The Cost of Climate Change Adaptation and the Effects on Revenue in Oyo State, Nigeria.

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Abstract

The effects of Climate change can be perceived in basic terms as the increase in global temperature that has resulted in variations in weather conditions. These variations have resulted in weather-related disasters that have had negative effect on the environment and agriculture as a whole, especially in Africa where we practice rain-fed agriculture. This study focuses on the effect of climate change and the possible adaptation strategies that have been adopted over time. This study aims at not only identifying the climate adaptation strategies adopted by cassava farmers but the monetary cost incurred by farmers who adopt these strategies and how it affects their income and yield. We can therefore identify this cost as the 'Cost of adapting to Climate Change. The study was carried out in Ibarapa East Local Government Area of Ibadan, Oyo state where 110 cassava farmers were randomly selected from three towns. Data was collected through a well-structured questionnaire. A 5-point scale likert analysis was used to check the level of Climate Change perception of farmers and it was found out that farmers are actually observant of the changes that occur on their farms due to Climate change. Multiple regression analysis was carried out to check for the factors that actually affect Income and yield. The cost of adapting to climate change has a significant negative effect on the annual production and does not have any significant effect on the annual income of farmers. From the findings of the study, it was recommended that more training on climate change sensitisation should be focused on by the extension workers. And also subsidised inputs should be made available for farmers.

Keywords: Adaptation strategies, cassava, Climate variability, Adaptation cost, Nigeria

Introduction

Cassava is obviously one of the most important food crops in Nigeria as well as Africa, because of its dietary contribution and job provision along the cassava value chain. (Ikuemonisan et. al., 2020). Consistent with (Nwaobiala & Isaac, 2017) Cassava *(Manihot spp*) is one among the principal helpful tropical plants and it's found on all the continents with Federal Republic of Nigeria because it is the largest producer in the world. It has special attribute of thriving well even in extreme conditions of drought and as such, has been called the famine security crop (Ikuemonisan et. al., 2020). However, the climate is rapidly changing and the efforts to mitigate the effects of the increase of greenhouse gases will take a while. Adaptation is therefore of critical concern in developing countries, particularly in Africa where vulnerability is high because ability to adapt is low.

Weather is an important component of agricultural production in Nigeria where agricultural production is majorly rain-fed (Sofoluwe et. al., 2011). (CGIAR, 2005) cited by Sofoluwe et. al., 2016) claims that the effects of climate change is most felt

in the tropics and sub-tropics and a little rise in temperature is likely to reduce crop yield in those regions. Hence, adaptation measures always seek to reduce the risks and impacts of climate change, to moderate the negative effects, and to exploit beneficial opportunity. Adaptation is a proactive process because it envisages reducing negative impact of climate change. (Kurukulasuliya & Mendelson, 2006)). However, these measures come at a price, and could be in any form. (economic, psychological or socioeconomic.

Cassava is a crop that is to an extent resistant to weather variations, however, human activities have changed atmospheric characteristics such as temperature, rainfall and ground level ozone thus increasing the severity of the effects of climate change. This is particularly worrisome because agriculture in Nigeria is predominantly rain-fed. Measures taken in mitigating the effects of climate change comes at a cost and is of importance for appraisal and documentation, especially when it is in relation to cassava that has been proven to add to dietary composition of people in several countries of the world including Nigeria and the economic potential it possesses. This study therefore intends to add to existing knowledge by identifying cassava farmers' climate change adaptation strategies as well as the relationship between the cost implications of these adaptation strategies to annual yield and income.

Methodology

This study was conducted in Oyo state, Southwestern region of Nigeria. It is delimited within the north by Kwara State, within the east by Osun State, within the south by Ogun State and within the west partially by Ogun State and by the Republic of Benin. The Climate is equatorial, notably with dry and wet seasons with comparatively high wetness. Ibarapa East Local Government Area is one of the local governments in Oyo state.

Data Collection and analysis

The study made use of primary data obtained through the distribution of structured questionnaires to cassava farmers in the study area. The multi-stage sampling technique was employed in the selection of farmers in the study area. Ibarapa East local government was purposively selected because it's one of the major Cassava producing belt in the state. Three villages (Temidire, Laware and Atanke) were randomly selected and from each of the villages 39, 42, 29 farmers were randomly selected respectively based on size of each village bringing the total number of selected farmers to 110.Descriptive statistics such as tables, means, standard deviation, and frequencies was used to analyse the adaptation and mitigation practices adopted by respondents, and their level of knowledge on climate change. OLS was used to check how cost adaptation strategies to climate change affects annual yield and income of cassava farmers. The four functional forms of the OLS were used and expressed explicitly as shown below:

Double log

$$\ln Y = \ln b_0 + b_1 l_n X_2 + b_2 l_n X_2 + b_3 l_n X_3 + b_4 l_n X_4 \ldots\ldots b_n l_n X_n + b_n + 1 + e_i \quad \text{eqn.1}$$

Linear Function

$$Y = b_0 + b_1 X_2 + b_2 X_2 + b_3 X_3 + b_4 X_4 \ldots\ldots b_n X_n + b_n + 1 + e_i \quad \text{eqn.2}$$

Semi – log function

$$Y = \ln b_0 + b_1 l_n X_2 + b_2 l_n X_2 + b_3 l_n X_3 + b_4 l_n X_4 \ldots\ldots b_n l_n X_n + b_n + 1 + e_i \quad \text{eqn.3}$$

Exponential function

$$\ln Y = b_0 + b_1 X_2 + b_2 X_2 + b_3 X_3 + b_4 X_4 \ldots\ldots b_n X_n + b_n + 1 + e_i \quad \text{eqn.4}$$

$Y_1 = \propto + X_i + \varepsilon$ eqn.1

$Y_2 = \propto + X_i + \varepsilon$ eqn.2 ($\propto$ =constant term and Xi = Independent variables)

Y_1 = Annual Income

Y_2 = Annual production

X_1 = Cost of Migrating to better land

X_2 = Cost of Planting resistant cassava stems

X_3 = Cost of Mixed Cropping

X_4= Cost of Increased Fertilizer use

X_5= Cost of Increased Herbicide use

X_6= Cost of Change of Planting dates

X_7 =Cost of increased Pesticide use

ε = error term

Results

Choice of Adaptation strategy

Table 1 below shows the distribution of farmers by the adaptation strategies they adopt. This shows that most adopted strategies are increase in the use of fertilizer, increased use of pesticides and herbicides. The implication of this is that the cost of production may increase as farmers need to spend more to buy fertilizer, pesticides and herbicides.

Adaptation costs and its effect on Annual yield and income

From the Regression below (Table 2), Cost of migration to better land, planting Resistant stems and increased Pesticide use were significant to yield and they all have negative effect on annual production which means an increase in these variables leads to a decrease in the annual production of farmers. The R^2 also implies that the variables collectively are responsible for 18.3% variations in Annual production. For annual income (Table 3), no variable was statistically significant at all significance level. The R^2 value implies that the variables collectively are responsible for just 3.9% variation in Annual income. This implies that exogenous factors are responsible for 96.1% variation in annual income and are not captured in the model. This implies that the cost of adaptation strategies does not have any effect on the Annual income of farmers.

Table 1: Distribution of farmers by choice of adaptation strategy

Measures	Adopted (%)	Not Adopted (%)	Total (%)
Migration to better land	15(13.6)	95(86.4)	110(100)
Planting of resistant stems	5(4.5)	105(95.5)	110(100)
Increased fertilizer use	99(90)	11(10)	110(100)
Increased herbicides use	107(97.3)	3(2.7)	110(100)
Increased pesticide use	108(98.2)	2(1.8)	110(100)
Change of planting dates	4(3.6)	106(96.4)	110(100)

Table 2: Regression analysis of Adaptation costs and its effect on Annual Production.

Variables	Linear	Semi-log	Double log	Exponential
(Constant)	164621.029	156110.527	11.947	12.011
	(0.00)	(0.00)	(0.000)	(0.00)

Cost of Migration to better land	-0.605 (0.165)	-1\267.578 (0.269)	-0.008 (0.226)	-3.737 (0.116)
Cost of Planting resistant cassava stems	-1.417 (0.009)*	-4073.381 (0.015)**	-0.025 (0.006)*	-9.166 (0.002)*
Cost of Mixed cropping	0.245 (0.291)	-162.105 (0.921)	0.00 (0.919)	5.011 (0.256)
Cost of increased fertilizer use	0.245 (0.559)	772.612 (0.578)	0.003 (0.636)	1.118 (0.625)
Cost of Increased Herbicide use	0.529 (0.400)	3081.894 (0.232)	0.018 (0.207)	2.695 (0.431)
Cost of Change of planting dates	-0.602 (0.660)	134.959 (0.900)	0.001 (0.909)	3.207 (0.667)
Cost of increased Pesticide use	-5.835 (0.061)***	--	--	-3.798 (0.026)**
	R^2 = 0.145 Adj R^2= 0.087	R^2 =0.109 Adj R^2=0.056	R^2 =0.129 Adj R^2=0.078	R^2 =0.183 Adj R^2=0.127

*Note: Values in Parenthesis represent the t-value of the coefficient, *=Sig at 1%, **=Sig at 5%, ***= sig at 10%*

Table 3: Regression model of the factors affecting the annual income

Variables	Linear	Semi-log	Double log	Exponential
(Constant)	319096.145 (0.000)	132938.882 (0.000)	12.055 (0.000)	12.625 (0.000)
Cost of Migration to better land	-0.050 (0.976)	3778.302 (0.386)	0.013 (0.309)	2.599 (0.957)
Cost of Planting resistant cassava stems	-1.620 (0.421)	-3145.828 (0.616)	-0.006 (0.764)	-3.907 (0.509)
Cost of Mixed cropping	1.345 (0.661)	3561.653 (0.569)	0.008 (0.652)	2.569 (0.775)
Cost of increased fertilizer use	1.084 (0.497)	5976.831 (0.228)	0.014 (0.332)	2.570 (0.583)
Cost of Increased Herbicide use	-1.650 (0.489)	12166.934 (0.215)	0.042 (0.142)	-3.603 (0.607)
Cost of Change of planting dates	-2.581 (0.619)	-5299.525 (0.439)	-0.15 (0.462)	-5.207 (0.733)
Cost of increased Pesticide use	6.982 (0.552)	--	--	2.435 (0.481)
	R^2 = 0.027 Adj R^2=-0.039	R^2 = 0.043 Adj R^2= -0.014	R^2 =0.038 Adj R^2= -0.019	R^2 =0.019 Adj R^2=-0.048

Note: Values in Parenthesis represent the t-value of the coefficient, *=Sig at 1%, **=Sig at 5%, ***= sig at 10%

Summary and conclusion

In summary, there is a negative relationship between the cost of adopting the improved cassava variety and yield, the same is the case with the relationship between yield and investment on assets such as land. This could be as a result of the high cost of purchasing land and improved varieties which may have restricted the farmers from investing in other inputs such as herbicides and fertilizer important for cassava growth. The costs of these adaptation strategies however do not have any significant effect on the annual income of the farmers. The variation in the level of annual income of farmers is largely affected by exogenous factors/variables that were not captured in the model.

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