Assessment of the Cost-Benefits of Climate Change Adaptation Strategies of Cassava-Based Farmers in Southern Nigeria

Abstract

The study examined the assessment of the cost-benefits of climate change adaptation strategies of cassava-based farmers in southern Nigeria. About 300 cassava-based farmers were selected using simple random sampling. Primary data were obtained through administration of questionnaire, interview schedule and Focus Group Discussion (FGD). Data were analyzed using descriptive and inferential statistics, Net Return model and Cost-Benefit Analysis (CBA). The findings of this study revealed that more than 55% of the cassava crop farmers indicated depletion of the ozone layer as the most cause of climate change in the area. The net returns of the cassava production were estimated at ₦215,240.86($614.97) and the gross marginal returns of ₦220078.86 ($628.80) respectively. This indicates that the cassava production using the adaptation strategies is profitable. Conservational agriculture recorded the highest internal rate of return of 68% over other adaptation strategies with Net Present Value of E399.53. The factor analysis revealed the major constraints in using climate change adaptation strategies as high cost of labor, inadequate information on climate change issues, high cost and scarcity of inputs, insecurity, poor extension services and low response from government among others. Farmers should be encouraged to practice conservation techniques as the cost-effective and efficient climate change adaptation strategies in the study area. Government support in bridging the gap between climate change and crop farmers' adaptation strategies and farm inputs provisions at a subsidized rate were recommended.

Keywords: Assessment, Cost-Benefits, Adaptation, Climate Change, Strategies, Cassava-based farmers

Introduction

Comment [TM1]: Your introduction is too long. Catch the reader's interest. Introduce your issue right away in the introduction. The introduction should unpack what you intend to do, how you are going to do it. There are a lot of quotations from various authorities but what is your voice regarding this.

Cassava (*Manihot esculenta*) belongs to the family of *Euphorbiaceae*. Cassava is a staple food crop which provides food for over 100 million people in Africa (Asante-pok, 2013), generating income for a large proportion of the farm households relative to other staple food crops (Oladejo, 2017)). This made it one of the most important root crops in Nigeria and serves as a major economic food security crop, thus meeting the food needs of the populace (Okoh, 2016; Henri-Ukoha, 2011). Nigeria is one of the highest producers of cassava (Food and Agriculture Organization, 2019). Though cassava tolerates all soil types but it is affected by weather. Adaptation strategy is one vital instrument that can be used to fight the dangers caused by climate change. "Adaptation to climate change could be defined as an adjustment in human, ecological or physical system in response to actual and or would be stimuli or their effects, which moderate harm or exploits beneficial opportunities" (Shongwe, 2013). Adaptation involves modification in ecological, social or economic systems in reaction to factual or anticipated climate stimuli and their consequences. For adaptation measures to be taken into consideration there is need to increase food production under climate change in many regions of the world as well as in-depth understanding of the potential impacts of climate change in basic food crops (Darand et al. 2015). Farmers need to be equipped with recent knowledge and information on climate change and agronomic practices to enable them cope with climate changes and other socio-economic conditions (Henri-ukoha and Osuji, 2017). Knowledge of the local assessment of climate change is vital in developing appropriate adaptation measures that can mitigate the adverse impact of climate change (Darand et al. 2015). This understanding will improve awareness on the challenges of climate change through rapid involvement of policy makers, scientists and all stakeholders in the climate change debate. Climate change is seen as changes in climate initiated by anthropogenic activities and instinctual variation that changes the composition of the global atmosphere observed over comparable period of time (Agriculture Management Information System, AMIS, 2018). Though the time lags, these changes occurs are being considered, noting the level of deviation from the normal and its impacts on the ecology. Climate takes hundreds or even millions of years to change. There is empirical evidence revealing that climate change is becoming increasingly manifest (Intergovernmental Panel for Climate Change, IPCC, 2007)

Climate change has become a phenomenal issue influencing various degrees of economic activities in different parts of the world and Southern Nigeria inclusive. Its effects are so obvious, felt in different extent and nature by many countries, activating diverse changes. The nature of climate change cannot be over emphasized as it is a complete variation of the atmosphere over decades to millions of years in a region (CBS, 2017). Thus, anthropological activities have shaped climate change causing increased effects on different sectors of agriculture

Comment [TM2]: I propose you have a separate heading for literature review and livelihoods in many communities of the world. “The major human implications of climate change is the increase of Greenhouse Gases (GHG) in the atmosphere resulting from gas flaring, fossil burning and deforestation arising from clearing of land for agricultural and industrial uses, in addition to other human activities that have led to increased concentrations of GHG especially carbon IV oxide (CO)” (IPCC, 2007). Increasing the average temperature of the earth is the sole effect of climate change which results to a diversity of other outcomes. “These effects are induced by increased temperature, changes in patterns of precipitation and rainfall, rising sea levels, altered patterns of agriculture, extreme weather events, expansion of the range of tropical diseases, and conservative attitudes of most farmers” (IPCC, 2007). Scientific appraisals proposed that in the absence of adaptation, climate change could result in a loss of between 2 to 11% of Nigeria’s GDP by 2020, rising between 6 to 30% by the year 2050 and all analytical judgments has shown that climate change will adversely affect food security cum income of the crop farmers in years to come if farmers fails to adapt to climatic changes (Ogbuagbor and Egwuchukwu, 2017). Sustainable climate adaptation measures increase productivity, heightens resilience (adaptation), reduces/removes GHGs (mitigation) and sustains national food security and development goals (Blythe, 2018). This goal is achieved through the practicing of anti-climate change techniques which increases the income of the farmers. Thus, the cost-benefits of climate change adaptation measures on agriculture cannot be undermined. This helps to check the excesses of climate change on agricultural activities through the cost and returns principles (MOALMC, 2018). Nevertheless, climate change, if not curbed, is likely to affect the overall income of cassava farmers in general, hence the significance of this study. The adaptation strategies used by the smallholder cassava-based farmers is expected to enhance resilience to climate change impacts, improve productivity and thus improve the livelihood by combating poverty and food insecurity. It is possible for adaptation practices adopted by the farmers not to be economical, unstainable and inefficient. This gap gave rise to such questions as: are the farmers using the economic strategies or are they using the adaptation strategies the right way? Such questions cannot be fully addressed until these adaptation strategies are evaluated in term of their efficiency and effectiveness. To address this concern, the study uses a cost benefit analysis to evaluate adaptation strategies used by households in order to identity the most economic and practical strategies. The study also ascertained the perceived causes of climate change, estimated the costs and return of cassava production as well as identify the constraints faced by the farmers while using the climate change adaptation strategies.

Materials and Methods

The study was conducted in Southern Nigeria. The area is made up of South East, South West and South-South Nigeria. Multi-stage random sampling procedure was employed in sample selection. In the first stage, two regions, South East and South-South geo-political regions were selected purposively from Southern Nigeria based on areas where cassava farming is most predominant. In the second stage, one state each was purposively chosen from each of the two geo-political regions making two states. This was states that have upland (Abia) and riverine areas (Rivers). In the third stage, five Local Government Areas, (LGA) randomly selected from each state making 10 LGAs. Fourthly, five communities were selected from each LGA making 50 communities. Finally, six cassava-based farmers were selected from a list of registered cassava-based farmers in each community using simple random sampling. This gives a total of 300 cassava-based farmers in the study area. Primary data were obtained through administration of questionnaire, interview schedule and Focus Group Discussion (FGD). Validation of the survey instruments were done using a pilot survey where ten percent of the questionnaire were given to the respondents to fill with the help of trained enumerators who were employed in data collection. Data were analyzed using descriptive and inferential statistics. Such descriptive

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Net Return model

The Net Return model is expressed as follows:

NI = TR – TC ……………………………………….. ………eqtn 1

TR = Q X Px ……………………………………………….. eqtn 2

TC = TFC + TVC ……………………………………………….. eqtn 3

Where,

NI = Net Income

TR = Total Revenue

TC = Total Cost

Q = Output

Px = Unit price

TFC= Total fixed cost

TVC = Total Variable cost

Cost benefit analysis (CBA)

CBA focuses on the quantitative evaluation of climate change impacts on crops, allows for estimation of the net benefits of different adaptation options and is used to assess adaptation options when efficiency is the only decision-making criteria. This involves calculating and comparing all the costs and benefits which are expressed in monetary terms (GE-Pethick and Dorwel, 2015). This approach identifies the most economic adaptation strategy and allows ranking all the proposed strategies based on economic efficiency. Net present values are used to discounts the future benefits to present values. Internal rate of returns are used to evaluate the most economic impacts. This involves;

(a.) Identification of the most adaptation strategies employed in the households which includes

1.Use of improved variety; 2. Use of minimum tillage; 3. Change in planting dates; 4. Mixed cropping and 5. Conservational practices

(b) For each adaptation strategy, the total costs incurred when using that strategy and benefits were computed to compute the net benefit for that particular adaptation strategy (Shongwe, 2013).

$NB = \Sigma TB - \Sigma TC$ ……………………………………………….. eqtn 4

Where;

NB represents the net benefits (E)

TB represents the total benefits (E)

TC represents the total costs (E)

For adaptations that do not have direct costs and benefits, shadow pricing and opportunity costs were used and the quantities computed.

iii) NPV was computed.

The Net present Value = $NPV = \Sigma (B\,t - Ct) / (1 + r)\,t$. ………………………………….. eqtn 5

Where:

B t = Total benefits in year t

Ct = Total costs in year t

r = Discount rate

(1+r) t = Discount factor for year t

The adaptation strategy with a positive and highest NPV is the most economic and efficient. A negative NPV indicates a non-viable intervention strategy. Sensitivity test was also carried out, where the net benefit was discounted at 5%, 10% and 15%.

Factor Analysis

Kaiser Normalization Criterion was applied for choosing the number of latent factors or the principal components describing the data (Akerele, 2016). The Principal component Analysis (PCA) model was utilized and specified in its linear form as follows:

$P_1 = a_{11}X_2 + a_{12}X_2 + \ldots a_{1k}X_k$ ……………………………………………….. eqtn 6

$P_2 = a_{21}X_2 + a_{22}X_2 + \ldots a_{2k}X_k$ ……………………………………………….. eqtn 7

$P_3 = a_{31}X_2 + a_{32}X_2 + \ldots a_{3k}X_k$ ……………………………………………….. eqtn 8

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$P_k = a_{k1}X_2 + a_{k2}X_2 + \ldots a_{kk}X_k$ ……………………………………………….. eqtn 9

Where,

$P_1, P_2, P_3 \ldots P_k$ = observed component variables that are constrained constraints faced by cassava-based farmers in using climate change adaptation strategies.

$A_1 - a_k$ = factor loadings rotated matrix or correlation coefficients.

$X_1, X_2, X_3 \ldots X_k$ = unobserved causal factor constraints faced by the cassava-based farmers in using climate change adaptation strategies were retained, the study chose factors with high factor rotation loading scores of $\pm$0.4 or greater than $\pm$0.4

Results and Discussion

Perceived Causes of Climate Change in the Area

Table 1: Perceived causes of climate change

Variable	***Frequency**	**Percentage**
Signs of the end time	55	18.33
Wrath of the gods	34	11.33
Depletion of the ozone layer	178	59.33
Heat trapping gases	96	32.00
Total	300	100

Source: Field Survey, 2020 *Multiple responses recorded

Table 1 reported the perceived causes of climate change in the area. From the table, more than 55% of the cassava crop farmers indicated depletion of the ozone layer as the most cause of climate change in the area. This implies that as the ozone layer depletes, it poses devastating threats to climatic changes which has serious implications and consequences on agricultural productions (Osuji, 2017). About 32% of the cassava crop farmers argued that heat trapping gases increased the incidence of climate change in the area (Shrestha et al. 2017). This is evident in the intense temperature and precipitations been experienced in agricultural localities. About 11.3% of the cassava farmers perceived wrath of the gods as an exponent to climate changes. Traditionally, it is believed that the gods when offended can induce adverse environmental concerns which are a sine-qua-non to climatic changes. Signs of the end time accounted for 18.3% of cassava crop farmers as its perceived causes of climate change.

Costs and Returns

Table 2: Costs and Return Per Hectare of Cassava-Based Production in a Changing Climate Condition in the Study Area.

Item	**Unit**	**Quantity (Kg)**	**Price (₦)**	**Value (₦/ha)**	**% Contribution to total cost**
Revenue					
Cassava tuber	Kg	5308.03	30.73	163139.42	
Cassava tuber	Bundles	28	1596	44688.00	
Maize	bags	667.69	120	80122.80	
Melon	bags	1.59	42600	67734.00	
Total Revenue **355684.22**					
Variable Cost					
Cassava stem	Bundle	24	1594	38256	27.24%
Maize seeds	cob	23.08	220	5077.60	3.62%
Melon	cup	2.88	185	532.80	0.38%
Fertilizer	bags	2.3	7450	17135	12.20%
Manure	bags	6.5	300	1950	1.39%
Clearing	Man-days	11	1991.96	21911.56	
Ploughing		3	2342.70	7028.1	
Planting		10	1451.05	14510.50	
Weeding		11	1752.10	19273.10	
Harvesting		6	1655.20	9931.20	
Total Labour				72653.96	51.73%
Total Variable cost				**135605.36**	

Fixed Costs		
Rent on land/annum	1735	1.24%
Interest on loan/annum	1241	0.88%
Depreciation on tools/annum	1862	1.33%
Total fixed costs	**4838**	0.60%
Total Cost	**140443.36**	100%
Net Returns (TR-TC)	**215240.86**	
Gross Margin (TR-TVC)	**220078.86**	
Return per naira invested	**2.53**	

Source: Field Survey, 2020; $1 = ₦350

The costs and returns per hectare of cassava-based production in a changing climate condition in the study area are shown in Table 2 below. The total revenue generated from the cassava-based production was ₦355, 684.22 comprising of cassava tubers, maize and melon measured in kg, bundles and bags. This implies that the individual crops were valued at their respective unit prices in relation to quantities produced (Osuji et al. 2017). The variable cost items which include the cassava stems, maize and melon seeds, manure, ploughing, clearing, weeding, harvesting, etc. accounted for the total variable cost estimated at ₦135605.36 with a percentage contribution to total cost of about 52%. This implies that a percentage increase in the variable cost of cassava-based farmers will invariably lead to 52% increases in total cost of production. This was evident in the cassava stem which produce about 27% increase in total cost of production making it the highest percentage contribution. The fixed costs of the cassava-based farmers which ranges from rent on lands, interest on loans, and depreciation cost gave the total cost of ₦140, 443.36 with less 1% contribution to total cost of production. This further implies that there is a marginal increase of about 97% in total cost of cassava production in the area (Osuji et al. 2017). The net returns of the cassava production were estimated at ₦215240.86 and the gross marginal returns of ₦220078.86 respectively. This implies that with the estimation of the above figures, the cassava-based production of the farmers was highly viable and profitable in the area taking into cognizance the climatic adaptation strategies (Herrero et al. 2017) employed by the cassava farmers in the area. Thus the climate change adaptation strategies used by the cassava farmers contributed immensely to the profitability of the cassava production (Ukonze et al. 2015). This profitability was also shown in the returns per naira invested in the cassava production which accounted for about 2.53%.

Cost-Benefit Analysis

Table 3: Net Present Value and Internal Rate of Return for Adaptation Strategies mostly Practiced by Cassava-Based Farmers in the Study Area

Adaptation Strategy	TC	TR	NB	IRR	NPV	NPV	NPV
	E'000	E'000	E'000	(10%)	(E)	(5%) (E)	(15%) (E)
1	100	356	246	9	333.64	349.05	319.57
2	1.8	356	356	18	325.44	340.85	311.37
3	1.4	356	354	51	325.04	340.45	310.97
4	**0.5**	**356**	**355**	**55**	324.14	339.55	310.07
5	**0.48**	**356**	**355**	**68**	324.12	339.53	310.05

Source: Field Survey, 2020

The cost-benefit analysis of climate change adaptation strategies of the cassava-based farmers as estimated by the net present value and internal rate of returns for adaptation strategies mostly practiced by the cassava-based farmers are shown in Table 3 below. The adaptation strategies were grouped into; 1: improved variety, 2: use of minimum tillage, 3: change in planting dates, 4: mixed cropping and 5: use of conservation techniques. From the Table, improved variety is good a adaptation strategy which involves the use of improved cassava stems for farming (Thornton et al. 2018). As can be seen in the table, improved variety had a total return of E356 and net benefits of E246 with the lowest internal rate of return of 9%. The net present value of improved variety of E349.05 was highest at 5% discount rate and this elaborates the relevance of improved variety as an effective adaptation strategy. Use of minimum tillage had a less total cost of E1.8 with a marginal increase in net benefit of E110 and internal rate of return of 18% over improved variety. Also the net present value E340.85 was highest at a discounted rate of 5%. The use of minimum tillage over other adaptation strategy downplays fewer disturbances on the soils surface thereby averting the destruction of soil structures and textures and other microbial organisms responsible for soil formation and growth. This agrees with the findings of (Shongwe,

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2013). Change in planting dates recorded a high internal rate of return of 51% over improved variety and use of minimum tillage. The net present value of E340.45 was also recorded at a discounted rate of 5%. The result showed that the total cost E1.4 and net benefit E354 were less when compared with the values in use of minimum tillage. Change in planting dates is an important adaptation strategy which helps farmers overcome adverse climatic changes and undue climatic variations (Augustine et al. 2018). By altering planting dates, crop farmers improve yields and income having gathered a deep knowledge and a priori insight on climate changes and its consequences. Furthermore, mixed cropping had the highest net present value of E399.55 and second highest internal rate of return of 55%. Mixed cropping is majorly practiced more than other adaptation strategies. This is because with mixed cropping adaptation strategy, farmers are relaxed and at peace in the farming adventure having overcome adverse effects of changing climates. The use mixed cropping secures food crops and improves farm outputs in case of emergency outbreaks which might shatter farm harvest. This agrees with the findings of (Baldos and Hertel, 2015). Conclusively, conservational agriculture recorded the highest internal rate of return of 68% over than adaptation strategies with net present value of E399.53. It could also be seen from the result that the total cost of conservational agriculture was E0.4 which seems to be the least amongst others. The implication is that the least total cost generated from conservational agriculture contributed immensely to the high internal rate of return and net present value. Akpan et al. (2014) advocated the use of conservational practices. Conservational farming involves the preservation and careful management of the environmental resources and as such this helps farmers to effectively mitigate untold climatic tendencies and further position crop farmers in improving outputs and possible incomes (Be´ne et al. 2019).

Constraints in using viable climate change adaptation strategies

Table 4: Varimax Rotated Component of Constraints in using viable climate change adaptation strategies by cassava-based farmers in the study area

S/N	Constraint	1	Factor 2	Components 3	4	Communalities
1	High cost of Labour	.756				.522
2	Inadequate information on climate change issues	.703				.475
3	High incidence of pests and diseases	.631				.421
4	Poor extension services	.621				.411
5	Inadequate credit facilities to adopt practice	.462				.284
6	Low capital	.360				.272
7	Land tenure issues	.327	.744			.629
8	Scarcity of drought resistant varieties	-.337	.646			.658
9	High cost of drought resistant varieties	-.413	.534			.623
10	Conflict in the community		.744			.675
11	High insecurity level		.685			.478
12	Ignorance of climate change issues		.573			.389
13	Poor market network			.902		.506
14	High incidence of flood			.701		.673
15	Low returns from cassava sales			.584		550
16	High cost of transportation			.435	.423	.454
17	Lack of government support				.941	.824
18	Delay in government response				.690	.824
19	Poor road network				.565	.506
20	Stealing of farm					.354

	produce					
21	Inadequate cassava processing equipment					.570
	Eigen value	3.393	3.173	2.584	2.244	
	Percentage variance	12.584	12.403	9.581	8.965	
	Cumulative	12.584	24.988	34.569	43.533	
	Kaiser-Meyer-Olkin(KMO)	0.57				
	Bartlett's Test of Sphericity	0.001				

Source: Field Survey, 2020 *Factor 1 = Input Factor; Factor 2 = Insecurity Factor Factor 3 = Infrastructural/Climatic/ Factor; Factor 4 = Government Factor
**Constraints variables that loaded under more than one component factor. Note: factor loading of /0.40/ and greater at 10% intersecting variance. Constraint variables with factor of less than /0.40/ were ignored.

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Table 4 shows the result of varimax-rotated principal component analysis (PCA) of the main factor constraints faced by the cassava-based farmers in using climate change adaptation strategies in the study area. From the result, the Kaiser-Oklin (KMO) measure of sampling adequacy was projected and estimated by each factor. The Barlett test sphericity was 0.001 is significant (0.05) indicating that the correlation matrix is considerably and significantly distinctive from an identity matrix, in which corrections among others tested zero. This implies that the constraint variables are highly correlated enough to provide sufficient basis for factor analysis for this study. From the result, four factors were extracted from the responses of the cassava-based farmers. The constraint variables were clustered into four namely: factor 1 (Input); factor 2 (insecurity); factor 3 (infrastructure/climatic) and factor 4 (government factor).

After rotation, the first Eigen values of the factor loadings were 3.393, 3.173, 2.584 and 2.244 for the first, second, third and fourth Eigen values respectively. The percentage of co-variation after rotation of each constraint variable loadings of the first, second, third and fourth factor explained for 12.584, 12.403, 9.581 and 8.965 respectively. The factual and accurate that were retained and maintained accounted for 43.53% of the variance in the constraint 21 components or variables.

Among the cassava-based farmers, the specific constraints that augmented inputs (factor1) were high cost of labour (.75), inadequate information on climate change issues (.703), high incidence of pests and diseases (.631), poor extension services (.621) and inadequate capital (.462) were highly loaded. High cost of labour is a limiting constraint in cassava production (Henri-Ukoha, et al. 2011). High incidence of pests and diseases is also a limiting constraint in cassava production. Poor extension services can prevent farmers from accessing timely climate related information especially as regards effective adaptation strategies. This corroborates the report of Otitoju (2013) who reported that poor extension services is the major constraint to climate change adaptation strategies in Southern Nigeria. Again, inadequate capital limits farmers from practicing effective climate change adaptation strategies. This agrees with the findings of Ojemade et al. (2019), who explained that finance affects farmers' ability to adopt the desired climate change adaptation practices. Again, inadequate information and inadequate funds were identified as the major barrier in adaptation to climate change(Onubuogu and Esiobu, 2014).

Land tenure issues (.744), high cost of improved and drought resistant varieties (.534), conflict in the community (.744) and ignorance to climate change issues (.573) were constraints loaded under factor 2 (insecurity). The peculiar land tenure system in the study area may not allow them to practice sustainable adaptation measures. High cost of improved and resistant varieties of crops as a major problem limiting farmers from adapting to climate change (Ebenehi, et al. 2018). Conflict affects the farmers' ability to engage in farming activities which limits agricultural production in the study area. This agrees with the findings of Onishi (2014) who reported that conflicts can deepen social grievances by increasing the scarcity of available resources which will be enable the farmers practice the effective adaptation strategies or by deepening inequalities among groups.

Awareness is another serious constraint. When farmers are not aware of issues of climate change, they may not be able to employ the cost-effective climate change adaptation strategies in cassava production. In line with this, Lata and Nunn (2012) reported the lack of awareness as a big barrier to climate change adaptation in developing countries.

The constraint variables that weighed under factor 3 (infrastructure/climatic factor) were poor market (.902), high incidence of flood (.701), low returns from cassava sales (.584) and high cost of transportation (.435). Poor market is a limiting constraint in using climate change adaptation strategies. Poor market will make farmers' incomes to be static and possibly decline, making production difficult to sustain (World Bank, 2006). This resultant low income also makes it difficult farmers to practice adaptation.

High incidence of flood is also a constraint that gives the farmers serious concern. Ebenehi, et al. (2018) in his study, identified flood as a limiting constraint in adapting to climate change. Flood was identified as a common hazard in Europe which poses a problem presently, and will pose more problem in the future (IPCC, 2014).

High cost of transportation (.423), lack of government support (.941) and poor road network (.565) were the constraints that loaded under factor 4 (government factor). High cost of transportation is a major problem encountered by the farmers while practicing the climate change adaptation options in the study area. In line with this, the IPCC synthesis report suggests the need to integrate climate change considerations into national transport policies and on research and development (IPCC, 2007). Also from the study, lack of government support constituted a serious constraint. Government should create the enabling environment to encourage farmers adopt the cost-effective climate change adaptation strategies. In line with this, Shahid and Piracha (2016) posited that lack of government interest, corruption, lack of attention/responsibilities of authorities and lack of planning constrain farmers in developing countries from practicing effective adaptation. This could be attributed to the fact that local governments are paying more attention to climate change mitigation rather than climate change adaptation strategies while addressing the problems (Bulkeley, 2010).

Conclusion

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Adaptation strategy is one vital instrument that can be used to fight the dangers caused by climate change. Modification of the adaptation strategies of the cassava-based farmers increases economic returns, hence the essence of this study. The findings of this study revealed that depletion of the ozone layer is perceived the major cause of climate change in the area. This implies that as the ozone layer depletes, it poses devastating threats to climatic changes which has serious implications and consequences on agricultural productions. The cost and return analysis shows that the cassava-based production of the farmers was highly viable and profitable in the area taking into cognizance the climatic adaptation strategies employed by the cassava farmers in the area. Conservational agricultural practices recorded the highest internal rate of return of 68% over than adaptation strategies with net present value of E399.53. High cost of labour, inadequate information on climate change issues, high cost and scarcity of inputs, insecurity, poor extension services and low response from government among others.

Recommendations

From the study, the following policy recommendations were made:

1. Government should increase their support in bridging the gap between climate change and crop farmers' adaptation strategies.
2. Farm inputs provisions at a subsidized rate.

3. Farmers should be encouraged to adopt the use of conservation measures as it is the most cost effective and efficient climate change adaptation measure in the study area.
4. Credit facilities should be made available to farmers to enable them procure improved and drought resistant varieties, acquire farmlands and access the resources that will enable them practice cost effective adaptation.
5. Agricultural extension services should be strengthened for effective capacity building on cassava production with requisite knowledge and information necessary for cost-effective and efficient climate change adaptation.

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