Utilization of Indigenous Knowledge Climate Change Adaptation Strategies Among Arable Crop Farmers in South –Western Nigeria

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ABSTRACT

Local people of southwestern Nigeria like in other climes, continue to be confronted with the vagaries of changing environments. This article analyses indigenous adaptation strategies for climate change with a view to enhancing sustainable crop farming in southwestern Nigeria. Multi-stage sampling procedure was used to select 225 respondents from the two major ecological zones (Forest and Derived Savanna) to allow geographical inclusiveness. Data were collected through the use of validated structured interview schedule Frequency distribution , percentages , means and standard deviation were used to describe the data. . Pearson product moment correlation (PPMC) was used to test the hypothesis formulated and multi-nomial logit regression analysis was used to determine important variables that influenced farmers choice of ICCAS The result showed that majority 80% of the arable crop farmers were male. The use of ICCAS was not hindered by the educational level of the farmers as most of them 73.3% had educational experiences at varying levels.

The findings also showed that seven indigenous adaptation strategies were commonly utilized by arable crop farmers. Nonetheless, crop diversification, consultation with rainmakers and involvement in non-agricultural ventures were prioritized in the order of 1-3, respectively. Also, there were positive and significant correlation between extent of ICCAS utilisation and selected personal characteristics of arable crop farmers, namely, age(r=0.260; P≤0.01), farm size(r=0.328; ;P≤0.01). The results of multiinomial logit regression analysis revealed that at P≤0.05 level of significance , land ownership, access to loan and education level were all important in explaining ICCAS utilised by arable crop farmers in southwest Nigeria . It was concluded that the use of organic manure, mulching, bush fallowing and crop diversification were the commonest ICCAS being used for climate change adaptation among arable crop farmers The study recommended that all the identified ICCAS need to be integrated into the development process for sustainable crop farming.

Key words: *Crop diversification, climate change, adaptation option, sustainable, small farmers*

INTRODUCTION

Rural people had their own body of knowledge before introduction of western education, considering the fact that over 80 per cent of the economically active population are involved in agricultural production, and the over 90 per cent of the food consumed in the country is from local agricultural production. It is the second largest earner of foreign exchange; next to the non sustainable petroleum sector, and it provides a ready market for industrial products (Ayanwale, 1990).

This sector is weather dependent, therefore climate variability and change has a direct, often adverse influence on the quality and quantity of agricultural products in Nigeria (Sowumi and Akintola, 2010). There is an observed decline in crop yield and food crop production due to reduction in rainfall and relative humidity, and an increase in temperature in Nigeria (Agboola and Ojeleye 2007). Like other developing countries, the pinch of climate change and global warming is high in Nigeria due to wide spread poverty. Agricultural and production activities are generally more vulnerable to climate change than other sectors (Ajetomobi and Ajiboye 2010).
Therefore, there is a need for agriculture and agricultural practices to adapt to change in order to ensure food security for the survival of the over 160 million Nigerians.

Changes in climate occur in two ways namely: climatic warming and climatic cooling. Climate change is caused by two basic factors, which include natural processes (bio geographical) and human activities (anthropogenic). The natural processes are the astronomical and the extraterrestrial factors. The astronomical factors include the changes in the eccentricity of the earth orbit, changes in the obliquity of the plane of ecliptic and changes in orbital procession while the extraterrestrial factors are solar radiation quantity and quality.
The human factors that emit large amounts of greenhouse gases include industrialization, burning of fossil fuel, gas flaring, urbanization and agriculture. On the other hand, human activities that reduce the amount of carbon sinks are deforestation, alterations in land use, water pollution and agricultural practices. While the green houses gases are released more by the developed nation; the developing countries are more hit by the adverse effects of climate change caused by these gases (IPCC, 2007).

Adaptation to climate change is the adjustment in natural or human system in response to actual or expected climatic stimuli or their effects (IPCC, 2001). Climate change adaptation aims at mitigating and developing appropriate coping strategies to address the negative impacts of climate change on man, animals and the vegetation. Various scientists have studied the different components of climate change to some extent. The causes of climate change have been scientifically studied and showed that industrialization, urbanization, water pollution, deforestation and transportation are among the highest contributors (IPCC, 2007, Nwafor, 2007, Odjugo, 2009)

Local people have various strategies to respond and adapt to climate change: diversified resource base chiefly to minimize the risk due to harvest failure, they grow many different crops and varieties, and they also hunt, fish, and gather wild food plants. Change in crop varieties and species and change in the timing of activities like crop harvests, wild plant gathering, fishing, changes in resources resorting to wild foods in the case of emergency situations such as droughts and floods, are their coping strategies to combat adverse climatic condition (Salick and Byg, 2007).

The importance of indigenous knowledge had been acknowledged in the design and implementation of sustainable development projects, little has been done to incorporate this into formal climate change adaptation strategies (Nyong and Adesina, 2007). Climate change cannot be divorced from sustainable development as sustainable development may be the most effective way to frame a crucial dimension of climate change (Swart, *et al.*, 2003; Cohen *et al.*,1998). Incorporating indigenous knowledge into climate change policies can lead to the development of effective adaptation strategies that are cost-effective, participatory, and sustainable (Hunn, 1993). However, incorporating indigenous knowledge into climate change concerns should not be done at the expenses of modern/western scientific knowledge. Indigenous knowledge should complement, rather than compete with global knowledge systems. Osunade (2002) was of the opinion that western technologies have either positive or negative impacts in ordering the development process of African nation's economies.

Some of the scientific adaptive strategies are at the detriment of the local people both on their resource base and health conditions, whereas indigenous people have always been confronted with changing environments. Their strategies for coping with change have allowed them to successfully negotiate historical shifts in climate and environment, by modifying existing practices, shifting their resource bases or restructuring their relationships with the environment(Manish *et al.*, 2012). There is a growing awareness that indigenous people may find themselves not only on the frontlines of climate change impacts, but also of impacts due to rapidly expanding efforts to adapt to climate change (Nakashima, 2000).

Indigenous people in many cases have built up knowledge over long periods about changes in the environment and have developed elaborate strategies to cope with these changes. However, indigenous knowledge systems in adaptation have, for a time, been neglected in climate change policy formulation and implementation and have only recently been taken up into climate change discourse. Indigenous people, who have survived over long periods of exposure to many kinds of environmental changes, including climate change, may have valuable lessons to offer about successful and unsuccessful adaptations which could be vital in the context of climate change. In order to establish an empirical explanation to some of the claims above, the thrust of this study is to examine the extent of utilization of indigenous climate change adaptation strategies among arable crop farmers of southwestern Nigeria.

. **Objectives of the study**

The main objective of this study is to analyze the extent of utilization of indigenous adaptation strategies (ICCAS) for climate change among arable crop farmers of southwestern, Nigeria.

The specific objectives of the study are to:

1. describe personal characteristics of arable crop farmers in the study area;
2. identify various indigenous climate change adaptation strategies utilized by arable crop farmers in the study area;
3. identify the reasons for using (ICCAS) among arable crop farmers in the study areas;

4. determine the benefits and constraints associated with utilization of ICCAS among the arable crop farmers in the study areas.

METHODOLOGY OF THE STUDY

Area of study

Ekiti and Oyo States in South Western Nigeria were studied. The area lies between latitude 5^0N and 9^0 N of the equator and longitudes 2.5^0E and 6º E of the Greenwich Meridian. The climate in South Western Nigeria is predominantly humid with rainfall from 1500mm to 3000mm per annum. The mean monthly temperature ranges from18^oc to 24^oc during the rainy season and 20^oc to 35^oc during the dry season (Sahib *et al.*, 1997). It is bounded by the Atlantic Ocean in the South, Kwara and Kogi States in the North, Anambra State in the Eastern Nigeria and Republic of Benin in the West. The study area has a land area of about 114,271km², representing about 12 per cent of the country's total land area. The nation's population put at about 140,003542 with about 65 per cent of this population living in the rural areas (National Population Commission, NPC, 2006). Farming is the major occupation of the majority.

Sampling size and sampling techniques

The study employed primary data. Multi-stage sampling technique was used in selecting respondents for the study. In the first stage, Ekiti and Oyo States was stratified into two ecological zones (Forest and Derived Savanna). In the second stage, two Local Government Areas (LGAs) were purposively selected from each of the two ecological zones based on their levels of arable crop production. In all, a total of eight (LGAs) were sampled for the study. The (LGAs) are: Ekiti East and Ilejemeje (Derived savanna), Ekiti West and Emure (Forest) in Ekiti State, and Orire, Atisbo (Derived savanna) Oluyole and Akinyele (Forest) in Oyo state. In the third stage, Six villages from each of the eight selected (LGAs) were randomly selected using Agricultural Development Programme (ADP) farmers list, making forty-eight villages. In the last stage, one per cent of the arable crop farmers from their list were randomly selected from each of the selected villages. In all, a total of three hundred and forty (340) arable crop farmers were used for the study in the entire study area. A validated and pre-tested, interview schedule was developed and used for data collection between January and April, 2020.

Measurement of Variables

The dependent variable, extent of utilization of ICCAS was measured by the number of adaptation strategies employed by arable crop farmers in guiding against erratic weather conditions (use of organic manure, mulching, bush fallowing, practicing of dual residency, crop diversification, consulting indigenous rain maker as well as ritual and divination). Adaptive Strategies Used Index (ASUI) was used to assess the extent of use of the different indigenous adaptation strategies for climate change among arable crop farmers was adapted and modified from Islam and Kashem (1999). The ASUI was computed as follows

$$ASUI = N1\times5 + N2\times4 + N3\times3 + N4\times2 + N5\times1 \text{ -------------(1)}$$

Where

ASUI is as already defined

N1 = Number of arable crop farmers using AS item frequently

N2 = Number of arable crop farmers using AS item occasionally

N3 = Number of arable crop farmers using AS item rarely

N4 = Number of arable crop farmers aware of but not using AS item

N5 = Number of arable crop farmers not aware of an AS item

Data Analysis

Simple descriptive statistical techniques such as frequency counts, percentages, measures of central tendencies (mean and standard deviation) were used to describe and summarize the data collected. Pearson's correlation analysis was used to determine the relationships between the dependent variable (Extent of ICCAS utilization) and independent variables and multinomial logit regression model was used to determine factors that influence farmers choice of indigenous climate change adaptation strategies

RESULTS AND DISCUSSION

The results show that majority (85.0%) of the arable crop farmers were male. The use of ICCAS was not hindered by educational level of the farmers as most of them(73.3.%) had educational experiences at various levels. The average household size was 6.54± person (SD=2.87). the average age of respondent in Ekiti and Oyo state Nigeria was 52.8 years (Sd=12.96) . two third (69.3 %) of the arable crop farmers were Christian. Majority (86.7 %) were married

Table 1: Distribution of respondents according to personal characteristics

Personal characteristics	Frequency	Percentage	n=340

Age (years)			
1. <30:00	87	21.0	
2. 30-59.00	237	67.9	
3. 60+	102	30.0	mean =52.48yrs
Household size			
1 <4.00	27	7.9	
4.00-8.00	310	91.2	std dev =2.87
12 and above	3	0.9	
Farm size (ha)			
<1	65	19.1	
1-2.99	173	50.9	
3.0-4.99	50	14.7	
5.0-6.99	42	12.4	
7 and above	10	2.9	
Educational level			
Had pay school education	92	27.1	
Had pay secondary education	88	25.8	
Had post –secondary education	83	24.4	
Had no education at all	76	22.4	
Sex			
1. Male	289	85.0	
2. Female	51	15.0	
Farming experience (years)			
1-5	39	11.5	

6-10	81	23.8
10 and above	220	64.7
Functional contact with extension agents		
Yes	250	73.5
No	90	26.5

Source: Field survey, 2020

The various indigenous climate change adaptation strategies,(ICCAS) utilized by arable crop farmers in the study areas are presented in Table 2.

Results reveal that 29.0 percent of the respondents in Ekiti and Oyo states utilized crop diversification as an adaptation strategy to against the effect of climate change.

However, mulching 19.2 per cent, use of organic manure 15.3 per cent, bush fallowing 13.3 per cent and practising of dual residency 10.4 per cent were other ICCAS that were utilized. The results in Table 2 also reveal that Ekiti State had the highest number of respondents that utilized indigenous rain maker, 8.1 per cent; whereas, Oyo State had the higher number of respondents that utilized ritual practices/divination 5.9 per cent as a climate change adaptation strategy. These findings support that of Odjugo (2010c) that local farmers in the Savanna zone of Nigeria had started responding to the changing climatic condition by practising crop diversification.

Table 2: **Distribution of arable crop farmers by the types of ICCAS utilized**

ICCAS	**n= 120 Ekiti State F**	**%**	**n=135 Oyo State F**	**%**	**n=255 Total F**	**%**
Use of organic manure	17	14.2	22	16.3	39	15.3
Mulching	21	17.5	28	20.7	49	19.2
Bush fallowing	16	13.3	18	13.3	34	13.3
Practicing dual residency	11	9.2	14	10.4	25	9.8
Crop Diversification	40	33.3	34	25.2	74	29.0
Consulting indigenous rain maker	11	8.1	9	7.5	20	7.8
Ritual /divination	6	5	8	5.9	14	5.5

Source: Field Survey, 2020

Reasons for utilizing ICCAS

Results in Table 3 reveal that 62.1 per cent of the respondents were of the opinion that they utilized ICCAS because modern adaptive strategies are expensive. Only 47.6 per cent of the respondents admitted that they used the strategies because resources for such strategies were always available. In addition 57.9 per cent of the respondents claimed that, "they use the strategies because they were very much more familiar with them than modern strategies". While respondents who felt, they use ICCAS because the extension agent encouraged them on the usage, were 49.1 per cent and about 66.2 per cent opined in that ICCAS were less hazardous than modern strategies. Some of the findings reflect the report of Teschade *et. al.* (2004) that "rural livestock owners are forced to rely on traditional medicine because modern adaptation strategies were expensive or they cannot afford to pay." In addition, the finding of Kolawole (2002) revealed that most (80.0 per cent) of the respondents were using the Indigenous Knowledge System, IKS, because they were easily practicable, and 60 per cent felt modern methods were expensive. This revelation still buttressed the fact that most ruralites are resources poor, in which case attention was still given to using lCCAS.

Table 3: Percentage distribution of respondents by reasons for ICCAS utilization

Reasons*	Frequency	Percentage
Modern adaptive strategies are expensive	211	62.1
Resources for such practices are always available	162	47.6
I use the strategies because I am very much familiar with it than modern strategies	197	57.9
I use ICCAS because of the frequent visit of Extension	169	49.7
I use the strategies because they are less hazardous	225	70.6

Sources: Field Survey, 2020

***Multiple responses**

Extent of ICCAS Utilisation

The result in table 4 showed that crop diversification ranked 1ST (35.5%) among the seven ICCAS considered in the study. Thus, the result of the analysis presented clearly showed the relative importance of crop diversification as a veritable strategy in climate change adaptation strategies. This was followed by mulching (24.9%). Bush fallowing ranked third (9.8%), while practicing of

dual residency ranked fourth (6.2%) and use of organic manure ranked fifth (5.4%). Practising of dual residency can be made possible for those that have another occupation aside from farming. When it seems that output from farming is not as high as expected, the farmer can migrate to the town especially during off season to engage in non-agricultural work.

Rituals / divination (2.6%) and consulting indigenous rain maker (3.1%) were the adaptation strategies that ranked low. This might be connected with the high level of respondents that possibly practised western religion, which might not be favourably disposed to the use of such strategies.

Table 4: Ranking of indigenous climate change adaptation strategies by extent of usage

ICCAS	HU	MU	LU	NU	ASUI	%	Rank
1.Use of organic manure	8	8	2	1	43	5.4	5th
2. Mulching	45	25	8	5	198	24.9	2nd
3. Bush fallowing	20	8	1	1	78	9.8	3rd
4. Practicing dual residency	10	8	2	1	49	6.2	4th
5. crop diversification	84	13	2	2	282	35.4	1st
6.Consulting indigenous rain maker	5	3	2	2	25	3.1	6th
7 Ritual/ divination	-	6	5	4	21	2.6	7th
Summation (∑)					**796**		

Source: **Field Survey**, **2020**

Benefits of ICCAS utilization

The results in Table 5 show that majority, 78.2 per cent of the farmers utilized ICCAS because they were economically better. Also, about 71.2 per cent of the population studied used ICCAS because it was environmental good. About 67.6 per cent reported that they utilized ICCAS because the effects of the strategies are not harmful.

Table 5: Percentage distribution of respondents by benefits derived from ICCAS utilization

Benefits*	Frequency	Percentage
1. Environmentally friendly	243	71.5
2. It is economically better	266	78.2
3. The effect of the strategies are not harmful	230	67.6

4.	The action of ICCAS are very fast in bringing relief to the farmers	199	58.5

***Multiple responses**
Sources: Field Survey, 2020

Constraints associated with the utilisation of ICCAS
Table 6 shows the constraints to utilization of indigenous climate change adaptation strategies among arable crop farmers in descending order of severity: economic problem in accessing most of the facilities for ICCAS utilization (WMS= 2.30), Lack of support from government (WMS=2.23), such as given of loans to acquire most of the facilities required in the utilization of ICCAS. Another constraint is that the custodians of ICCAS are not open (WMS=2.02). This finding buttresses the statement of Emeagwail (2003) that indigenous knowledge is less transferable due to holistic and even spiritual dimension. The above shows the first, second and third ranks, respectively and represents the extension constraints to the utilization of ICCAS among the arable crop farmers.

Table 6: Percentage distribution of respondents by constraints in utilization of ICCAS

Constraint	**Minimal**	**Average**	**Extensive**	**WMS**	**Rank**
Economic problem	72 (21.2)	94(27.6)	174(57.2)	2.30	1st
Land tenure problem	95(27.9)	183(53.8)	62(17.6)	1.90	4th
Openness of custodian of 1k	95(27.9)	134(39.4)	111(32.6)	2.02	3rd
Lack of support from the govt	81(23.8)	96(28.2)	163(48.0)	2.23	2nd
Mystery associated with Some practices	185(54.2)	98(29.3)	60(16.0)	1.87	5th

Grand mean score = 2.07 Standard Deviation = 0.20

Hypothesis Testing

The result in Table 6 showed that three personal characteristics of farmers had positive and significant relationship with ICCAS at 0.01 level of significance . The values of identified variables were age of respondents (r= 0.26), farm size (r=0.323) The positive correlation of age and farm size indicated that the more the magnitude of the variation in these variables, the higher of number ICCAS utilised by arable crop farmers in adapting to climate change.

Table 6 : Relationship between personal characteristics of the farmers and extent of utilisation of ICCAS

Variable	**Coefficient**	**P-value**	**remarks**
Age	**0.26****	**0.001**	**Significant**
Farm sise	**0.323**	**0.000**	**Significant**
Years of Farming experience	**0.001**	**0.003**	**Significant**

Source: Data Analysis, 2020

**** significant at 0.01**

MULTINOMIAL LOGIT MODEL

The findings in Table 7 revealed that seven of the explanatory variables influenced the utilization of ritual /divination. This implies that the moment personal attributes of farmers favor the usage of ritual/divination, the more the farmers continue to utilize it. The result also revealed that access to loan significantly influenced the following adaptation strategies, bush fallow (t=0.027),practicing of dual residency(t=0.004) and crop diversification (t= 0.01). The result implies the important role of institutional support in promoting the use of adaptation options among arable crop farmers to reduce the negative effects of climate change. The educational level of respondents were found to be significant at ($p<0.10$) for the following strategies, mulching (t= 0.005), practicing dual residency (t= 0.045) and crop diversification(t= 0.013). This implies that an increase in these variables will increase the likelihood of arable crop farmers to choose these strategies. It could be concluded, that farmers with higher levels of education are more likely to adapt to climate change by taking up multiple strategies.

The result further revealed that landownership was significantly influenced by the following variables bush fallowing (t=0.025), crop diversification (t=0.019) and consultation with indigenous rain maker (t=0.010). The farmer that owns a piece land had the likelihood of being diversified into planting of other crops and practicing of bush fallowing due to availability of land that is void of land tenure arrangement. Furthermore, contact with extension agent was found to be significant and positive, for strategies crop diversification ($p<0.01$) practicing dual residency ($p<0.01$) implying that an increase in this variables will increase the likelihood of arable crop farmers these strategies, respectively.

Years of farming experience: The coefficient of years of farming experience is also significant ($p<0.05$) and positive for strategies, bush fallowing, practicing dual residency and crop diversification. The findings suggest that an increase in these variables will increase the probability that the respondents would choose each of these adaptation options respectively. This is because with increase in the years of farming, there is higher possibility of an individual acquiring experience he would be encouraged to use ICCAS based on his past experiences that will help to improve his farming activities and livelihood in general

Table 7: Parameter estimates of the multinomial logit climate change adaptation model

Factors	1		2		3		4		5		6		7	
	Coeff	**P-value**	**Coeff**	**P-value**	**Coeff**	**P-value**	**Coeff**	**p-value**	**Coeff**	**P-value**	**Coeff**	**p-value**	**Coeff**	**p-value**
EXTOFESTS	-0.266	(0.38)	5250697	0.076	-0.873	0.012*	0.541	0.008**	0.484	0.062	0.160	0.002**	0.124	0.018*
ACCESSOL	0.120	(0.021)	-0.906	0.162	0.150	0.027*	0.215	0.004**	0.993	0.01*	0.619	0.412	0.153	0.027**
HHSIZE	0.430	(0.028)	0.863	0.006*	0.241	0.016*	0.152	0.010**	-0.574	0.037	0.854	0.055*	-0.116	0.008**
RELIGION	-0.823	0.065	-0.600	0.048	0.118	0.09	-0.215	0.01*	0.204	0.01*	0.388	0.026*	0.132	0.01**
CONTACT	0.1783	0.097	-0.863	0.047	0.132	0.072	0.638	0.034*	-0.409	0.022*	-0.234	0.001**	-0.561	0.003**
AGE	0.344	0.018	0.111	0.060	-0.803	0.042*	-0.128	0.068	-0.312	0.017*	-0.239	0.013**	-0.903	0.048*
SEX	0.893	0.051	0.949	0.054	-0.528	0.030	-0.555	0.031*	0.369	0.002*	0.640	0.036*	0.112	0.065
MRST	0.1645	0.01*	-0.358	0.054	-0.632	0.004**	-0.604	0.037*	0.811	0.011**	0.522	0.032*	0.142	0.009**
EDU	-0.284	0.195	0.653	0.005**	0.402	0.27	0.659	0.045*	0.510	0.03**	-0.185	0.013**	0.110	0.076
LANDOWN	0.830	0.051	-0.433	0.025*	-0.114	0.016*	0.827	0.063	0.316	0.019**	0.178	0.010**	-0.964	0.056
FARMSIZE	0.036*	0.130	0.123	0.084	0.391	0.026	0.931	0.026	0.919	0.07*	0.674	0.046	0.699	0.034
YROFFARM	0.859	0.066	-0.871	0.007	0.487	0.037**	-0.343	0.026*	0.469	0.036*	0.232	0.018**	-0.806	0.062

Chi-squared=21.96449

Loglikelihood function=-57.59386
Restricted loglikelihood= -68.57611
Note:** significant @ 0.01 level of significance
*Significant @0.05 level of significance
Key: (1) use of organic manure (2) mulching (3) bush fallowing (4) practicing dual residency (5) crop diversification (6) consulting indigenous rain maker (7) ritual/ divination
Farm size 2. YROFFARM (Years of farm experience) 3. LANDOWN , MRST Marital status 4.HHSIZE Household size,5.ACCESOL (Access to loan)6. EXTOFESTS

CONCLUSIONS AND RECOMMENDATIONS

The types of ICCAS utilized by arable crop farmers in adapting to vagaries of weather in the study areas were use of organic manure, mulching, bush fallowing, practicing of dual residency,. Crop diversification ,consulting indigenous rain maker and usage of ritual/divination Some of the constraints militating against the use of ICCAS were, that the traditional land holding system has always been a constraint to the practice of bush fallow and shifting cultivation; that trash burning could sometimes prove destructive if not properly applied; and the mystery associated with some of the practices were inimical to the utilization of ICCAS. To a large extent if the identified adaptation strategies could be integrated into development process it will enhance sustainable crop farming in Nigeria

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