

Exploring the Effects of Climate Change on Net Revenue of Farmers: An Econometric Investigation Using Farm-Level Data in Cross River State, Nigeria

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Abstract

This paper addressed the effects of climate on the net revenue of farmers in Cross River State. The specific objectives of this paper are; to examine the level of yam production in Cross River State and, to determine the factors that affect farmers' net revenue. Data was collected from 209 farmers using a well-structured questionnaire. The analysis was done using the independent sample t-test, the Chi-square test and Ordinary Least Square (OLS) regression. The findings revealed that the mean value of the respondents on the level of profit was N88,192.13, while the maximum and minimum amount were N110,000 and N50,000, respectively. The independent sample t-test showed that education produced a statistically significant difference in means. The Chi-square test showed that educational level (p-value =0.047), age (p-value=0.034), farming experience (p-value=0.061) and access to credit (p-value=0.088) have a relationship with the net revenue of farmers. The result from the OLS regression revealed that the variables that affect the net revenue of farmers are farming experience, household size, access to the weather forecast and tenure status. This research recommends that policymakers should emphasise how to improve these factors to enhance farmers' net income to increase self-sufficiency in food crop production.

Keywords: climate change, net revenue, farmers, production

1. Introduction

According to Stern (2006), the decline in food crop harvests is most considerable in developing countries where the dependence in Agriculture is more significant compared to many other parts of the world. Therefore, climate change will probably increase the risk of food insecurity for some vulnerable groups, especially the poor, who mainly depend on Agriculture (Jalloh *et al.*, 2013). Crop farming is exceptionally susceptible to climate change, and it has been predicted that climate change will impact negatively on agricultural yield in the 21st century (IPCC 2007; World Bank, 2010; Sarker, Alam and Gow, 2012). The predicted climate changes could have a devastating negative impact on agriculture in Nigeria, causing decreased crop productivity over the entire country (BNRCC, 2011).

Moreover, the effect of climate change on agriculture is expected to differ by location depending on the contributing factors (Uleberg *et al.*, 2014; Mishra, Sahu and Sahoo 2016). However, assessing many studies that cover a wide range of regions and crops, a report by IPCC (2014), concluded that the negative impact of climate change on crop yields have been more common than the positive impacts. Accordingly, the vulnerability of the Nigerian agricultural sector to climate change is of concern to policymakers because agriculture is a critical sector in the economy (Ater and Aye, 2012). Therefore, addressing the issue of climate change in the agricultural industry is of high importance to Nigeria and especially in Cross River State, where the smallholders depend basically on agriculture for survival. Also, the state is mainly in a tropical rain forest agro-climatic zone and is primarily rain-fed.

In the past, cross-sectional studies have made use of the Ricardian approach as demonstrated in Kurukulasuriya

and Mendelsohn 2008; Ater and Aye 2012; Ibrahim *et al.*, 2014; Mishra, Sahu and Sahoo, 2016; Fonta *et al.*, 2018. Regardless of the extensive use of the Ricardian cross-sectional method, it presents some limitations. One of the shortcomings, with relevance to this present-day study, is that the Ricardian approach has the assumption of long-run equilibrium of factor markets. In other words, markets are incomplete, and factor mobility is restricted, which assumes fully integrated markets challenging (World Bank, 2003; Mishra, Sahu and Sahoo, 2016). More so, the non-integration of markets, thus, makes the use of land values (prices) in explaining the performance in agriculture a challenge. Additionally, the model requires a perfectly competitive land market that does not exist in most developing countries.

Therefore, this study relies on net revenue, which is a more robust measure given the concern about market equilibrium. This is so because it estimates the farmer's current income without any considerations for expected returns, discounting capital, or labor markets (World Bank, 2003; Mishra, Sahu and Sahoo, 2016). Moreover, following previous related studies (Sarker, Alam and Gow, 2013 and Elijah, Osuafor and Anarah, 2018), the impact of climate change on net revenue of farmers employed the use of Ordinary Least Square (OLS) analysis, a Chi-square test and an independent sample t-test. The regression analysis tool (OLS) was applied to investigate the influence of the socio-economic, institutional and farm characteristics to farm profit (which is defined as net revenue) under changing climatic conditions. The independent sample t-test was used to compare the means of net revenue between groups, while the Chi-square test was employed to show the relationship between the variables.

2. Materials and Methods

2.1 The Study Area

Cross River State belongs to the south-south geopolitical zone in Nigeria. It lies between latitudes 5°32'N and 4°27' North and longitudes 7°50' and 9°28' East. The state is located within the tropics and shares borders with Cameroon Republic in the East, Benue state in the North, Enugu and Abia States in the West and Akwa-Ibom state in the south.

Two distinct seasons are experienced in the state- wet season and dry season. The wet season starts about February/March and continues till October/November, while the dry season begins about November/December and continues till January /February. The mean annual rainfall is 1,300mm to 3,000mm prevail over the state, and this varies from place to place. The highest does not exceed 37°C, and the lowest does not go below 15°C, and it varies from place to place. The vegetation of the state comprises of four different features which range from Mangrove Swamp (wetland), through the rainforest, to derived savannah and finally montane parkland (Ettah and Angba, 2013).

Moreover, the two primary soil types found in the area are the deep laterite fertile soil and dark clayey basalt soil. The weather conditions and the full range of vegetation types give the farmers in Cross River State advantage in the cultivation of oil palm, cocoa, cassava, yams, plantain, rice, maize, sweet potatoes and a wide range of vegetables including waterleaf, *telfera*, *amaranthus spp*, okra, pepper, etc. Cross River State indigenes are also engaged in fishing and poultry farming. The state comprises of eighteen (18) Local Government Areas (LGAs).

For administrative convenience, these LGAs are grouped into three agricultural zones as follows;

- 1) Ogoja agricultural zone which comprises of Ogoja, Yala, Bekwarra, Obudu and Obanliku, LGAs;
- 2) Ikom agricultural zone which includes of Ikom, Abi, Yakurr, Obubra, Etung, and Boki LGAs;
- 3) Calabar agricultural zone which comprises of Calabar Municipal, Calabar South, Bakassi, Akampa, Odukpani, Akpabuyo, and Biase, LGAs.

2.2 Data Required for the Study

Data needed for this study was generated from primary sources. The primary data was obtained through the use of a well-structured questionnaire. The questions covered the socio-economic characteristics of farmers, farm characteristics, and institutional accessibility.

2.3 Study Population and Sampling Technique

The population of this study consisted of all yam farmers situated in the different ADP zones in Cross River State. In order to draw a sample size, 5% of the population of the study is considered to be a suitably large enough for sample size in survey research (Bartlett *et al.*, 2001; Sarker, Alam and Gow, 2013). Similarly, the standardised tabulation recommends that at the level of precision $\pm 7\%$ and for a population higher than 3,000 but less than 4,000, the sample size of about 200 should be used (Etta, Angba and Angba, 2018). Since the population of registered yam farmers in the chosen agricultural zones is 3,484 (State Bureau of Statistics, 2011), the study,

therefore, used a sample size derived from the standardised tabulation of sample size.

A multi-stage sampling procedure was adopted for this study; Firstly, two zones were selected from the three Cross River State Agricultural Development Project (CRADP) zones. Purposive sampling technique was used to choose Ikom and Ogoja agricultural zones because the cultivation of yam in Cross River State is principally done in these zones (FMARD, 2009). Secondly, simple random sampling was employed to select two (2) blocks each from the six (6) and five (5) blocks that constitute Ikom and Ogoja agricultural zones respectively giving a total of four (4) blocks. In the third stage, a simple random sampling technique was employed to select three (3) cells out of the eight (8) cells that make up each block chosen giving a total of twelve (12) cells. In the final stage, a simple random sampling technique was used to select two hundred and nine (209) yam farmers from the selected cells. A list containing the registered number of yam farmers from the ADP office was used in the final selection of the farmers for the study. Hence, the sample size for this study was two hundred and nine (209), which is 6% of the farm population in the selected zones. Figure 1 below shows a flow chart of the steps that were taken in conducting this research and the process of data collection.

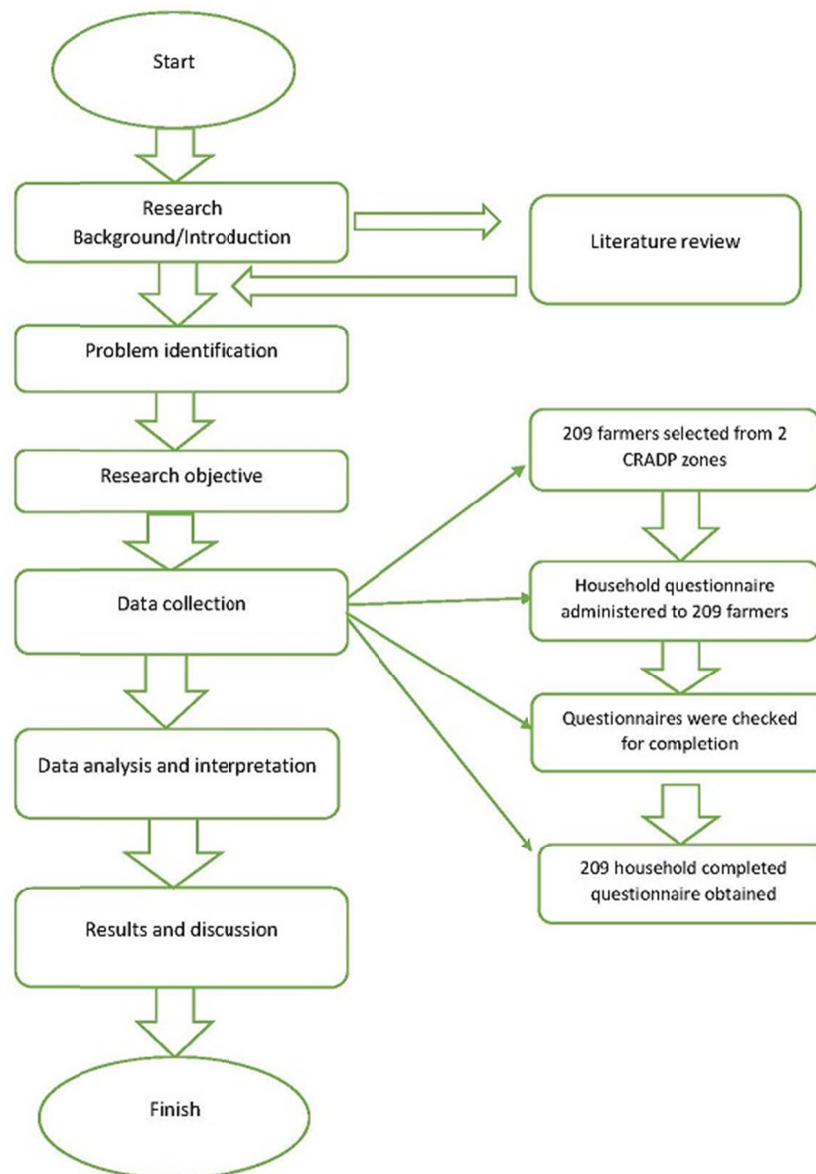


Figure 1. Flow chart of the research method and data collection process

2.4 Theoretical Framework and Model Specification

2.4.1 Theory of Production

From a theoretical viewpoint, the theory of production explains the change of physical inputs (e.g., labour and capital) into outputs. That is, the production function reflects the level of technical efficiency in the process of production by showing the ratio of observed output to the maximum level of the production that a producer can produce, using given input (Angba and Iton, 2020).

Importantly in economics, the production transformation is expressed mathematically using the production function. Hence, this leads us to the production function, which is presented in the next sub-section.

2.4.2 Production Function

The production function is defined as the mathematical expression, which indicates the maximum output that a producer can produce, given available physical input. Nevertheless, it is worthy of note that one of the approaches that are applied to evaluate the physical and economic impacts of changes in weather patterns on agriculture is the production function model. This model estimates the effects of climate change by varying one or more variables such as rainfall or temperature. Besides, the fundamental idea of this method is that the development of production in agriculture relies on soil-related and climatic variables that are employed as independent variables in the model (De Salvo, Begalli and Signorello, 2013; Elijah, Osuafor and Anarah, 2018).

Similarly, a crop production function can be stated based on endogenous and exogenous variables; endogenous variables include labour, capital, fertilisers, and other inputs while the exogenous variables are the climatic variables

Mathematically, the crop production function can be expressed as:

$$Q_t = f(m_t, z_t, x_t) \quad (1)$$

Where Q_t denotes agricultural productivity or yields per hectare of a specific crop, m_t represents farmers' characteristics, z_t represents climatic variables, x_t represents endogenous variables and the sub-index t , represents the time of the year observed.

This method depends on the fact that farmers attempt to maximise their profit and thus, they choose the number of inputs (X) that allow them to achieve this goal given the explanatory variables like weather factors. Climatic variables, considered as explanatory, however, play a significant role in determining crop yields. This is so because plant development depends on their exposure to rainfall and temperature in their growth stage. There exists a relationship between the climatic variables and the growth stage in the phenology of plants; for example, moisture relates to the germination and flowering, and temperature correlates with the growth and maturation of the fruit.

In addition, to estimate the production function, the Cobb–Douglas production function is used. Usually, a functional quadratic formula is preferred to determine the production function to detect the temperature and rainfall levels that affect agricultural production positively or negatively. After the estimation, the production function, calculating the impact on the different variables (production or crop yield) is then possible given the variations in one or more factors like rainfall and temperature.

2.4.3 Data Analysis

The data collected was analysed using both descriptive statistics and inferential statistics. Descriptive statistics such as frequency, percentage and mean were used to show and describe the level of yam production in the study area. The Ordinary Least Square regression model was employed to determine the factors that affect farmers' net revenue in the study area.

3. Results and Discussion

3.1 Level of Yam Production

It is, however, necessary for policymakers to become aware of the variations in yam farmers' profit or net revenue (proxied for the level of production) in yam production. In Table 1 below, the mean value of the respondents on level of profit was estimated as N88,192.13 (Naira), while a maximum and minimum amount were estimated as N110,000 and N50,000 respectively in yam production. Thus, the respondents with a profit level below N88,192.13 were categorised as having low profit, whereas those with N88,192.13 and above have a high level of profit in the study area. The result revealed that 51.7% of the respondents had a high level of profit, whereas 48.3% had low-profit level. This result, therefore, suggests that the attributed changes in weather patterns by the yam farmers may not be detrimental to the level of yam production in the study area. There may

be other factors responsible for the low level of profit earned by yam farmers, and this could be further investigated in future studies. This report is, however, suggestive and not conclusive.

This finding, however, contradicts a study by Oluwasusi and Tijani (2013), who researched farmers adaptation strategies to the effect of climate variation on yam production in Ekiti State, Nigeria. In his research, he investigated the level of yam production among farmers in Ekiti state. He found out that the majority of the farmers (56.3%) had low production level, whereas, the remaining 43.7% had a high level of production in the study area. This study further concluded that the main reason for the low production level in yam is attributed to changes in climate by the yam farmers in Ekiti state.

Table 1. Distribution of yam farmers according to their level of profit (net revenue)

Profit level	Value (in Naira)	Frequency	Percentage	Mean	Min value	Max value
High	88,192.13 and above	108	51.7			
Low	Below 88,192.13	101	48.3	88,192.13	50,000	110,000

Source: Field survey, 2019

3.2 Impact of Climate Change on Net Revenue of Farmers

3.2.1 Independent Sample T-Test Comparing the Means of Net Revenue between Groups

In order to compare the means of profit (net revenue) between groups in the study area, the two-sample t-test was used. The result of the analysis is presented in Table 2 below using values for equal variances assumed as the Levene's test for equality (F) values were above 0.05. The findings show that only one variable produced a statistically significant difference in means, which is education (p-value=0.063). In making the comparison appropriate, the respondents were categorised into two clusters (which is consistent when the t-test is applied). The two groups were the educated farmers and uneducated farmers. The outcome of the analysis further indicates that the mean of net revenue of the educated farmers (89,409.32) is higher than that of illiterate farmers (84,881.25), and the mean difference is statistically significant at 10% level of significance. This result, however, implies that education is an essential determinant of the net revenue of yam farmers. A study confirms this suggestion carried out in Nigeria on "the economic impact of climate change on maize sector" using a Ricardian approach by Ibrahim *et al.*, (2014). The study ascertained that farmers with a higher level of education earned more profits than uneducated farmers.

The result of this analysis is thus, consistent with that of Sarker, Alam and Gow (2013), who also found out that education produced a statistically significant difference in means among rice farmers in Bangladesh.

Table 2. Independent sample t-test result

Variables	Two sample t-test (equal variances assumed)	
	Value	P-value
Gender (male and female)	0.420	0.645
Access to credit (yes and no)	1.619	0.788
Education (educated and uneducated)	0.572*	0.063
Access to extension services (yes and no)	0.910	0.572
Use of improved variety (yes and no)	1.956	0.963
Tenure status (yes and no)	7.832	0.556
Non-farm job (yes and no)	0.928	0.412
Livestock ownership (yes and no)	0.321	0.145

Note: * indicates significance at 10% level

3.2.2 Chi-Square Test to Observe the Association between Net Revenue and Various Determinants

In order to determine the existing relationship between net revenue and various socio-socioeconomic, institutional, and farm factors, a chi-square test was utilised. The outcome of the analysis is presented in Table 3 below. The chi-square test is used to observe if there is an association between two categorical variables. However, the chi-square test is unable to demonstrate the strength of the relationship. Alternatively, Phi (symmetric measures) and the uncertainty coefficient (directional measures) can provide some information on the strength of the existing relationship. Based on the result of the Pearson chi-square analysis, four variables were discovered to be statistically significant. These are educational level (p-value=0.047), age (p-value=0.034), farming experience (p-value=0.061) and access to credit (p-value=0.088). Nonetheless, this existing relationship is merely indicative and not conclusive.

Furthermore, the significance values of Phi for the same variables found to be significant, suggest a statistically significant relationship. Moreover, the value of Phi range between 0.006 and 0.527, which implies that the link is from weak to vigorous. Notably, Phi values higher than 0.3 indicate a strong relationship, whereas, the values lower than 0.3 signifies a weak correlation between two variables (Muijs 2010; Sarker, Alam and Gow, 2013). Therefore, the level of education and access to credit facility have Phi value of 0.098 and 0.010, respectively which show a weak relationship between these variables and net revenue. On the contrary, a strong relationship is observed between age and net revenue; farming experience and net revenue as the Phi value of these variables are 0.448 (age) and 0.420 (farming experience). As for the directional measures, otherwise known as the uncertainty coefficient, the p-values imply that most of the variables are not statistically significant.

However, the outcome of this analysis contradicts with that of a study by Oluwasusi and Tijani (2013) carried out in Ekiti State, Nigeria on the adaptation strategies carried out by farmers to cope with the effect of climate variation on yam production. The research employed the Pearson's chi-square analysis to show the relationship between demographic characteristics of the household and the level of yam production. The study found out that the secondary occupation and farm size of the yam farmers were statistically significant. The study result implies that farmers with a large proportion of farmland usually have more economic resources, which includes land. Also, they are better in the adoption of innovation on improved agricultural practices, and even better yam farmers with additional worthwhile income than farmers with a small size of farmland. The farm size and secondary occupation of yam farmers for this present study in Cross River State were not statistically significant.

Furthermore, in another study (which has similar findings to that of this present study) conducted in Bangladesh by Sarker, Alam and Gow, (2013), the study investigated the factors that determine the net revenue of farmers using a chi-square analysis. The result of the investigation showed that most of the variables were statistically significant, which included the level of education, age, farming experience and access to credit. This study, however, agrees with that of this present research as these four variables mentioned were found to be statistically significant.

Table 3. Chi-square result showing the relationship between net revenue and the characteristics of respondents in the study area

Variables	Pearson Chi-square test		Symmetric measures (Phi)		Directional measures (uncertainty coefficient)	
	Value	P-value	Value	P-value	Value	P-value
Gender	0.569	0.450	0.527	0.450	0.002	0.450
Educational level	1.994**	0.047	0.098**	0.043	0.006**	0.026
Household size	14.252	0.219	0.261	0.219	0.025	0.166
Farm size	0.500	0.919	0.049	0.919	0.001	0.919
Age	41.971**	0.034	0.448**	0.034	0.065	0.423
Farming experience	36.805*	0.061	0.420*	0.061	0.054	0.778
Distance to market	1.967	0.161	0.097	0.161	0.007	0.160
Marital status	1.053	0.788	0.071	0.788	0.004	0.786
Access to credit	0.023*	0.088	0.010*	0.088	0.000*	0.070
Extension service	0.006	0.936	0.006	0.936	0.000	0.936
Access to weather information	0.492	0.483	0.049	0.483	0.002	0.482
Tenure status	1.501	0.220	0.085	0.220	0.006	0.220
Non-farm jobs	0.906	0.341	0.066	0.341	0.003	0.341
Livestock ownership	0.078	0.780	0.019	0.780	0.000	0.780

Note: *and **indicate significance level at 10% and 5 % respectively

3.2.3 Determinants of Net Revenue Using the Ordinary Least Square (OLS)

The multiple regression analysis was employed to address the possible factors that influence farmers' net revenue in yam production. The relevant factors that were incorporated in the model were identified based on literature (Kurukulasuriya and Mendelson, 2008; Ibrahim *et al.*, 2014; Chukwuone, 2015; Mishra, Sahu and Sahoo 2016; Elijah, Osuafor and Anarah, 2018). Table 4 below presents the result of the multiple regression analysis. The result presented shows evidence of a very high significant estimation. This is because the general significance testing indices, designated as Prob>F, is not just less than 0.05, but it is 0.000. Additionally, the findings reveal that the R-square is 0.660, which infers that 66% of the dependent variable (net revenue) is explained by the specified independent variables in the model.

The result of the analysis shows that most of the explanatory variables are not statistically significant. However, the variables that have substantial effects on the net revenue of farmers are farming experience, household size, access to the weather forecast and tenure status. The result further shows that age, farm size, distance to market, access to credit, access to extension services and livestock ownership all have negative relationship with the net revenue of farmers and are statistically not significant. Besides, the gender, educational level, and marital status are positively related to the net revenue of farmers. However, they are not statistically significant. This implies that each of the insignificant variables has no influence on the net revenue of yam farmers in the presence of climate change in the study area. It further means that most of these variables are not relevant in the model.

Moreover, farming experience has a significant positive impact on the net revenue of the respondents. This indicates that farmers with many years of experience have a better capacity to use better agricultural practices in their enterprise based on their knowledge and skill over time than their counterpart with lesser years of experience. This outcome conforms with a study carried out by Elijah, Osuafor and Anarah, (2018) in research on the topic effects of climate change on yam production in Cross River State, Nigeria. Another study by Ajayi (2015), is also in agreement with this result; the survey on the effects of climate change on the production and profitability of cassava in the Niger Delta Region of Nigeria revealed that farmers' years of experience in farming positively influenced the net farm income in the study area.

The second statistically significant variable that will be discussed is the number of household members, which is

positively related to the net revenue of farmers. This suggests that farmers with larger household sizes save costs as they don't hire a lot of farm labour since they rely on household labour in the study area. This, in turn, promotes net revenue. Also, households with more members practice division of labour to increase efficiency in farming as opposed to farmers with smaller household sizes where a division of labour is a challenge with fewer members. This result corresponds with that of a study by Elijah, Osuafor and Anarah, 2018 who reported that the outcome of his research is not very odd, given that the number of household members is significant in determining farmer's profit. The study added that it is therefore expected that the farmers with more significant household members shouldn't hire much of farm labour because they mostly make use of household labour which is available to them. On the contrary, research by Ezekiel *et al.*, (2012), reported that household size and farming experience do not have a significant effect on the net revenue of cassava farmers in Osun State, Nigeria. Rather educational level and access to credit were statistically significant among the study variables considered.

The next variable that showed statistical significance is access to weather information. Access to information on the weather forecast is negatively associated with the net revenue of farmers in the study area. This negative relationship could be as a result of the insufficient and inaccurate weather forecast information in Nigeria. Information on the weather forecast is often given on major cities in the country, and the minor towns and villages are left out. Sometimes, the predictions made do not come to reality. Consequently, the farmers who rely on the weather forecast for agricultural activities are misinformed and thereby disadvantaged. A negative influence of weather forecast on net revenue of farmers was also revealed in a study in Bangladesh by Sarker, Alam and Gow (2013). A similar result was reported in another study by Gbetibouo (2009), in South Africa.

Finally, the result of the analysis showed that tenure status was significant and positively related to the net revenue of farmers in Cross River State. This suggests that land ownership reduces the uncertainty of obtaining the benefits of capital and labour investment in farming (Sarker, Biswas and Maniruzzaman, 2015). This positive influence of land ownership on the net revenue of farmers also conforms with the findings of Kurukulasuriya and Ajwad (2007); Charles (2009) and Ajayi (2015).

Table 4. Parameter estimates of determinants of net revenue of farmer in Cross River State

Variables	Unstandardized Coefficients		t	P-value
	B	Std. Error		
Gender	169.222	943.757	0.179	0.858
Age	-36.346	82.404	-0.441	0.660
Educational level	5.957	652.661	0.009	0.993
Household size	182.408	215.292	2.247**	0.014
Farm size	-603.523	545.469	-1.106	0.270
Household income	-125.441	148.403	0.322	0.723
Distance to market	-922.185	890.389	-1.036	0.302
Farming experience	177.307	91.234	1.943**	0.023
Marital status	534.454	885.103	0.604	0.547
Access to credit	-242.641	896.298	-0.271	0.787
Access to extension services	-766.255	906.005	-0.846	0.399
Information on weather forecast	-577.506	611.038	1.945**	0.036
Livestock ownership	-362.605	910.831	-0.398	0.691
Tenure status	-1911.414	939.108	-2.035**	0.043
Summary of model				
Constant	81735.689	4089.862	19.985	0.000
R-square	0.660			
Prob>F	0.000			

Note: ** signifies 5% level of significance

4. Summary and Conclusion

4.1 Summary and Conclusion

The analysis of the economic impact of climate change on the net revenue of farmers employed the use of, an independent sample t-test, a Chi-square test and Ordinary Least Square (OLS) analysis. The independent sample t-test was used to compare the means of net revenue between groups; however, the Chi-square test was applied to show the relationship between the variables. At the same time, the regression analysis tool (OLS) was employed to investigate the influence of the socio-economic, institutional, and farm characteristics of farmers on their net revenue under changing climatic conditions.

Consequently, in comparing the means of net revenue between groups in the study area, the result of the two-sample t-test (which used values for equal variances assumed) showed that only one variable produced a statistically significant difference in means, which is education (p-value=0.063). Thus, the findings suggested that there is a significant difference between the means of net revenue of educated farmers and uneducated farmers. Based on the results of the Pearson Chi-square analysis, four variables were discovered to be statistically significant. These are educational level (p-value =0.047), age (p-value=0.034), farming experience (p-value=0.061) and access to credit (p-value=0.088). Therefore, the findings implied that these variables have a relationship with the net revenue of farmers.

Regarding the OLS, the multiple regression analysis was employed to address the possible factors that influence farmers' net revenue in yam production in the face of climate change. The findings showed evidence of a very high significant estimation because the estimated Prob>F was 0.000. Additionally, the results revealed the R-square value of 0.660, which indicates that 66% of the dependent variable (net revenue) is explained by the specified independent variables in the model. Furthermore, the findings of the analysis showed that most of the explanatory variables are not statistically significant. However, the variables that have statistically significant effects on the net revenue of farmers are farming experience, household size, access to the weather forecast and tenure status.

4.2 Recommendation

Based on the findings of the study, the following recommendations are given;

- Since education has the probability of reducing yam farmers' net revenue in the presence of climate change, the government should emphasise on the need for training to enhance the ability of farmers to adopt farming innovation and modern adaptation practices.
- Policymakers should revisit the existing policy on agricultural extension, technology development and transfer to confirm its efficiency so that uneducated farmers, especially younger farmers, can gain appropriate knowledge and understanding of the extension services and new technologies provided. Alternatively, the existing extension services could be reformed so that the extension agents spend more time and are more frequent on field visits to give support in enhancing farmers' knowledge.
- Farming experience, household size, access to the weather forecast, and tenure status were found to have a statistically significant effect on the net revenue of farmers. Thus, policymakers should emphasise how to improve these factors to enhance farmers' net income to increase self-sufficiency in food crop production.

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