respondents were in disagreement that Government institutions have provided mitigation or adaptation measures to assist small scale Irish potato farmers cope with climate change in North and Central Zones of Plateau State. 33.8% further disagreed to that. This thus suggests that measures provided by government to mitigate climate changes that affect Irish productions has not roundly been effectual.

Figure 5: Small Scale Enterprises in Irish Potato Farming do not possessed new Technology for Preservation Central Area of Plateau

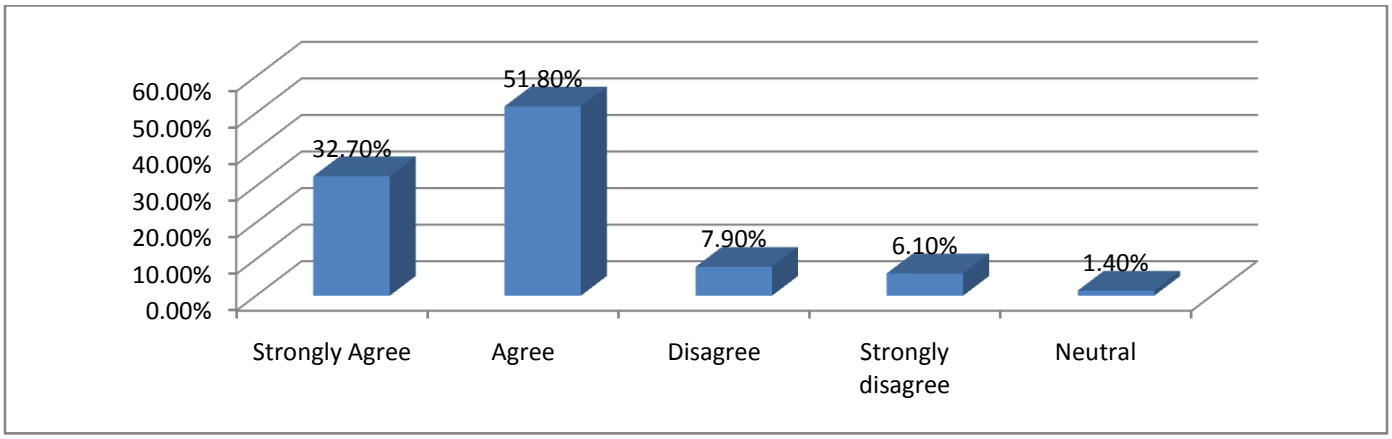


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Figure 5, revealed 51.8% of the respondents stated that Small Scale Enterprises in Irish potato farming do not possessed new technology for preservation in North and Central Zones of Plateau State. 32.7% of the entire respondents also agreed to that. However, 7.9% of the respondents disagreed that Small Scale Enterprises in Irish potato farming do not possessed new technology for preservation in North and Central Zones of Plateau. 6.10% strongly disagreed also, while only 1.40% of the respondents were neutral on it as captured in figure 5.

Statistical Test of Hypotheses

Two of the three hypotheses earlier formulated under the introduction section of this paper were approached by the use of correlation analysis, while the other was approached with t-test statistical tool.

H_0: $\beta_0 = 0$ (Null hypothesis)

Nijsse (1988) contains the justification and use of t-test application to the product moment Pearson Rho (p). According, the t-test is defined as:

$$t = \frac{\rho}{\left(1-\rho^2 \big/ n-2\right)^{\frac{1}{2}}}$$

The level of significance for the study is 5%, for a two tailed test. The decision rule is that the study shall accept the null hypothesis if the calculated value is greater than the, critical t-value (±1.96) reject the null hypothesis. That is, using the *t*-test (*t*-statistic), the study believe that a variable is statistically significant if t^* (*t*-calculated) is greater than the critical t- value of ±1.96 under 95% (or 5%) confidence levels and it is statistically insignificant if the t^* is less than the tabulated value of ±1.96 under 95 %(or 5%) confidence levels.

H_{01}: *There is no significant relationship between climate changes and Irish Potato Farming in North and Central Zones of Plateau State.*

Table 1: Correlation Result for Climate Changes and Irish Potato Farming in North and Central Zones of Plateau State.

Product Moment Correlation Coefficient {Sig.(2-tailed)}						
Variables	N	Mean	SD	rho	p-value	Remark
climate changes	143	2.87	1.49	0.782	0.0002	p<0.05
Irish Potato Farming	143	2.87	1.65	0.782	0.0002	p<0.05

Table 1 shows the correlation coefficient (rho) on whether there is significant correlation between climate changes and Irish Potato farming in North and Central Zones of plateau state. The rho value gave 0.782 (indicating a very good or strong positive correlation) and with a p-value of 0.002. The p-value of 0.0002 was found to be less than the 0.05(or 5%) confidence level thus implying that we reject the first null hypothesis. ***This indicates that there is a strong relationship between climate changes and Irish Potato Farming in North and Central Zones of Plateau State.***

H_{02}: *There is no significant relationship between climate changes and quality of Irish Potato farming in North and Central Zones of Plateau State.*

Table 2: Pearson Correlation statistical Result for Hypothesis two there is no significant relationship between climate changes and quality of Irish Potato farming in North and Central Zones of Plateau State.

Variables Responses	Pearson Correlation	shows responses on the climate changes	showing quality of Irish Potato farming
shows responses on the climate changes	Pearson Correlation	1	0.634**
	Sig. (2-tailed)		0.021
	N	143	143
showing quality of Irish Potato farming	Pearson Correlation	0.634**	1
	Sig. (2-tailed)	0.021	
	N	143	143

**. Correlation is insignificant at the 0.05 level (2-tailed).

Table 2 shows the correlation coefficient (rho) on whether there is a significant relationship between climate changes and quality of Irish Potato farming in Central Area of Plateau State. The rho value gave 0.634 (also indicating a strong correlation) and with a p-value of 0.021. The p-value of 0.021 was found to be less than the 0.05(or 5%) confidence level thus implying that we reject the second null hypothesis. ***This indicates that there is a strong correlation (relationship) between climate changes and quality of Irish Potato farming in North and Central Zones of Plateau State.***

H_{03}: *There is no significant relationship between climate changes and use of low technology equipment by SMEs farmers of Irish potato in North and Central Zones of Plateau State.*

Table 3: There is no Significant Relationship between Climate Changes and use of low Technology equipment by SMEs Farmers of Irish Potato in North and Central Zones of Plateau State (E-Views, 7.0 output)

Stepwise Regression Analyses on Use of low technology equipment and SMEs farmers of Irish potato Variables				
Dependent Variable: **Irish potato farming** ***R^2 =0 .3314; F = 4.2319; Sig = 0.0012***				
Independent Variable	Beta	t-value	Pearson Correlation(r)	Probability value
Low level of technology	1.25	1.41	0.00189	0.6733

From table 3, the calculated t-value for gave 1.41 and the critical value is given as 1.96, under 95% confidence levels. Since the calculated t-value is less than the critical value (1.41 < 1.96), this study therefore, reject the third null hypothesis (H03). The study *thus concludes that* ***there is no significant relationship between climate changes and use of low technology equipment by SMEs farmers of Irish potato in North and Central Zones of Plateau State.***

More so, the R^2 (R-square) value shows that ***use of low technology*** has a very weak impact on ***SMEs farmers of Irish potato*** in North and Central Zones of Plateau State. This was explained by 33.14% impact, which is quite poor.

Discussion of Findings

The result from the analysis showed that there is no strong relationship between climate changes and Irish Potato Farming in North and Central Zones of Plateau State. This suggests that frequent changes in climate conditions have a significant impact on Irish potato farming. This agrees with Ayindea, Muchiea and Olatunjib (2011) whom observed that climate change affects food and water resources that are critical for livelihood in Africa where must population especially the poor, rely on local supply system that are sensitive to climate variation. Disruptions of existing food and water systems will have devastating implications for development and livelihood. These are expected to add to the challenges climate change already poses for poverty eradication.

More so, the study revealed that there is a strong correlation (relationship) between climate changes and quality of Irish Potato farming in North and Central zones of Plateau State.

This shows that favorable weather conditions influences the quality of Irish Potato farming. Niggol and Mendelsohn (2008) stated that climate can also affect the quantity and quality of feed stuffs such as pasture, forage, and grain and also the severity and distribution of livestock diseases and parasite. Obioha (2009) noted that the sustainability of the environment to provide all life support systems and the materials for fulfilling all developmental aspirations of man and animal is dependent on the suitability of the climate which is undergoing constant changes. The effect of these changes is posing threat to food security in Nigeria.

Lastly, it was discovered that there was no relationship between use of new technology and Irish potato farming in North and Central Zones of Plateau State. It shows that use of low technology equipment leads to wrong weather predictions which could impact negatively on Irish potato farming and preservations.

CONCLUSIONS

The issue of climate change has become more threatening not only to the sustainable development of socio-economic and agricultural activities of any nation but to the totality of human existence. Since agriculture in North and Central Plateau State is mostly rain-fed, it follows therefore that any change in climate is bound to impact its productivity in particular and other socio-economic activities in the North and Central Zones of Plateau State. The impact could, however, be measured in terms of effects on crop growth, availability of soil water, soil erosion, incident of pest and diseases, sea level rises and decrease in soil fertility which affects Irish productions. As further explained by UNFCCC, the effect of climate change implies that the local climate variability which people have previously experienced and adapted to is changing and this change is observed in a relatively great speed. The threat that climate changes pose to agricultural production does not only cover the area of crop husbandry but also includes livestock and in fact the total agricultural sector.

RECOMMENDATIONS

Based on the findings, this study recommends that:

i. There should be an explicit national agricultural research policy framework to provide a conducive environment for continuity and effectiveness in agricultural programmers' or projects. This could be achieved through radical departure from reliance on rain-fed food production through heavy utilization of irrigation. There is therefore the need for adequate provision of irrigation and drainage infrastructure which could be regarded as crucial for climate change adaptation

ii. The government should take a bold step to establish better-equipped weather stations and high technological machines as against the scanty and ill-equipped ones. With this, accurate weather forecast and predictions will be possible and this will help to prevent weather-related disasters through early warning and effective response/adaptation system. In addition, efforts need to be made towards tackling the dilapidated infrastructure in the country. With the increasing rate of erratic rainfall patterns, drought and desertification, drought resistant and short duration high yielding crops should be developed through research efforts and made available to farmers.

iii. The high climate variability that characterizes North and Central Zones of Plateau State presupposes that people have developed successful indigenous adaptation strategies. It is therefore advocated that indigenous knowledge and practices should be integrated into formal climate change mitigation and adaptation strategies. There is need for effective capacity building to strengthen the most vulnerable group in agricultural production with requisite knowledge and information necessary for climate change mitigation and adaptation.

LIMITATIONS AND FURTHER STUDIES

This study has the following limitations: the coverage was limited to North and Central zones of Plateau State and the data collected were only restricted to the study areas. In other ward, the result in this study would not be generalized to cover the entire Nigeria. However, further studies could explore ways to conduct research that will address entire Nigeria.

REFERENCES

Apronius M., Georgina O.S. and Vivian K. (2013). Impact of Climate Change to Small Scale Farmers: Voices of Farmers in Village Communities in Tanzania. The Economic and Social Research Foundation (ESRF), Uporoto Street (Off. Ali Hassan Mwinyi Rd.) Ursino Estate, Dares Salaam. ISBN: 978-9987-610-80-8.

Ayindea, O. E., Muchiea, M. and Olatunjib, G. B. (2011). Effect of Climate Change on Agricultural Productivity in Nigeria: A Co-integration Model Approach. Hum Ecol, 35(3): 189-194 (2011)

Chioma E. (2015). Climate Change in Nigeria: the Impacts and Adaptation Strategies. Electronic Copy Available at: http://ssrn.com/abstract=2543940

Ifeanyi-obi C.C., Etuk U.R. and Jike-wai O. (2012). Climate Change, Effects and Adaptation Strategies; Implication for Agricultural Extension System in Nigeria. Greener Journal of Agricultural Sciences ISSN: 2276-7770 Vol. 2 (2), pp. 053-060,

Jwanya, B. A., Dawang, N. C., Zarmai, D. U. and Mashat I.M. (2014). Economic Analysis of Irrigated Irish Potato Production in Plateau State Developing Country Studies. Vol.4, No.12.

Kooman, P.L. (1995). Yielding ability of potato crops as influenced by temperature and daylenght. PhD thesis, Wageningen Agricultural University Wageningen, Netherlands.

Kooman, P.L, and Haverkort, A.J. (1995). Modelling development and growth of the potato crop influenced by temperature and daylength LINTULPOTATO. In: AJ Haverkort and DKL.

McCarthy, J.J., Canziani, O.F., Leary, D.J., Dokken, N.A. and White, K.S. (2001). Climate Change 2001. Impacts, Adaptation, and Vulnerability. Contribution of Working Group I1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK.

Nancy, M.L. and John, M.O. (2014). Market Structure and Price: An empirical analysis of Irish potato markets in Kenya. This research paper was produced under the Future Agricultures, Early Career Fellowship Programme. www.future-agricultures.org

Niggol, S. and Mendelsohn R. (2008). Animal Husbandry in Africa: Climate impacts and adaptations. AfJARE, 2(1): 66.

Obioha, E. (2009). Climate variability, environmental change and food security nexus in Nigeria. Journal of Human Ecology, 26(2):107-121.

Olaniyi, O.A., Funmilayo O.A. and Olutimehin I.O (2014). Review of Climate change and its effect on Nigeria Ecosystem. International Journal of Environment and Pollution Research Vol.2,No.3, pp.70-81,

OKonkwo, J.C. Ene, L.S.O. and Okoli, O.O. (1995). Potato production in Nigeria. National Root Crops Research Institute, Umudike, Umuahia, Abia State, Nigeria Pg 1-109.

Robert, J. H. (2003). The Effect of Climate Change on Global Potato Production. International Potato Center (CIP), Apartado 1558, La Molina, Lima 12, Peru. 80:271- 280 271.

Stol W, GHJ de Koning, AJ Haverkort, PL Kooman, H van Keulen, and FWT Penning de Vries. (1991). Agro-ecological characterization for potato production. A simulation study at the request of the International Potato Center (CIP), Lima, Peru. CABO-DLO, Report 155.

Tewodros A. (2014). Analysis of Seed Potato (Solanum tuberosum L.) Systems with Special Focus in Ethiopia: Review Asian Journal of Agricultural Research, 122-135.

Van-Keulen, H. and W Stol, W. (1995). Agro-ecological zonation for potato production. In: Haverkort, A.J. and DJL MacKemon (eds), Potato Ecology and Modeling of Crops under Conditions Limiting Growth.

APPENDIX

QUESTIONNAIRE ON THE EFFECTS OF CLIMATE CHANGE ON IRISH POTATOES FARMING IN NIGERIA

Dear Respondents,

We are undertaking a study on, '**The Effects of Climate Change on Irish Potatoes Farming in Plateau: A Study of North and Central Zones of Plateau State'** in view of the above; it would be appreciated if you offer candid option to the attached questions, please.

Tick as appropriate

Key Notes: 1= Strongly Disagreed, 2 = Disagreed, 3 = Neutral, 4 = Agreed, 5 = Strongly Agreed

S/No.	Items	Agreement scale				
		SD%	D%	N%	A%	SA%
1.	Climate change did not encouraged Irish potato varieties to grow very well in North and Central Zones of Plateau State.					
2.	The variation of weather (rainfall, temperature, extreme events) has negatively affected Irish Potato quality production in North and Central Zones of Plateau State.					

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3.	Irish Potato farming has improved small scale Enterprises farmers revenue drive in North and Central Zones of Plateau State.					
4.	Government institutions have provided mitigation or adaptation measures to assist small scale Enterprises Irish potato farmers cope with climate change in North and Central Zones of Plateau State.					
5.	Small Scale Enterprises in Irish potato farming possessed new technology for preservation North and Central Zones of Plateau.					