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ASSESSMENT OF THE SOCIOECONOMIC FACTORS INFLUENCING THE CHOICE OF INDIGENOUS ADAPTATION STRATEGIES TO CLIMATE CHANGE IN GOMBE STATE, NIGERIA

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Abstract

The study assessed the socioeconomic factors influencing the adoption of local adaptation strategies. Primary data was used for this study and a list of registered farmers from Gombe State Agricultural Development Project (GSADP) was obtained and used in the selection of the respondents. Multistage sampling technique was used to determine the sample size. Descriptive statistics and binary logistic regression model were used to analyse the data. The results revealed that there were more male (70.3%) than female (29.7%) gender among the studied population. Majority of the respondents (64%) were within the age range of 40 – 49, and about (64.3%) of them were married. Results from the binary logit model reveled that; cooperative society membership (p-value = 0.063), income (p-value = 0.015) and years of farming experience (p-value = 0.008) were the significant factors influencing the choice of indigenous adaptation strategies to climate change. Age of the respondents (0.184), education (0.627), access to credit (0.011), climate change awareness (0.073) and family size (0.180) positively influenced adaptation decision while sex of the respondent (-0.278), access to extension service (-0.485) and income (-0.883) negatively influenced the adaptation decision. The study concluded that income and years of farming experience does not influence Indigenous Adaptation Strategy (IAS).

Keywords: Adaptation, Indigenous, Socioeconomic, Livelihood, Climate Change

1. Introduction

Changing climate is among the alarming threat affecting indigenous peoples' livelihood in the 21st century. The impact of climate change is experience in various forms depending on the location and the prevailing human activities. Adaptation to climate change is the means where the affected victims can go on with their lives despite the challenges. Indigenous Adaptation Strategy (IAS); refers to the local method/strategies of adapting to climate change with a particular location. Climate change is the deviation in the statistical mean of climatic variables over a long period like thirty years and above. Climate change refers to a change in the state of the climate that can be identified by

changes in the mean and or the variability of its properties and that persists for an extended period, typically decades or longer (Intergovernmental Panel on Climate Change (IPCC, 2007).

Natural resources worldwide which many people (particularly rural communities) rely on for their existence, including rainfall, land, agricultural crops and forests are today being adversely affected by climate change (Waiyaki,Owiti, Angwenyi and Muriuki (2012). Climate change have direct impact on development of climate-dependent activities (such as agriculture) and indirect impact on social systems (such as issues of poverty, conflict, health and education) (Orindi *et al*, 2005). Climate extremes have direct impacts on food crops and can indirectly influence food supply by altering the ecology of plant pathogens, and higher soil temperatures can promote fungal growth that kills seedlings. Climate change worsen current water stress caused by population growth and economic and land use change in Africa (Waiyaki, 2012). Mishra (2017) reported that climate change has the potential to exacerbate inequality and prevent economic growth. Climate changes affect both social and economic development of the people through decrease in agricultural production and natural resources like mining activities, forestry, water and other human activities.

Ringler, Zhu, Cai, Koo and Wang (2010) noted that climate change lead to changes in yield and area growth, higher food prices and therefore lower affordability of food, reduced calorie availability, and growing childhood malnutrition in Sub-Saharan Africa. Bello and Msheliza (2018) observed that climate change is threating the livelihood of the people because they rely on a system that is climate sensitive, which is currently facing many challenges in Gombe state. Various factors influence adaptation strategies to climate change positively and negatively, for example large family size positively influence the adaptation strategies by creating large labour force while accesses to credit facility negatively influence adaptation strategies Fagariba, Song and Baoro (2018). Shikuku,et al., (2017) reported that household size, sex, group membership, access to credit facilities positively influence adaptation while food insecurity and hunger were the barriers to adaptation to climate change. Examining the socioeconomic factor that determine the choice of indigenous adaptation strategies is important so as to provide policy information on the specific factors and encourage the people to use other strategies. The aim of this study is to assess and identify the socioeconomic variables influencing the choice of local adaptation strategies.

2. Study Area

The State is located between Latitude 11°10' 0.00''E and 10° 15'0.6''N and Longitude 11.16º 5'0.7''E and 10°45' 0.3''N. Gombe state shares its boundaries with five states within the North East sub -region, Bauchi State to the West, Yobe State to the North, Borno and Adamawa States to the East and Taraba State to the South as presented in (Figure 1). The State have isolated hills in the southern parts and a flat landscape in the northern part of the state, it has a total land area of 5705.99 km^2 which constituted 33.06% of the state located in river basin areas. The temperature ranges between 25ºC – 38ºC in the hammartan season (December-February) and hot dry/rainy season (March-May) respectively. The population of Gombe State was 2,353879 during the 2006 census (National Population Commission [NPC], 2006). Majority of the people engage in primary activities such as farming, hunting and mining.

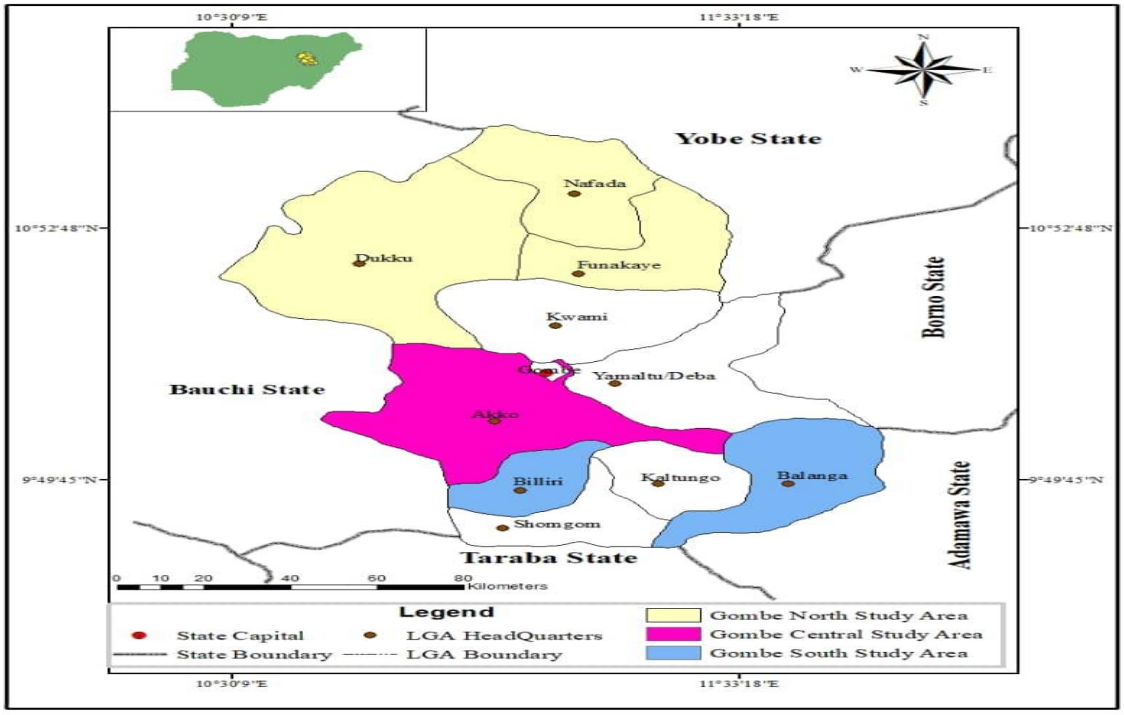

Figure 1. Gombe State showing Sampled Study Areas

2. Methodology

2.1 Sources of Data

The data for this study were from both primary and secondary sources. The primary data was obtained through household interview while the secondary data (List of registered farmers) was obtained from Gombe State Agricultural Development Project (GSADP). Only heads of household were interviewed because they were the oldest by age and decision makers, who have 40 years and above, and residing in the communities for at least 30 years. Only those who understand the native language were employed as research assistant in each of the studied communities.

2.2. Sample size and sampling technique.

Multistage sampling technique was used to select the sample for this study. This sample was determined through the following stages; Stage I: 50% of LGAs were determined from the three (3) senatorial zone and six LGAs selected through random sampling (by balloting), just to give equal chance of been selected (Figure 1) and (Table 1.1). Stage II: The second stage involved the selection of eighteen (18) political wards by purposive sampling technique. The political wards represent North, Central and South of each LGA. Stage III: The third stage, 50% of the villages were determined through stratify sampling technique where fifty- four (54) Villages were selected from each of the

political wards. Stage IV: The fourth stage, Krejcie and Morgan (1970) sampling technique was used to select sample size for the administration of interview schedules.

The sample size was determined using a formula recommended by Krejcie and Morgan (1970) is as follows;

$$S = \frac{x^2\, NP\, (1-P)}{d^2\, (N-1) + x^2\, P(1-P)} \quad \ldots\ldots\ldots\ldots (1)$$

Where;

S = Required size
X^2 = the table of value of chi – Square for 1 degree of freedom at the desired confidence level
N = the population size
P = the population proportion
d = the degree of accuracy expressed as a proportion.

Cochran (1977) recommends a formula for the determination and distribution of sample sizes as follows:

$$N = \frac{Nh \times n}{P} \quad \ldots\ldots\ldots\ldots (2)$$

Where Nh = Population
N = Sample size
n = Total number of respondents
P = Total population of the selected communities within the study area. See (Table1.1).

From Krejcie and Morgan (1970) table of sampling technique, the sample size for the study is 384 out of total number of the registered household 10069 selected for the study. (Table1.1). This implies that three hundred and eighty four respondents were selected for the study.

Table 1: Sampled Frame

Senatorial District	LGAs in Gombe State	50 % of LGAS	LGA	Selected Ward	Number of villages	Number of Registered Household	Sample Size
Gombe South	Billiri, Balanga, Shomgom and Kaltungo	2	Billiri	Bare	4	603	23
				Tanglan	2	537	20
				ToduKwaya	3	568	22
			Balanga	Talasse/Dong/Reme	3	533	20
				Kulani/Degre/Sikkam	3	554	21
				Bambam	4	617	24
Gombe Central	Akko and Yamaltu	1	Akko	Kalshingi	3	555	21
				Kumo West	2	562	21
				Kashere	4	767	29
Gombe North	Nafada, Dukku, Funakaye, Gombe and Kwami	3	Nafada	BarwoWinde	4	698	27
				Jigawa	2	455	17
				BirinBolawa	2	445	17
			Dukku	Waziri North	2	457	17
				Waziri South	4	502	19
				Gombe Abba	2	365	14
			Funakaye	Bajoga East	2	431	16
				Ashaka/Magaba	3	547	21
Total				Tongo	6	893	34
					54	**10069**	**384**

Source: Number of Respondent from ADP (2016)

3. Methods

In order to determine the socioeconomic factors influencing the adaptation of indigenous strategies, the binomial/binary logistic regression model was adopted. The binomial logistic regression predicts the probability that an observation falls into one of two categories of a dichotomous dependent variable based on one or more independent variables that can be either continuous or categorical. Binomial logistic regression estimates the probability of event occurrence. If the probability is less than 0.5 the event is not occurring. The input in logistic regression analysis is often coded as 1 or 0, where (1) implies that the outcome of a finding is true and (0) indicates that the outcome of the finding is false. If P in the equation is the probability that an outcome is 1, the logic regression model can be expressed as:

$$\text{Logit [P(outcome)]}=\left[\frac{P(outcome)}{1-P(outcome)}\right]=\{\beta_0+\beta_1+X_1+\beta_2X_2+\beta_3X_3\ldots..\beta_pX_p\}\ldots\ldots\ldots\ldots(3)$$

The probability of obtaining the outcome of the model is by exponentiating both sides of the equation as:

$$\left[\frac{P(outcome)}{1-P(outcome)}\right]=\exp\ \{\beta_0+\beta_1+X_1+\beta_2X_2+\beta_3X_3\ldots..\beta_pX_p\ \}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

P is the expected probability that an outcome has the potential of being true or false. X_1, X_2, X_3, up to Xp are independent variables that predict the outcome of P; β_0, β_1, β_2, up to βp are regression coefficients of the independent variables. To predict the odd outcome of an

event with a known characteristic, substitute the applicable values into the independent variables and take the log of the expected outcome of the odds; this is expressed as:

$$\text{Ln}\left[\frac{PX}{(1-p)}\right] = \beta_0+\beta_1+X_1+\beta_2X_2+\beta_3X_3\ldots.\beta_pX_p \quad (5)$$

From the model equation, PX represents the probability of the indigenous people being influenced by certain factors to adapt to climate change and (1-P) represents the probability of not adapting to climate change. The binary logit regression model was used to analyse the socioeconomic factors affecting the use of indigenous adaptation strategies to climate change in Gombe state, the decisions were: Use of local adaptation strategies (1) or not used of local adaptation strategies (0). The dependent variable is dichotomous that is adapt the local method or not adapt the local method while the independent variables were age, sex etc.
Logit model can be specified as;

$$\text{Log}\,(P_1) = (\alpha_k\, X_i + U_i) \quad (6)$$

Equation (6) is a Log adaptation function which reveal the log adaptation that access to credit, income, education and awareness,
Pi = 1 if adapt < Z and
Pi= 0 if otherwise β_k

α_k vector of parameter to be estimated
X= vector of explanatory variable (adaptation estimate) vector to be estimate or correlated.

Z= Cumulative of adaptation by the indigenous people in the study area

$$\text{Expoc} = \beta_0+ \beta_1\,\text{AG} + \beta_2\,\text{SX} + \beta_3\,\text{EDU} + \beta_4\,\text{MCS} + \beta 5\text{AC} + \beta 6\,\text{AES} + \beta_7\,\text{ACC} + \beta_8\,\text{I} + \beta_9\,\text{FS} + \beta_{10}\,\text{YFE} + U_i \quad (7)$$

Where, Expoc is average per adaptation strategies in practice

Y= Adaptation strategies = expoc on the indigenous people.

Dependent Variable: Expoc = Adaptation or not adaptation

Independent Variable;
AG = Age (years)
SX = Sex (Male = 1, Female = 0)
these will increase and improve their socioeconomic characteristics of X, where

EDU = Education (Educated = 1, Non Educated = 0)
MCS = Membership of Cooperative Societies (Member = 1, Non Member = 0)
AC = Access to Credit (Yes = 1, No = 0)
AES = Access to Extension Services (Access = 1, No Access = 0)
ACC = Awareness of Climate Change (Aware = 1, Not Aware = 0)
I = Income (Naira)
FS = Family Size (Numbers)
YFE = Years of Farming Experience (Years)
β = Coefficient of explanatory variable
U_i = Error Term
β_0 = Constant intercept
$\beta_1 - \beta_{10}$ = Parameters to be estimated

The Exp (B) is the exponential coefficient (Table 1.4). The exponential coefficient is the odds ratio. That is, it is a constant multiple associated with the odds of "success" associated with one unit change in the covariate. An Indigenous Adaptation Strategies (IAS) = Socioeconomic characteristics of the respondent (sex,

education, belonging to cooperative societies, access to credit, access to extension services, awareness of climate change, income and family size).Used Indigenous Adaptation Strategies = f (sex, education, belonging to cooperative societies, access to credit, access to extension services, awareness of climate change, income and family size).

The binary logistic model considers the relationship between binary dependent variables (adapt or not adapt) and many independent variables (age, sex, education). Many authors like Hassan and Nhemachena (2008), Gadédjisso-Tossou, (2015), Muzamhindo et al., (2015), Shikuku, et al., (2017), and Fagariba, Song and Baoro (2018) used this method to analyse socio-economic factors affecting adaptation in climate change studies.

4. Results and Discussion

4.1 Socio-Economic Characteristics of the Respondents

This section examines some of the socio-economic statuses of the respondents. Majority of the respondents (64%) fall between age's brackets 40 - 49, those between ages 50-59 constitute (15.1%) while those above 60 years constitute over (20.9%). This indicates that all the respondents are old enough to understand the changes in the behaviour of climatic variables of the past to the present. This finding is in line with the findings of Abaje and Jeje (2016) who reported that ages 41-50 (74.7%) were the highest age brackets among the respondent. The gender distribution of the respondent; about (70.3%) of them were male while (29.7 %) were female (Table 1.2), this results coincide with the findings of Abaje and Jeje (2016) where they reported more male respondent than female and Onyegbula (2017) who reported having more male than female respondent. Considering the marital status of the respondent, about (64.3%) of them were married and (27.3%) were single while (8.4%) of them constitute widowed and widower. Majority of this respondent married, this means that they are responsible because in an African setting any married person is responsible. Out of the 384 respondents (22.4%) have no formal education, (35.7%) attended primary school education and (27.3%) have secondary education while (14.6%) have tertiary education. This result concur with the findings of Onyegbula (2017) who reported that there were more respondent with formal education, this means that mass literacy education was effective in the studied areas. Household size may influence the adaptation of indigenous strategies, about (34.1%) of the respondent have less than five (5) member which is the largest in the group, (33.6%) have about 6-10 members of household, (17.4%) of the respondent have sixteen (16) and above which is the largest size in the group while (14.8%) were those who ranges from 11-15 members of household.

Table 1.2: Socioeconomic Characteristics of the Respondents

Respondent Characteristics	Frequency	Percentage %
Age		
40-49	246	64.0
50-59	58	15.1
60-69	43	11.2
≤ 70	37	9.7
Sex		
Male	270	70.3
Female	114	29.7
Marital Status		
Married	247	64.3
Widowed	26	6.80
Single	105	27.3
Widower	6	1.60
Education		
Non-formal education	86	22.4
Primary	137	35.7
Secondary	105	27.3
Tertiary	56	14.6
Family Size		
≥ 5	131	34.1
6-10	129	33.6
11-15	57	14.8
≤ 16	67	17.4
Number of Farm Land		
1	74	19.3
2	152	39.6
3	78	20.3
4	58	15.1
≥ 5	22	5.70
Farm Size		
≤1 ha	57	14.8
2-3 ha	99	25.8
4-5 ha	66	17.2
≥ 6 ha	162	42.2
Distance to the Farm		
≤ 1	40	10.4
2-3 km	68	17.7
4-5 km	69	18.0
≥ 6 km	207	53.9
Total	**384**	**100**

Source: Field survey, 2018.

Acquiring farmland is a vital assess in the indigenous setting, most of the respondent (39.6%) have two (2) number of farmlands followed by those with three (3) number of farmlands constitute (20.3%) and those with one (1) farmland constitute (19.3%) followed by the respondent who own four (4) number of farmland constituting (15.1%) while those with five (5) numbers of farmland and above constitute (5.7%). The results revealed that more than have of the respondent own between two (2) and three (3) number of farmland, which constitute (59.9%). Having less number of farmlands will encourage them to focus on the once they have and to attend maximum productions.

4.1.1 Belonging to Cooperatives, Length of Farming Experience, Access to Credit and Types

Assessing the respondent membership to social societies such as association and cooperatives organization. These kinds of societies have a way of informing its members about certain environmental challenges like climate change, landslide and the rest. Majority of the respondent (71%) belong to cooperative organizations while (29%) of them did not belong to any societies (Figure 1.2). Most of the people join the cooperatives societies because of what they will gain from either government or NGOs.

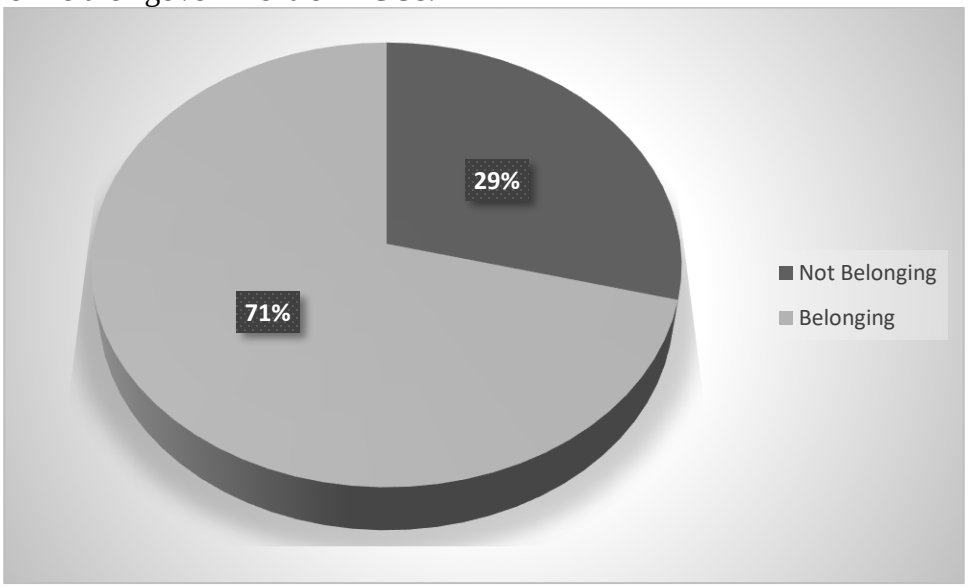

Figure 1.2 Belonging to Cooperatives
Source: Field survey, 2018

Duration of the farming period help the people to understand certain changes in the climatic variable and to developed strategies to cope with it. Most of the respondent have 21-30 years of farming experience, followed those with 15-20 years, 31 years and above while those with less than 15 years were the least (Figure 1.3).

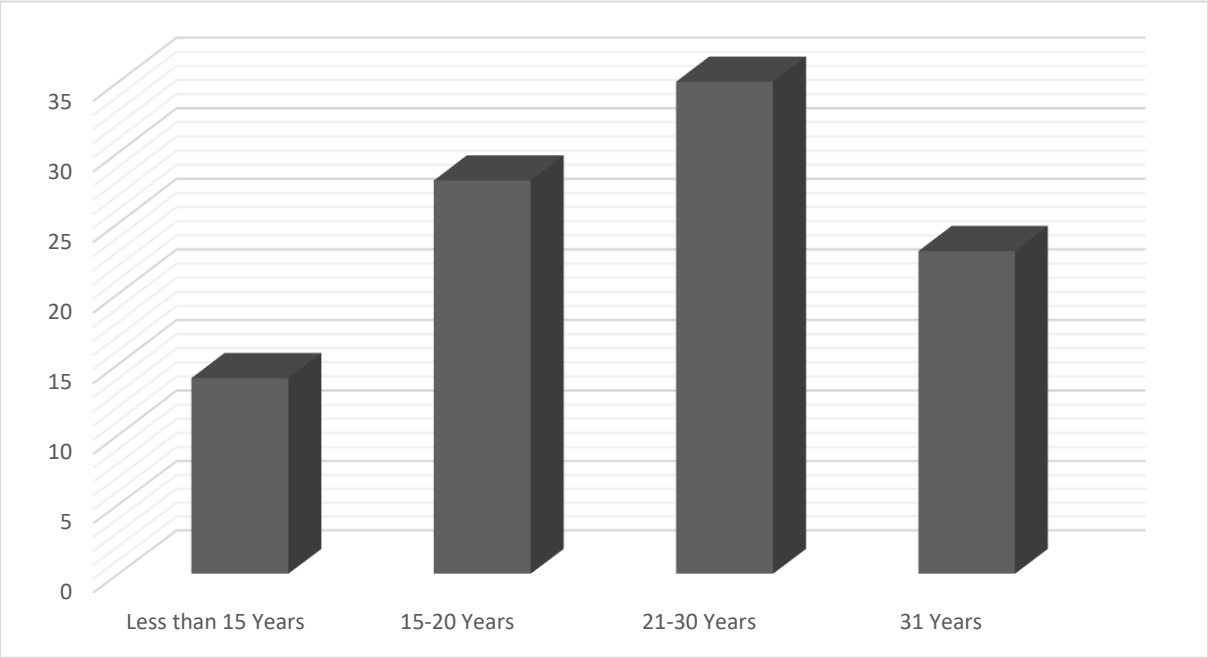

Figure 1.3 Length of Farming Experience
Source: Field survey, 2018.

The respondent access to credit is very important in influencing local adaptation to climate change or not. About (76%) of the respondent have access to credit facilities while the majority of them (24%) have no access to credit facilities, these may go a long way in determining their adaptation strategies (Figure 1.4).

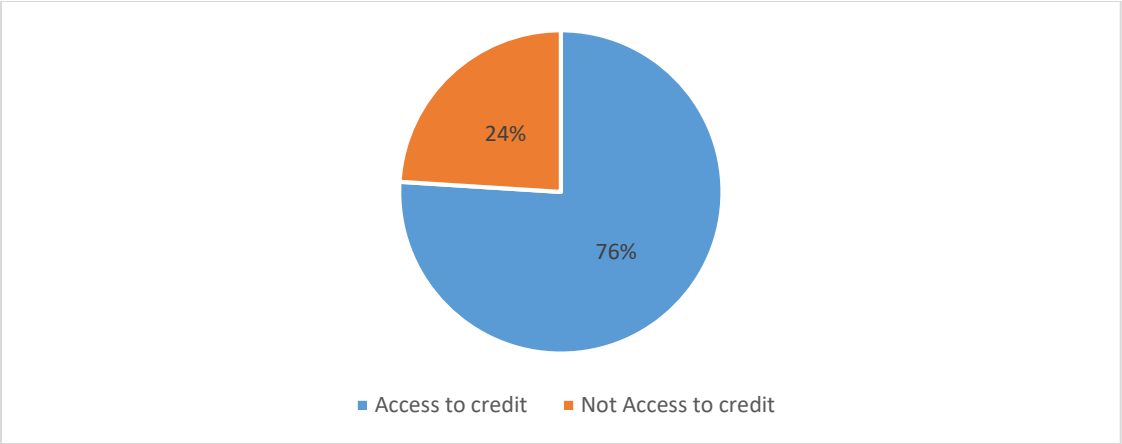

Figure 1.4 Source of Credit
Source: Field survey, 2018.

The people do not patronize the formal means of obtaining credit for their livelihood that is why the majority of them engage in another source of funds, followed by co-operative loan then microfinance loan while food security soft loan was the least among them. Other means of funds include *Badaka* (meaning collecting money from someone that the money will be quantified with the price of the farm produce in the market at that time, then after the harvest the farmer will bring double of amount of money collected or the farm produce (Figure 1.5). For example if the price of one bag of maize is ₦ 7000 at the time of collection, after the harvest the farmer will either bring ₦14,000 or two (2) bags of maize.

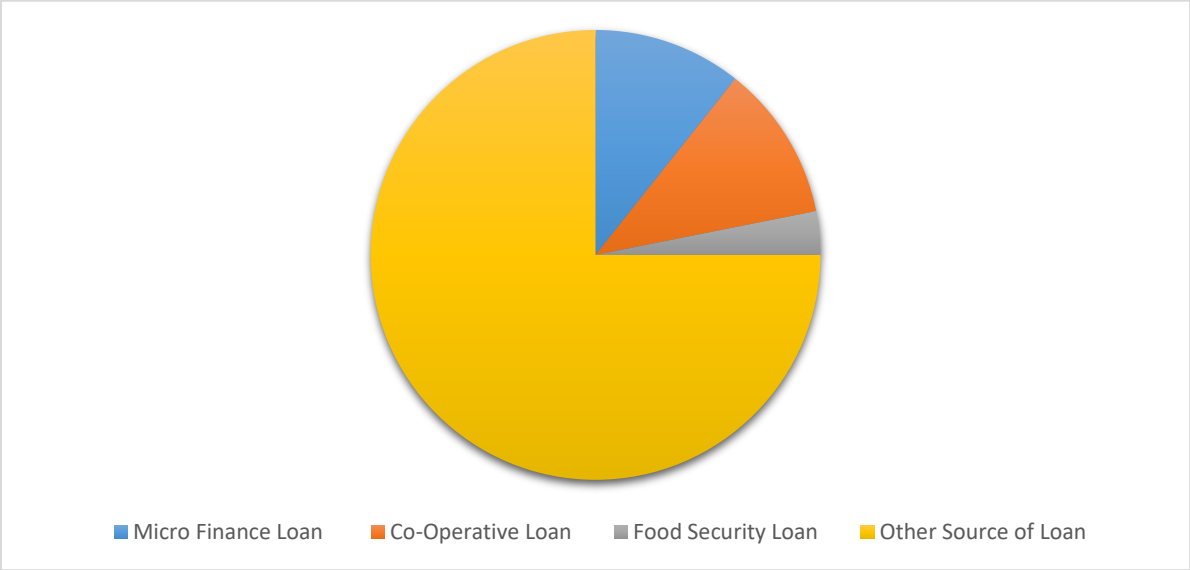

Figure 1.5 Types of Credit
Source: Field survey, 2018.

4.1.2: Extension Visit, Awareness, Source of Awareness, Knowledge of Climate Change and Income

Access to extension service goes a long way of informing people about the current changes and improvement in agricultural practices. Results from(Table 1.3) reveals that majority of the respondents (272) which constitute (70.8%) had not visited any extension agents, while only about (112) of the respondent constituting (29.2%) had visited extension agents. This study is in line the findings Adebayo et al., (2012) noted that majority of the respondent had no contact with extension agents.

Table 1.3 Extension Visit and Awareness of Climate Change

Variables	Frequency	Percentage
Extension Visit		
Visited	112	29.2
Not Visited	272	70.8
Awareness of Climate Change		
Aware	320	83.3
Not Aware	64	16.7
Total	**384**	**100**

Source: Field survey, 2018.

Awareness of climate change help the people to plan their lives with the current uncertainty of climatic variables, even though there are poor extension services in the study areas, but the people device a means of understanding the changes within their environment. About (320) respondents who constitute (83.3%) were aware of climate change while about (64) respondent constituting (16.7%) were not aware of climate change (Table 1.3). The finding is in line with the result of Adebayo *et al.*, (2012) who reported that more respondents were aware of climate change than those that are not aware

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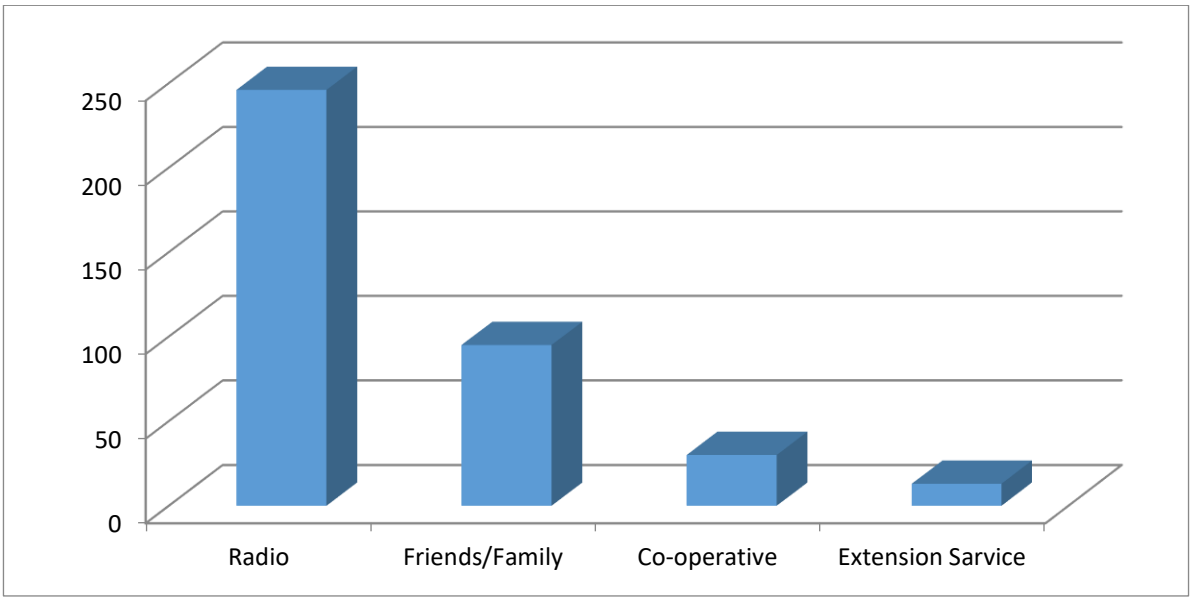

Figure 1.6 Source of Information about Climate Change

Source: Field survey, 2018.

A large number of the respondent obtained their information about climate change through radio, followed by who had their information from friends/family then those who belong to a co-operative society while those who had their information from extension workers were the least Figure 1.6.

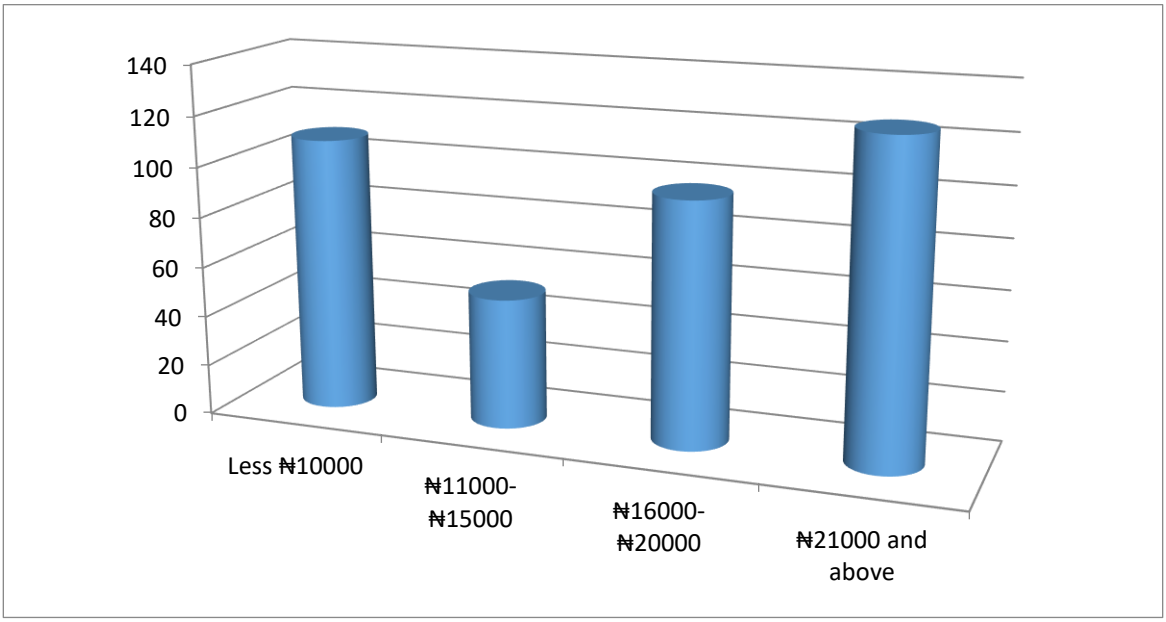

Figure 1.7 Amount of Income Realized Per Month
Source: Field survey, 2018.

The respondent have varied amount of income per month, the highest amount of income received is ₦21000, followed by those who earn less than ₦ 10000, followed by those who earn ₦16000 - 20000 and those who earn ₦11000 – 15000 were the less among the respondent. Having more income will influence the adaptation to climatic changes in (Figure.1.7).

5. Factors Affecting Adaptation

Dependent Variable = Indigenous Adaptation Strategies (IAS)
Independent variable = Age, Sex, Education, Belonging to cooperative societies, Access to credit, Access to extension services, Awareness of climate change, Income and Family size.

Table 1.4 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	319.340[a]	.051	.087

The overall model fit in logistic regression is the likelihood ratio test. It is the chi-square difference between the null model (i.e., with the constant only) and the model containing the predictors. From the Model Summary (Table. 1.4) -2 Log Likelihood statistics is 319.340.The statistic measures how poorly

the model predicts the indigenous people adapt the local strategy in adapt status, the smaller the statistic the better the model. Cox and Snell's R^2 attempts to imitate multiple R^2 based on likelihood. The result of Cox and Snell R2 indicates that 5.1% of the variation in the dependent variable is explained by the predictor variable (Table. 1.4). The estimation terminated at iteration number 5 because parameter estimates changed by less than .001

Table 1.5 Goodness of fit (Model Diagnostic)

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	9.654	8	.290

Source: Authors Computation, (2019)

Result presented in (Table 1.5) revealed that the P-value is 0.290, which is greater than the level of significance at 5%. We can conclude that the data used fits the model. Since the p-value is 0.290 which is insignificant. Therefore, our fitted logistic regression model is good fit. From the regression result presented in (Table 1.5), the findings revealed that there is a functional relationship between the independent and dependent variables.

Table 1.6 Binary Logistic Regression Model Results of Factors Influencing the Choice of Indigenous Adaptation Climate Change

Variable	β	S.E.	Wald	df	Sig.	Exp (β)	Probability
Age	0.184	0.367	0.252	1	0.616	1.202	0.5450
Sex	-0.278	0.333	0.697	1	0.404	0.757	0.4308
Educational Status	0.627	0.479	1.718	1	0.190	1.873	0.6519
Cooperative Society	0.689	0.371	3.449	1	0.063*	1.992	0.6657
Access to Credit	0.011	0.419	0.001	1	0.979	1.011	0.5027
Access to Extension	-0.485	0.403	1.451	1	0.228	0.615	0.3808
Climate Change Awareness	0.073	0.482	0.023	1	0.880	1.075	0.5180
Income	-0.883	0.364	5.890	1	0.015**	0.413	0.2922
Family Size	0.180	0.337	0.287	1	0.592	1.198	0.5450
Years of Farming Experience	-0.776	0.291	7.104	1	0.008**	0.460	0.3150
Constant	2.261	0.540	17.52	1	0.000***	9.589	0.9055

Source: Authors Computation, 2019.

*Significant at 10% level
** Significant at 5% level
***Significant at 1% level

There is a positive relationship between belonging to cooperative society and IAS. Been a member of cooperative society encourages more indigenous adaptation strategies than not been a member. The Beta (β) coefficient for cooperative is (0.689), the Exp (β) is (1.992) and the p-value is (0.063) which is significant at 10% (Table 1.6). This result implies that belonging to cooperative has the probability of influence the choice of

IAS at (66.57%) (Table 1.6). These findings do not agree with the results of Gadédjisso-Tossou (2015) pointed out that belonging to cooperative society like farmers clubs does not influence the adaptation to climate change while Shikuku et al., (2017) noted that belonging to group membership enhanced adaptation.

There is a negative relationship between income and IAS. The Beta (β) of the coefficient of income is (-0.883), the Exp (β) is (0.413) and the p-value is (0.015) which is significant at (5%). From the probability component of the table, income contributes (29.22%) to IAS (Table 1.6). This could be because most of the IAS are locally sourced. Income has a negative relationship with the choice of adaptation to climate change (Muzamhindo et al., 2015) while (Temesgen et al., (2014) noted that household income has positively and significantly influence adaptation options.

The relationship that exist between years of farming experience and IAS is negative with a Beta (β) coefficient of (-0.776), the Exp (β) is (0.460) and the p-value is (0.008) which is significant at 1%. A probability of (31.50%) implies that farming experience does not influence the choice of IAS (Table 1.6). This could probably because IAS is a new concept and has no connection with previous practices. This result does not agree with the result of Hassan and Nhemachena, (2008) reported more years of experienced are more likely to adapt the strategies than the less experienced and Gadédjisso-Tossou (2015) observed that experience increases the probability of adopting changes in climatic conditions

6. Conclusion

The study conclude that income and years of farming, experience does not influence the adaptation of IAS. Education, age of the respondent, family size, climate change awareness and belonging to cooperative society have over (50%) probability of influencing local adaptation strategies. Belonging cooperative society, household income and years of farming experience were the significant factors affecting the choice of indigenous adaptation strategies to climate change.

7. Recommendation

The study recommends that the indigenous people should developed more local adaptation strategies peculiar to the existing problems. Other socioeconomic factors influencing the choice of indigenous adaptation strategies should be examined.

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