Original Research Article

Small- scale farmers' perception of climate change impact and variability in Saki community of Oyo state, southwest Nigeria

ABSTRACT

Climate change and variability have been a source of contention and debate in many parts of the developing world for many years. Different people have different perspectives on climate change and variability. This study examines small-scale farmers' perceptions on climate change impacts and possible adaptation strategies in the Saki community of Oyo State. The population comprises of two hundred and forty (240) small scale holders' farmers in the Saki community of Oyo state, with sample population size of one hundred and fifty (150) randomly selected with non – probability (judge-mental) sampling technique. Survey research design was adopted for the study. Descriptive statistics and chi-square tests were used to analyze the data collected. The results from

the analyzed data reveals among others the following, 74.7 percent of farmers were aware of climate change prior to the time this survey was conducted. Furthermore, 92 percent of farmers claimed to have noticed an increase in temperature, while 47.3 percent reported a decrease in rainfall. The farmers' perceptions of temperature and rainfall were supported by trend analysis, which revealed that total rainfall was decreasing by 2.1mm per year while temperatures were increasing by 0.029 degrees Celsius per year. They responded to the changing climate by implementing a variety of climate-adaptive strategies, including the planting of drought-resistant and pest/disease-resistant crops, government assistance, the use of NIMET seasonal rainfall prediction forecasts, and mulching to reduce water loss. However, the study found a positive and significant relationship between farmers' socio-demographic characteristics and their perceptions of climate change, implying that only farmers' age, education level, and annual household income had a significant impact on their climate change perceptions.

Keywords: small -scale, farmers', climate change, variability.

Introduction

Climate change is defined as a mean shift in the earth's average weather conditions, including changes in temperature, precipitation, and wind patterns (CIESIN, 2005). Global climate change is caused by a variety of factors, including increased concentrations of greenhouse gases (GHG), human drivers and other land use changes, human activities that increase aerosol and methane in the atmosphere, and so on. Furthermore, natural causes such as the Earth's orbital cycle and solar radiation have been attributed to it (Ayoade, 2003). Droughts will occur in some areas, while increased precipitation will occur in others, resulting in environmental consequences.

Climate change is a global issue, with varying impacts and adaptation strategies around the world (Ehrhat and Twena, 2006). Climate change is expected to have a significant impact on developing countries (Kurukulasuriya and Mendelsohn, 2008). Because the majority of the population relies on rain-fed agriculture for food and overall livelihoods, these countries are said to be more vulnerable to climate change impacts (Morton, 2007; IPCC, 2007a; Boko et al., 2007).

Many decades ago, there were concerns about the possibility of global warming. Scientists established the certainty of global warming in relation to greenhouse gases under the Intergovernmental Panel on Climate Change. Their findings unequivocally confirmed the climate system's warming, with a 0.74°C increase in global average temperature (IPCC, 2007). For the past 100 years, Africa has been warming at a rate of 0.05°C per decade (Hulme et al., 2001). Model projections show that this rate will continue to rise. Under a range of possible emissions scenarios, the Climate Model simulation for Africa indicates a median temperature increase of between 3°C and 4°C, roughly 1.5 times the global mean response (Christensen et al., 2007). It is expected that drier subtropical regions will become warmer than the moister tropics, with rainfall declines expected across much of Mediterranean Africa, northern Sahara, and southern Africa (Collier 2008). While all models agree that it will get warmer, the exact amount of warming is unknown (Hulme et al., 2001). Rainfall, on the other hand, has been shown to be highly spatially and temporally inconsistent (IPCC, 2007).

Majority of the farmers in Africa are subsistence farmers who have small holding ranging from 0.5-4 hectares, they produce food for their household plus little for the local market (Aina, 2007). When compared with the international standards, which classified all farm lands less than 10,000 hectares as small-scale, about 94% of all farm holdings in Nigeria are small-scale while the remaining 6% are medium scale (Ozowa, 2002). Studies exist on the regional distribution of rainfall and temperature over the southwest Nigeria and major eco-climate regions in Nigeria (Adejuwon, 2006; Awotoye and Matthew, 2010).

Majority of the studies have revealed temporal fluctuations and spatial variations and often base their conclusion on secondary data and only a few have involved the perception of small-scale farmers on the effects of climate on agricultural products. (Sofoluwe, 2010 and Apata, 2011) identified factors that influence farmers' perception and choice of adaptation strategies. (Owombo et al. 2014) examined the difference in gender adaptation options among farmers.

Extreme climatic conditions may be short–lived but they can impact significantly on environmental and agricultural processes. Extreme climate conditions include, among others, heavy downpour with short period of dry spells within growing seasons when certain crops require moisture to be available at field capacity or heavy rains at times when crop require dry spell (Maracchi et 106 al., 2005).

The anticipated changes in climatic conditions and the associated significant impacts on many agricultural systems suggest a broad and pressing need for adaptation. For farming households, the nature of these responses will depend on their recognition and perception that the climate is changing and their ability to adjust their behavior in response, perhaps through altering farm management practices or diversifying into other income-generating activities.

Adaptations in agriculture vary with respect to the climatic stimuli to which adjustments are made (i.e. various attributes of climate change, including variability and extreme events) and according to the different farm types and locations, and the economic, political and institutional circumstances under which the climatic stimuli are experienced and management decisions are made. Many potential agricultural adaptation options have been suggested, representing measures or practices that might be adopted to alleviate the likely adverse impacts.

They come in a variety of shapes (technical, financial, managerial), sizes (global, regional, local), and participants (governments, industries, farmers). Their use has been influenced by phenomena of interest (biological, economic, social, etc.) as well as time scales (instantaneous, month, years, centuries) (Smit and Wandel, 2006). The majority of these strategies are only potential adaptation measures, not ones that have been implemented.

The aim of this study, is to investigate the impact of climate change and variability on small-scale farmers in Saki community of Oyo State, Nigeria.

The specific objectives of the study are;

1. analyze seasonal trends of rainfall and temperature distributions in the study area.
2. examine farmers' indigenous perception of climate change and climate variability.
3. analyze determinants of farming households' adaptation strategies in response to extreme events in the study area

Description of the study area

The study was carried out at Saki West Local Government in Oyo State. The community is one of the largest cities in the state. It has an area of 2,014km^2 and a population of 278,002 as recorded at the 2006 census. Saki is located between latitude 8^{o}40'0" N and longitude 3^o 24'0'E in Figure 1. The town lies near the source of the Ofiki River. The community is about 60km from the Border of Republic of Benin. It is referred to as the food basket of Oyo State because of its agricultural activities. Yam, Cassava, Corn, sorghum, beans, Shea nuts and Okra are mostly cultivated in the community.

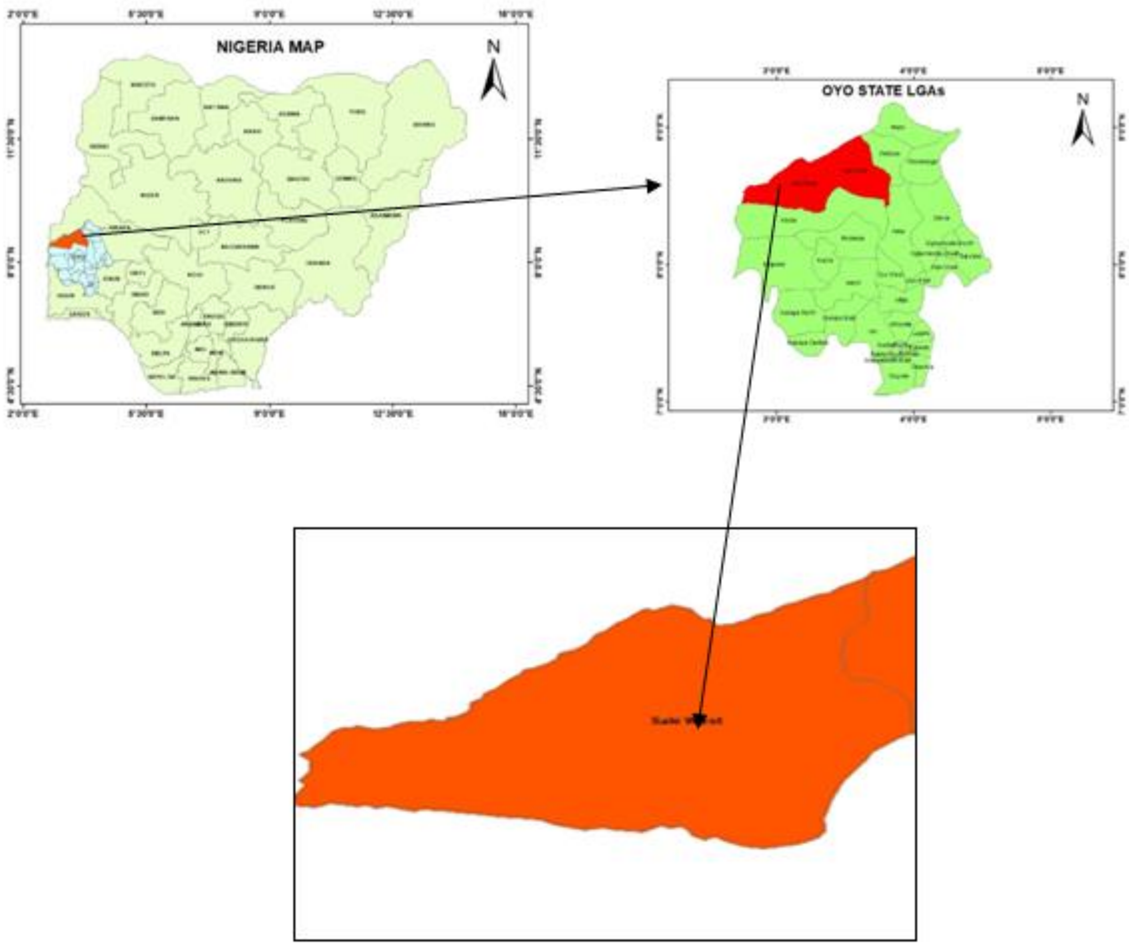

Figure 1: Showing the study area Saki West, Oyo State

Material and Methods

Research instruments

A well-structured questionnaire combined with an in-depth interview was used to elicit information on demography, extreme climate awareness and its effects on crop production, and measures and methods used in adapting to extreme climate events from selected small-scale farmers in the study area. For the study, 150 copies of the questionnaire were distributed and analyzed. The questionnaire asks about the households' socioeconomic characteristics, their perceptions of climate change, and their adaptation strategies.

Secondary Data

Climate data for 29 years (1984– 2013) on Rainfall and Temperature (maximum and minimum) was obtained from the Nigerian Meteorological Agency (NIMET), Abuja, Nigeria.

Population of the Study

The population of this study comprises of two hundred and forty (240) Small scale holders' farmers randomly selected within Saki West LGA.

Sample Size and Sampling Technique

A sample size of (150) one hundred and fifty respondents were used for the study, which represent 63% of the studied population. Stratified sampling technique was adopted for the study because it possesses the characteristic that can serve the purpose of the study.

Method of Date Analysis

The Primary Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) to generate descriptive statistics and Chi-Square Statistic test was carried out to study the relationship between respondent socio demographic characteristics and their perception on Climate Change and Strategies in mitigating or coping with it.

Chi-square was used for testing the following hypotheses at 95% level of confident interval or level of significance.

The chi-square statistics is given as

$$x^2 = \sum \frac{(O-E)^2}{E} \quad \rightarrow equation(3.1)$$

Where $x^2 = Chi - square$

$O = Observed\ frequency$

$E = Expected\ frequency$

Trend analysis of Secondary Data that is Meteorological Dataset (1984-2013) was performed to obtain seasonal and annual variations for climate variables namely rainfall, maximum temperature and minimum temperature to analyze extent of climate change and pattern of climate variability in the study area.

Rainfall and temperature (seasonal and annual) anomalies were constructed and plotted for 29-year dataset given that the savannah zone fully depend on Rain-fed Agriculture.

Rainfall and Temperature anomalies were computed as deviations from their long-term averages for the dataset. The homogeneity of these climatic parameters (annual and seasonal) was tested based on cumulative deviations from their means to check whether numerical values well represented the same population.

Mann-Kendall and Sen's Slope Statistical Test

The non-parametric Mann-Kendall and Sen's methods were used to determine whether there was a positive or negative trend in weather data with their statistical significance. A Mann-Kendall test with a 90% confidence limit was used as a monotonic trend test. The null hypothesis (H_0) that there has no trend from which the dataset is drawn and the alternate hypothesis (H_1) that there was a trend in the data tested. The H_0 will be rejected if $p \leq 0.1$.

The Mann-Kendall statistic provides an indication of whether a trend exists and whether the trend is positive or negative. Subsequent calculation of Kendall's Tau permits a comparison of the strength of correlation between two data series.

Results and Discussion of Findings

The trend of temperature and rainfall is presented; this is also compared to perception of farmers in the study area. The coping strategies of the farmers is also discussed.

4.1 Rainfall and Temperature Anomalies

Figure 2 shows the pattern of rainfall and temperature in Saki from 1984 to 2013. The highest mean annual total rainfall amount occurred in 1995 at 1469.1mm, while the driest period was in 2012 which recorded mean annual total rainfall 840.4mm. The temperature was maximum at about average of (32^0C), while lowest mean annual temperature recorded was 30^0C as observed in 1996. The trend analysis showed that annual total rainfall was decreasing by 2.12mm per year in (Fig 2) while it was observed that temperature was increasing by 0.029^{O}C per year.

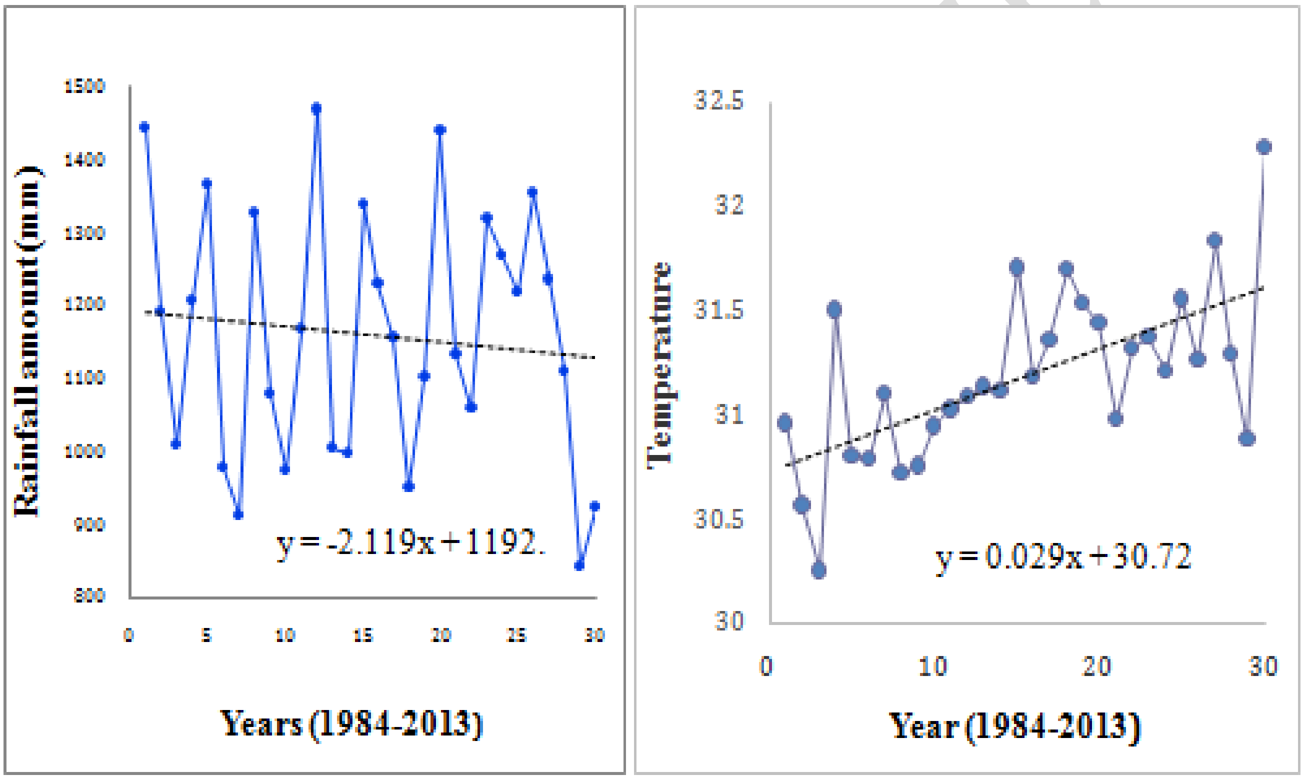

Figure 2: Seasonal Variation of Rainfall and Temperature from 1984-2013 in Saki

Figure 3 shows Rainfall Anomalies from (1984-2013). Wet years occur 15 times during the period of (1984-2013) and dry years had 14 occurrences.

Table 1 shows Rainfall Anomalies values and Wet, Dry and Extreme Rainfall Occurrences in Saki. Deduction from the table indicated the following Near normal years had 7 occurrences, moderately wet years had 5 occurrences, Very Wet years had 3 occurrences, moderately dry had 12 occurrences and severely dry had 2 occurrences.

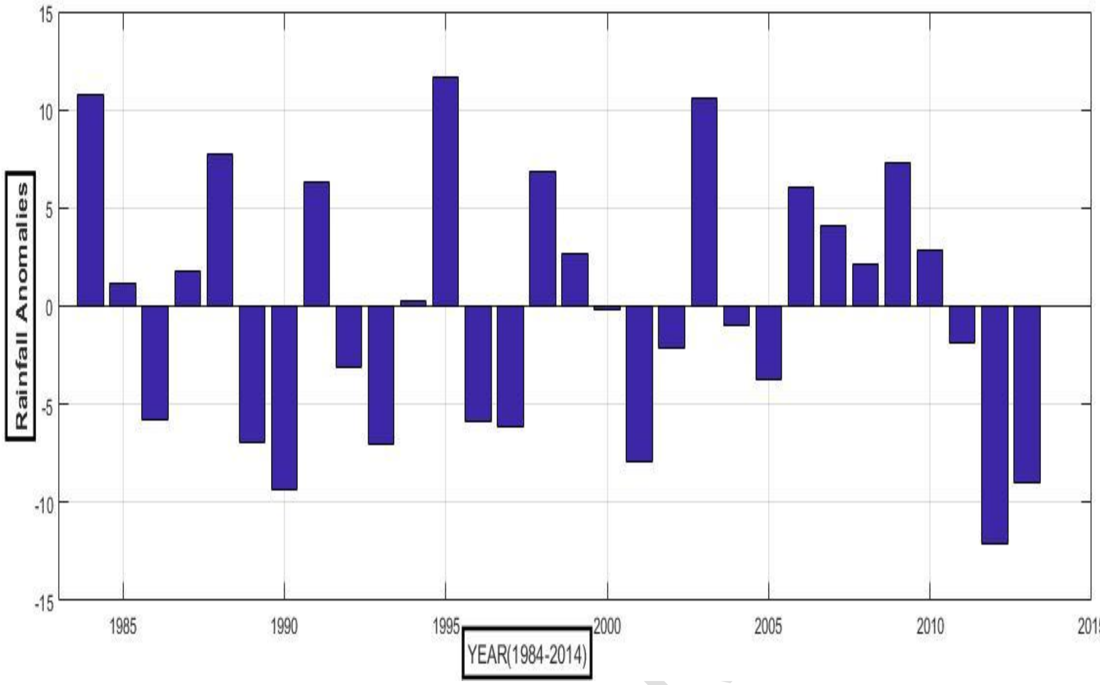

Figure 3 : Rainfall Anomalies from 1984-2013

Table 1: Wet, Dry and Extreme Rainfall Occurrences in Saki community

RANGE	RANGE MEANING	NUMBER OF OCCURENCES
-0.5-4.99	Near normal	8
5.0-9.49	Moderately wet	5
9.5-14.99	Very wet	3
15+	Extremely wet	-
-1.0 to -9.49	Moderately dry	12
-9.5 to -14.99	Severely dry	2
-15 and less	Extremely dry	-

4.2 Rainfall and Temperature Trend

Trend analysis was carried out statistically using Mann Kendall test and Sen's Slope estimation. The results are presented in the Table 2.

Table 2: Mann Kendal Test Results

PARAMETER	KENDALL TAU	SEN SLOPE	P-VALUE	ALPHA
RAINFALL	-0.047	-2.489	0.04	0.05
TEMPERATURE	0.042	0.567	0.03	0.05

Test Interpretation:

H_0 =There is no trend in the series

H_1 =There is a positive/negative trend in the series

As computed, the p-value for both rainfall and temperature is less than the significant level alpha=0.05, we reject the null hypothesis (H_0), and accept the alternative hypothesis(H_1). The results revealed that there was significant increase (positive trend) temperature and decrease in rainfall at 0.05 confidence level.

4.3 Climate Change Perception and Variability on Small Scale Farmers

Socio-demography characteristics of respondents as it relates to perception of climate change impacts on farming activities and coping strategies were illustrated in Tables (3 to 5).

4.3 Socio Demography Characteristics of Respondents

Table 3 shows the socio demography of farmers in Saki community.

As indicated in Table 3, 58.7% of the farmers were males and 41.3% were females. Majority (41.3%) of the farmers were of the active productive age bracket (36-45 years). With regard to educational level, 54% of the farmers had secondary level as against 2.7%, having Tertiary level. About 84.7% of the farmers were married. Likewise, 54.7% of the farmers were found to earn a household income of less than 500,000 per annum, where majority (57.3%) of the farmers had a household size of 10 and above. Farmers' age, level of education, marital status, household size, and annual household income are all assume to influence their perceptions of climate change's effects on small-scale farming.

Table 3: Socio Demography of Farmers in Saki Community

Variables	Frequency	Percentage (%)
Sex: (n=150)		
-Male	88	58.7
-Female	62	41.3
Marital Status:(n=150)		
-Single	12	8
-Married	127	84.7
-Divorced	4	2.7
-Widowed	7	4.6
Age: (n=150)		
$\leq \mathbf{25}$	4	2.7
26-35	25	16.7
36-45	62	41.3
>46	59	39.3
Household income per annum: (n=150)		
<250,000	60	40

<500,000	82	54.7
<1 million	8	5.3
>1 million	0	0
Size of Household: (n=150)		
2-4	12	8
5-7	21	14
8-10	31	20.7
10 and above	86	57.3
Educational Level: (n=150)		
Primary	31	20.7
Secondary	81	54
Tertiary	4	2.7
None	34	22.6

4.4 Perception of Climate Change and its Impact

The perception of climate change indicators (increase in temperature and rainfall variability) and its impacts on farming activities in Saki community was illustrated in Table 4, and cross tabulation was done to examine the relationship between socio-demographic variables and the knowledge of the respondents on climate change, this was illustrated in Table 5.

Table 4 shows the responses of the respondents on their climate change knowledge/awareness. A majority of about 74.7% (n=112) of the respondents were aware of climate change. On perception of climate change indicators, 52.7% and 92% of the respondents respectively believe that rainfall and temperature trend was increasing, while 47.3% and 8% of the respondents respectively believe both rainfall and temperature trend have been decreasing. About 74.7% of the population of the respondents agreed that climate change had impacts on their farming activities over time, while 25.3% of this respondent disagreed, claiming otherwise. Among the respondents who were aware of climate change (n=112), majority (73.2%) felt that climate change impact was as a result of high/increase in temperature, while 10.7% of the respondents suggested its impact as a result of low rainfall. The study participants' perceptions of temperature, on the other hand, are consistent with those of respondents in many other African studies (Hassan 2008, Okoya 2013 and Pelling 2013). In terms of the time span of climate change-related disasters and extremes, more than half of the respondents (55.4%) believe that extremes have only occurred twice in the last ten years.

The results of chi-square analysis in Table 5 indicate that there was a positive and significant relationship between perception of climate change and the following socio-demographic variables namely: age ($X^2cal = 18.36$), Education level ($X^2cal = 25.62$) and household income (since the calculated chi-statistic was greater than the critical value, while on the other hand, respondents Sex ($X^2cal = 1.46$), household size ($X^2cal = 3.62$) and marital status ($X^2cal = 3.44$) were found to be positive but not significant relationship to climate change. A respondent with a secondary level of education was more likely to perceive climate change as a significant problem in the area, as shown in the contingency table in Table 5. Farmers' perceptions of climate change are also influenced by their age. Farmers who were much younger were more likely to perceive climate change as a result of their education and changes in their environment over time.

Table 4: Respondent Perception of Climate Change Impact

Variable	Frequency (%)
Have you heard of "climate change"	
Yes	112 (74.7%)
No	38 (25.3%)
What has been the trend of Rainfall?	
Increasing	79 (52.7%)
Decreasing	71 (47.3%)
What has been the trend of Temperature?	
Increasing	138 (92.0%)
Decreasing	12 (8.0%)
What has been the distribution of Rainfall?	
Evenly distributed	82 (54.7%)
Uneven distributed	60 (40.0%)
No change	8 (5.3%)
Farming activities affected by climate change?	
Yes	112 (74.7%)
No	38 (25.3%)
What climate change impacts are seen?	
Low crop production	99 (88.4%)
	13 (11.6%)
Have climate extremes affected your land?	
Yes	112 (74.7%)
No	38 (25.3%)
What causes the impacts seen?	
Low rainfall	12 (10.7%)
High temperature	82 (73.2%)
Drought	18 (16.1%)
Period of Flood/drought occurrences in 10 yrs	

Once	12 (10.7%)
Twice	62 (55.4%)
Thrice	13 (11.6%)
More than thrice	25 (22.3%)
Any casualty during the flood/drought events?	
Yes	47 (42.0%)
No	65 (58.0%)

Table 5: Association between socio-demographic variables and knowledge of climate change

	Knowledge of Climate Change			
Variable	**Yes (%)**	**No (%)**	**Total (%)**	**Chi-square Statistics**
Age-group				
≤ 25	3(75.0)	1(25.0)	4(100)	$X^2 = 18.36$
$26 - 35$	22(88.0)	3(12.0)	25(100)	$df = 3$
$35 - 45$	54(87.1)	8(12.9)	62(100)	
> 45	33(55.9)	26(44.1)	59(100)	Critical value=7.815
Total	112(74.7)	38(25.3)	150(100)	$\alpha = 0.05$
Sex				
Male	66(75.0)	22(25.0)	88(100)	$X^2 = 1.46$
Female	46(74.2)	16(25.8)	62(100)	$df = 1$
Total	112(74.7)	38(25.3)	150(100)	
				Critical value=3.841
				$\alpha = 0.05$
Education of Respondent				
Primary	20(64.5)	11(35.5)	31(100)	$X^2 = 25.62$
Secondary	73(90.1)	8(9.9)	81(100)	$df = 3$
Tertiary	3(75.0)	1(25.0)	4(100)	
None	16(47.1)	18(52.9)	34(100)	Critical value=7.815
Total	112(74.7)	38(25.3)	150(100)	$\alpha = 0.05$
Household Income				
<250,000	36(60.0)	24(40.0)	60(100)	$X^2 = 14.25$
<500,000	70(85.4)	12(14.6)	82(100)	$df = 3$
<1 million	6(75.0)	2(25.0)	8(100)	
>1 million	0(0)	0(0)	0(0)	Critical value=7.815
Total	112(74.7)	38(25.3)	150(100)	$\alpha = 0.05$
Household Size				
2-4	8(66.7)	4(33.3)	12(100)	$X^2 = 3.62$

5-7	15(71.4)	6(28.6)	21(100)	$df = 3$
8-10	20(64.5)	11(35.5)	31(100)	
10 and above	69(80.2)	17(19.8)	86(100)	Critical value=7.815
Total	112(74.7)	38(25.3)	150(100)	$\alpha = 0.05$
Marital status of Respondent				
Single	7(58.3)	5(41.7)	12(100)	$X^2 = 3.44$
Married	98(77.2)	29(22.8)	127(100)	$df = 3$
Divorced	2(50.0)	2(50.0)	4(100)	
Widowed	5(71.4)	2(28.6)	7(100)	Critical value=7.815
Total	112(74.7)	38(25.3)	150(100)	$\alpha = 0.05$

4.5 Mitigation and Adaptation Strategy on Climate Change Impact

Respondents who were aware of climate change were asked climate change related mitigation and adaptation strategy questions, to explore their perception and awareness towards the influence of Climate change on their farms and what steps and measure that have been taken to adapt with it. Studies have also indicated that the challenge of food insecurity has not always been met with appropriate mitigation strategies (Deressa et al., 2008).

73.2% of the respondents agreed receiving information of NIMET daily forecast on television at news hour and said in most cases the forecast were accurate (70.5%). They also received text messages on daily and quarterly weather report from ISKA weather. Iska is a mobile weather forecast platform supporting rural farmers across sub-Saharan Africa. (www.ignite.sc)

According to the farmers, they diversified their crops in order to manage the risk of drought, spread of pest and diseases, soil fertility decline and inputs prices variations. Studies show that farmers used crop diversification as a self-insuring strategy to reduce income variability (Briglauer, 2000; Jema, 2008). The majority of the farmers surveyed grow melon primarily as a yam cover crop. Literature backs up the practice of using cover crops and mulching to protect soils from water loss (Adeniyan et al., 2008). The Catholic Church was assisting the respondents by donating fertilizers to improve crop yield, but they were pleading for more help because not everyone benefited.

According to Table 7, respondents preferred any and all strategies for mitigating or alleviating the effects of climate change on their farming activities. However, because most farmers did not perceive a reduction in the use of inorganic fertilizer, any recommendation to reduce the use of inorganic fertilizer may be met with resistance from farmers.

Table 6: Strategies to Reduce/Alleviate the Effect of Climate Change

Possible Strategy	Agree	Disagree	Undecided	Overall Perception
Assistance from government and NGOs	105(93.8%)	6(5.4%)	1(0.8%)	Agree
Using NIMET	82(73.2%)	20(17.9%)	10(8.9%)	Agree

forecast				
Mulching of crops to reduce water loss	76(67.9%)	24(21.4%)	12(10.7%)	Agree
Increase use of organic manure	61(54.5%)	28(25%)	23(20.5%)	Agree
Are NIMET forecast accurate	79(70.5%)	23(20.5%)	10(9%)	Agree
Planting of drought resistant crops	51(45.5%)	37(33%)	24(21.5%)	Agree
Planting of flood resistant crops	58(51.8%)	47(42%)	7(6.2%)	Agree
Stop the use of fertilizer	51(45.5%)	52(46.4%)	9(8.1%)	Disagree
Planting Pest/disease resistant crops or variety	78(69.6%)	28(25%)	6(2.4%)	Agree

Table 7

The Chi-Square Statistics given as $X^2 = \sum \frac{(0-E)^2}{E}$ for Table 7 is given as follow

Variable	Calculated chi statistics (X^2 Cal)	Critical value $\alpha = 0.05$
Reduction/Coping Strategies	X^2 =127.9 degree of freedom (df)=16	Critical value=26.296

The chi-square statistics revealed that there was a positive and significant relationship between perception of respondents and Reduction/coping strategies on climate change impact, since the calculated chi-statistic ($X^2 = 127.9$) was greater than the critical value (26.296). Overall perception of our respondents agreed on the suggested coping strategies.

4.6 **Focus Group Discussion**

A total of 75 small holder farmers participated in the FGD and 95% of the respondent's age range was between 35-55 years. Reports from the group discussions showed that all members have lived in the community for more than 30 years with experience on climate change and its impact. Respondents had some level of education about 85% had secondary school certificate and the remaining 15% had primary school certificate.

From the semi-structured interviews, the study found that most farmers complained of poor crop yield due to vandalization of farmland by Fulani herdsmen.

Furthermore, the results indicated 74% of the respondents reported decrease in rainfall increase in temperature respectively, associated with prolonged drought periods and food shortages for the last 10 years. To solve the problem of food shortages 90% of the respondents proposed fertilizer application as the best option. 60% of them admitted to get assistance from catholic church and were pleading that the local government council should assist with more provision of fertilizer.

With respect to weather updates from NIMET 65% of the respondents admitted to get daily weather updates at news hour via media as opposed to 35% who claimed to be in the dark due to poor power supply.

Conclusion and Recommendations

The study has provided valuable insights on the impact of climate change on small scale farmers, revealing socio demographic factors that influence their perception and coping strategies used to alleviate or mitigate climate change effects on farming activities. The findings revealed that in the shaki community, the trend of annual total rainfall has been decreasing with an increase in temperature, corresponding to farmers' perceptions of climate indicators over time. However, the study found a positive and significant link between farmers' socio-demographic characteristics and their perceptions of climate change and coping strategies. Crop varieties and livestock breeds that are tolerant to adverse conditions associated with climate change, such as diseases, flood, drought, and temperature, should be developed and made available. All levels of government should use the available extension structures on the ground to launch a multi-media enlightenment campaign about the effects and possible coping strategies. Local disaster risk committees can also be formed by farming communities to encourage local adaptation measures as survival tactics for ensuring food security. However, there is an urgent need to integrate and mainstream local farmers' perceptions and adaptation strategies into policies aimed at mitigating the impact of climate change at the international, national, and local levels, as well as raising awareness about the importance of climate change adaptation and, most importantly, providing financial capital to farmers with low income capacity to improve their adaptive capacity.

REFERENCE

1. Adejuwon, J.O. (2006) Food Security, Climate Variability and Climate Change in Sub-Saharan West Africa, A final Report submitted to Assessments of Impacts and Adaptation to Climate Change (AIACC), Project No.AF 23.

2. Adeniyan, B. O., Ojeniyi, S. O., & Awodun, M. A. (2008). Relative effect of weed mulch types on soil properties and yield of yam in Southwest Nigeria. *Journal Soil Nature*, *2*(3), 01-05.

3. Aina, L.O. (2007) Globalization and small-scale farming in Africa: what role for Information Centre. World Library and Information Congress, 73rd General Conference and Council, 19 -23rd August, Durban South Africa.

4. Apata, T.G. (2011). Factors influencing the perception and choice of adaptation measures to climate change among farmers in Nigeria: evidence from household in Southwest Nigeria, Environ. Econs. 2 (4) 74-83.

5. Awotoye, O.O. and Matthew, O.J. (2010) Effects of Temporal changes in climate variables on crop production in tropical Sub-humid south western Nigeria. Institute of Ecology and Environmental Studies, Obafemi Awolowo University, IIe-Ife, Nigeria

6. Ayoade, J. O. (2003). Climate change: a synopsis of its nature, causes, effects and management. *Vantage*, *Ibadan*.

7. Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, (2007). Africa. Cambridge University Press.

8. Christensen, J. H., & Christensen, O. B. (2007). A summary of model projections of changes in European climate by the end of this century. *Climatic change*, *81*(1), 7-30.

9. CIESIN, F. (2005). Gridded Population of the World, Version 3 (GPWv3): Population Count Grid. *Center for International Earth Science Information Network (CIESIN), Columbia University*.

10. Ehrhart, C., & Twena, M. (2006). *Climate change and poverty in Tanzania: Realities and response options for CARE*. CARE international.

11.Ford, J. D., Smit, B., & Wandel, J. (2006). Vulnerability to climate change in the Arctic: a case study from Arctic Bay, Canada. *Global Environmental Change*, *16*(2), 145-160.

11. Griggs, D. J., & Noguer, M. (2002). Climate change 2001: the scientific basis. Contribution of working group I to the third assessment report of the intergovernmental panel on climate change. *Weather*, *57*(8), 267-269.

12. Hulme, M., Doherty, R., Ngara, T., New, M., & Lister, D. (2001). African climate change: 1900-2100. *Climate research*,*17*(2), 145-168.

13. Jena, K. K., & Mackill, D. J. (2008). Molecular markers and their use in marker-assisted selection in rice. *Crop science*,*48*(4), 1266-1276.

14. Kurukulasuriya, P, Mendelsohn, R, Hassan, R, Benhin, J, Deressa, T, Diop, M, Eid, HM, Fosu, KY, Gbetibouo, G, Jain, S, Mahamadou, A, Mano, R, Kabubo-Mariara, J, El-Marsafawy, S, Molua, E, Ouda, S, Ouedraogo, M, Sène, I, Maddison, D, Seo, SN & Dinar, A, 2006. Will African agriculture survive climate change? World Bank Economic Review 20, 367– 88.

15. Maracchi, G., Sirotenko,O., and Bindi, M.(2005).Impacts of present and future climate variability on agriculture and forestry in the temperate region. Europe. Climate Change, 70(12) 117-135

16. Morton, T. (2007). *Ecology without nature: Rethinking environmental aesthetics*. Harvard University Press.

17. Owombo, P.T., koledoy,G.F, Ogunjimi,S.I.,Akinola and Bolarinwa. (2014). Farmers adaptation to climate change in Ondo State

18. IPCC, (2001). Climate change: Impacts, adaptation, and vulnerability. Contribution of working group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. 761pp. PCC, (2001). Climate change: Impacts, adaptation, and vulnerability. Contribution of working group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. 761pp.

19. Hassan, R., & Kurukulasuriya, P. (2008). *A Ricardian analysis of the distribution of climate change impacts on agriculture across agro-ecological zones in Africa*.

20. Sofoluwe, N. A., Tijani, A. A and Baruwa, O. I. (2011) Farmers' perception and adaptation to climate change in Osun State, Nigeria, African J. of Agricultural Research, 6(20), 4789-4794.

21. Weiss, C. R., & Briglauer, W. (2000). *Determinants and dynamics of farm diversification* (No. 0002). FE Workingpaper/Universität Kiel, Department of Food Economics and Consumption Studies. planning response. *Local Environment* 11: 609 – 625.

22. Yesuf, M., Di Falco, S., Deressa, T., Ringler, C., & Kohlin, G. (2008). *The impact of climate change and adaptation on food production in low-income countries: evidence from the Nile Basin, Ethiopia*. Intl Food Policy Res Inst.