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RESEARCH ARTICLE

DETERMINANTS OF FACTORS INFLUENCING ADOPTION OF CLIMATE CHANGE ADAPTATION PRACTICES (CCAPS) AMONG FARMERS IN DUTSIN-MA AGRICULTURAL ZONE OF KATSINA STATE, NIGERIA

Edoka M. H.[1], Idris M. K[2] and Adiel K. B.[2]

1. Dept. of Agricultural Extension and Rural Development, Faculty of Agriculture, Federal University Dutsin-Ma, P. M. B. 5001, Katsina State, Nigeria.

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Abstract

The study was carried out in Dutsin-Ma agricultural zone of Katsina state, Nigeria. A total of 281 registered farmers were randomly drawn from three Local Government Areas (LGAs) of the zone. Data were collected using a well-structured questionnaire administered to the selected respondents. Both descriptive statistics (frequency distribution s, percentages, and means) and inferential statistics (Tobit regression) were used to analyse the data collected. The findings revealed that, majority (85.7%) of the respondents were males with a mean age of about 44 years. Majority (82.0%) were married with a mean household size of six persons, while more than half (57.1%) had farm size between 1-3 hectares, with a mean farming experience of about 15 years. Majority (63.6%) had extension contact, while more than half (55.8%) belonged to cooperative societies. Drought-resistant varieties (73.3%), use of organic fertilizers (65.4%), and agroforestry (45.2%) were some of the adaptation strategies adopted by the respondents. Acc ess to credit (P=<0.000), extension contact (P=<0.000), cooperative membership (P=<0.000), income diversification (P=<0.035), and educational level (P=<0.024) were found to be statistically significant factors determining the adoption of climate change adaptation practices by the respondents.The study therefore recommended that; climate change adaptation infrastructure should be provided by government and other stakeholders in the agricultural sector to farmers at affordable prices to enable their access with ease andextension services should be further intensified to provide the necessary training and other services needed by farmers, government and private extension service providers should be made to enforce this.

Introduction:-

Agriculture sustains food security and livelihoods but faces rising pressures from the growing population, dietary shift toward meat, and competition for land, water, and energy (Singh, et. al., 2024). The increased intensification to

Corresponding Author:- Edoka M. H
Address:-Dept. of Agricultural Extension and Rural Development, Faculty of Agriculture, Federal University Dutsin-Ma, P. M. B. 5001, Katsina State, Nigeria.

meet human food needs make agricultural sector one of the largest contributors to global greenhouse gases (GHGs) emissions, such as methane (CH_4), nitrous-oxide (N_2O), and carbon-dioxide (CO_2) - accounting for 10-24% of anthropogenic totals (Soegoto, et. al., 2025).Agriculture is therefore, highly vulnerable to climatic change, which disrupts yields, livestock health, and ecosystem stability (Boccan, 2025). Agriculture is both a driver and a victim of climate change, contributing significantly to global greenhouse gas (GHG) emissions while being highly vulnerable to its impacts (Mohammed, et. al., 2025). The aforementioned has led to increased disruption of agricultural productivity, livelihoods, and food security due to rising temperatures, altered rainfall, and extreme weather events (Mohammed, et. al., 2025). Yield decline accelerates once thermal thresholds crossed, as heat stress reduces grain filling and water use efficiency (Tian, et. al., 2023). The adoption of climate-smart agricultural practices (CSAPs) therefore, becomes the major option to avert this ugly trend in farm operations.

The adoption of climate-smart agriculture (CSAPs) among smallholder farmers is influenced by a combination of socio-economic, institutional, and environmental factors. Socio-economic characteristics such as farmers' age, level of education, farm size, household income, and farming experience play a significant role in determining the likelihood of adopting new agricultural innovations. Studies indicate that younger farmers with higher education levels are more likely to adopt climate change adaptation practices because they are more receptive to new technologies, better able to understand climate information, and more willing to take calculated risks (Shiferaw, et. al., 2023). Access to financial resources and credit facilities is another critical factor influencing adoption of climate adaptation practices. Farmers with sufficient income or access to loans are better positioned to invest in improved seed varieties, irrigation systems, and organic fertilizers, which are often required for effective implementation of CSA practices. Conversely, resource-poor farmers face constraints that limit their ability to adopt even low-cost adaptation strategies, highlighting the importance of targeted credit schemes and subsidies in enhancing adoption rates (Adeleke, et. al., 2021).

Studies equally show that, institutional support such as extension services significantly affect adoption of climate change adaptation practices. Farmers who receive regular guidance, training, and information from extension agents or agricultural cooperatives are more likely to implement climate-smart agriculture practices successfully. Extension services provide technical knowledge, demonstrate best practices, and offer updates on weather forecasts and pest management, all of which build farmers' confidence and capacity to adopt CSA (Obayelu, et. al., 2019). Similarly, membership of farmers' cooperatives or social networks facilitates access to collective resources, knowledge sharing, and community-based adaptation strategies. Access to climate information services (CIS) and early warning systems further influences adoption decisions. Farmers who can obtain timely and reliable information on rainfall patterns, temperature fluctuations, and potential hazards are more likely to adjust planting dates, select appropriate crop varieties, and implement water management strategies. Research in northern Nigeria has shown that households with greater exposure to climate information adopt more CSA practices, thereby enhancing their resilience to climate variability (Lawal, et. al., 2024).

Agboola, et. al., (2023) assert that, cultural beliefs, risk perception, and local knowledge can either facilitate or constrain adoption. In some communities, traditional farming practices are deeply rooted, and innovations may be perceived as risky or incompatible with local conditions. Farmers' perception of climate risks and the expected benefits of CSA practices directly affect their willingness to adopt these strategies. Therefore, interventions aimed at increasing adoption must integrate local knowledge, address perceived risks, and demonstrate tangible benefits to encourage wider uptake (Agboola, et. al., 2023). Recent climate data revealed alarming trends in the region, such as: erratic and shortened rainy seasons, prolonged droughts, higher temperatures, increased desertification, and a rise in the frequency and intensity of extreme weather events (Adeleke, et. al., 2021). These climatic changes have led to declining soil fertility, unpredictable planting seasons, increased pest infestations, and significant yield losses, thereby undermining food security and household income for maize farmers in the area (Usman & Ibrahim, 2021).
The import of various climate change adaptation practices such as drought-resistant seeds, soil conservation techniques, agroforestry, and small-scale irrigation adopted by farmers in the study area to mitigate these challengesremains relatively low. Factors such as low adoption rates include limited access to climate information services, poor dissemination of adaptation technologies, inadequate extension support, lack of financial capital, and socio-cultural resistance to innovation (Obayelu, et. al., 2019; FAO, 2018)impair effective adoption of climate change adaptation practices. This study therefore looked into the factors influencing the adoption of climate change adaptation practices among farmers in Dutsin-Ma agricultural zone of Kastina state, Nigeria.

Methodology:-

Description of the Study Area:-

The study was carried out in the Dutsin-Ma Agricultural Zone of Katsina State, Nigeria. Dutsin-Ma is one of the three agricultural zones in Kastina state and is strategically located within the Sudan-Savanna ecological belt, which provides favorable climatic conditions for the cultivation of cereal crops, particularly guinea corn, maize, rice, etc. The Dutsin-Ma Agricultural Zone comprises ten (10) Local Government Areas (LGAs), namely: Kurfi, Safana, Batsari, Kankia, Musawa, Ingawa, Kusada, Matazu, Sandamu, and Dutsin-Ma. Geographically, the zone lies between latitude 12°27"N and longitude 7°29"E, with an annual rainfall ranging between 800 mm and 1,000 mm and an average temperature of 26°C to 35°C. These conditions are suitable for cereal production both as a subsistence and cash crop. Most farmers in the zone operate as smallholders, cultivating between 1 to 5 hectares, while a few commercial farmers manage farms exceeding 10 hectares.The LGAs within the Dutsin-Ma Agricultural Zone are recognized for their vibrant farming communities and intensive grain production. Farmers employ a mix of traditional and modern farming techniques, ranging from manual land preparation and animal traction to mechanized systems involving tractors, improved crop varieties, and the application of inorganic fertilizers.In recent years, however, these farming systems have come under increasing threat from the adverse effects of climate change, including erratic rainfall, prolonged dry spells, and declining soil fertility. These challenges have led to reduced crop productivity and heightened food insecurity. In response, climate change adaptation practices (CCAPs) such as the adoption of drought-tolerant crop varieties, water harvesting, agroforestry, crop rotation, and soil conservation methods are being gradually introduced through the support of agricultural extension services, non-governmental organizations (NGOs), and government intervention programmes.

Sampling Technique and Sample Size:-

The sample size for this study was determined using Yamane's (1967) formula:

$n = N/1+N(e)^2$

$$n = \left(\frac{N}{1} + N(e)2\right)$$

Where:

n = Sample Size
N = sample frame
e = error term (level of precision or 0.05)

Multi-stage sampling technique was used for the study. At stage 1, Dutsina Agricultural zone was purposively selected for the study due to the intensity of agricultural activities in the area. At the 2nd stage, three Local Government Areas (LGAs) noted for high level of farm production were randomly selected, these were Kurfi, Kankia, and Safana. At the 3rd stage, three communities were randomly selected from each LGA hence making a total of nine communities for the study. At the 4th stage,a list of 3, 017 registered maize farmers obtained fromKatsina State Agricultural and Rural Development (KTARDA)constitute the total sample frame (N) for the study. Taro Yamanne formula was used to determine the sample size (n) of 281. At the 5th stage, proportionate sampling technique was used to select the respondents from each of the communities sampled. Structured questionnaire was designed and administered to the respondents for data collection.

Table 1: Sampling Procedure and Sample Size

LGAs	Communities sampled	No. of registered farmers	Sample size
Kurfi	1. Birici	**200**	18
	2. Rawayau	**160**	15
	3. Kurffi A	**220**	20
Kankia	1. Guchi	100	9
	2. Rimaye	200	18
	3. Kafinsoli	150	14

Safana	1. Tsaskiya 2. Safana 3. Runka	663 556 768	62 52 73
TOTAL	**9**	**3,017**	**281**

Data Analysis:-
Both descriptive and inferential statistics were adopted to analyze the data collected. Descriptive statistics such as frequency distributions, percentages and means were used, while inferential statistics such as Tobit regression were used to measure the stated objectives of the study.

Model Specification:-
Tobit Regression Model:-
The Tobit regression model is implicitly represented below;
$Y = f(X_1+X_2+X_3+X_4+X_5+$ ----------- $X_{n+}\mu$ ------(Eq. 1)
The functional form is expressed explicitly as seen below;
$Y = bo + b_1X_{1\,+}b_2X_2+b_3X_3+ b_4X+ b_5X_5+$ ------------ $b_nX_n + \mu$ ------ (Eq. 2)
Where:
Y = Participation in APPEALs programme (Participation =1, Non-participation= 0)
X_1= Extension contact (Yes =1 No= 0)
X_2 = Income (₦)
X_3 = Membership of cooperative society (Yes = 1 No =0)
X_4 = Household size (Actual number of people living together under same roof)
X_5 = Farm size (Hectares)
X_6 = Farming experience (Years)
X_7 = Educational level (Years)
X_8 = Gender (Male =1 Female =2)
μ =Error term

Results and Discussion:-
Socioeconomic Variables of Respondents:-
Findings in Table 2 show the socioeconomic characteristics of the respondents.

Table 4.1: Socio-economic Characteristics of Maize Farmers (N=217)

Characteristic	Category	Frequency	Percentage (%)	Mean	Std. Deviation
Age (Years)	Below 30	28	12.9	43.7	10.2
	31–40	74	34.1		
	41–50	68	31.3		
	Above 50	47	21.7		
Gender	Male	186	85.7	–	–
	Female	31	14.3		
Marital Status	Single	19	8.8	–	–
	Married	178	82.0		
	Widowed	15	6.9		
	Divorced	5	2.3		
Educational Level	No formal education	67	30.9	–	–
	Primary	89	41.0		
	Secondary	48	22.1		
	Tertiary	13	6.0		
Farming Experience	Less than 5 years	22	10.1	14.5	8.3

(Years)					
	6–10 years	58	26.7		
	11–20 years	91	41.9		
	Above 20 years	46	21.2		
Farm Size (Hectares)	Less than 1 ha	41	18.9	2.8	1.9
	1–3 ha	124	57.1		
	4–6 ha	38	17.5		
	Above 6 ha	14	6.5		
Household Size	1–4 persons	63	29.0	6.2	2.4
	5–8 persons	112	51.6		
	Above 8 persons	42	19.4		
Access to Extension	Yes	138	63.6	–	–
	No	79	36.4		
Cooperative Membership	Yes	121	55.8	–	–
	No	96	44.2		

Source: Field Survey, 2025

According to the table, majority (85.7%) of the farmers were males with a mean age of about 44 years. Akinola and Adeyemi (2023) reported that, men dominate agricultural production in southwestern Nigeria due to stronger control over productive assets. Nearly half (40.1%) of the farmers had primary education, and 22.1% of the farmers had secondary education. More than half (57.1%) had farm size between 1-3 hectares with a mean farming experience of about fifteen years. Majority (63.6%) had access to extension services, while more than half (55.8%) of these farmers belong to cooperative societies. Adeagbo, et. al., (2021) reported positive correlation between extension contact and adoption decision of farmers. Extension contact influences farmers' adoption of climate change technologies positively.

Climate Change Adaptation Strategies Adopted by Farmers:-

Results in Table 3 reveal the various adaptations strategies adopted by farmers to cushion the effects of climate change.

Table 3: Distribution of respondents according to climate change adaptation strategies

Adaptation Practice	**Frequency**	**Percentage (%)**
Drought-resistant maize varieties	159	73.3
Organic fertilizers	142	65.4
Agroforestry or intercropping	98	45.2
Water harvesting techniques	74	34.1
Conservation tillage	63	29.0
Crop rotation	45	20.7

Source: Field Survey, 2025

The findings in Table 3 revealed that majority (73.3%) of the respondents adopted drought resistant crop varieties to adapt to climate change. In a related study carried out by Abubakar, et. al., (2025), more than half (58%) of maize farmers in Bauchi local government area of Bauchi state adopted improved crop varieties to mitigate the effect of climate change. Table 3 further show that 65.4% of the respondents applied organic fertilizers/manures instead of synthetic fertilizers like NPK or single super-phosphate (SSP). Application of organic fertilizers help to improve soil fertility, water holding capacity and increased microbial activities especially at the root zones. Agroforestry (45.2%) was fairly adopted, this could be due to arid nature of study area and the high cost of raising plant seedlings to maturity.

Factors Determining Adoption of Climate Change Adaptation Strategies:-

Some selected factors determining the adaptation to climate change by farmers in the study area are shown in Table 4.

Table 4: Binary Logistic Regression on Determinants of Adoption of Climate Change Adaptation Practices

Variable	B	S.E.	Wald	Odds Ratio (Exp(B))	p-value
Age	-0.012	0.018	0.445	0.988	0.505
Education Level	1.204	0.532	5.128	3.333	0.024*
Farm Size	0.156	0.132	1.397	1.169	0.237
Income Diversification	1.058	0.501	4.458	2.880	0.035*
Access to Credit	1.742	0.489	12.694	5.711	0.000***
Extension Contact	2.315	0.612	14.301	10.125	0.000***
Cooperative Membership	2.891	0.674	18.394	18.000	0.000***
Constant	-4.112	1.203	11.683	0.016	0.001***

Source: Field Survey, 2025; *=sig.@ 10%; **=sig.@ 5%; *=sig. @1%**

Membership of cooperative societies, extension contact, and access to credit were the major statistically significant factors influencing farmers' decision to adopt climate change adaptation practices. Cooperative society (B= 2.891) was significant at 1% (P= 0.000); implying that as farmers registered in cooperative society there is a likelihood that they will adopt more climate change adaptation strategies, while extension was equally significant at 1% (B= 2.315), which implies that, as farmers have extension contact there is a probability that farmers will adopt more climate change adaptation strategies. Abubakar, et. al., (2025) found out that, majority (75%) of maize farmers in Bauchi local government area of Bauchi state had extension contact. The import of extension contact could not be overemphasized, as farmers are exposed to modern adaptation practices, exchange innovative ideas, and participate in training that can bring about improvement in their practices and livelihoods. Access to credit (B=1.742) and significant at 1% (P= 0.00) was fond to be another significant factor influencing adoption of climate change adaption practices. The result implies that as farmers have access to credit, more of climate change adaptation strategies will be adopted by farmers. Jibril, et. al., (2025) reported that, access to resources both informational and financial emerges as the most decisive factor shaping the uptake of climate-smart agricultural practices. The table also revealed that income diversification (B=1.058) and educational level (B= 1.204) were significant at 10% respectively, which equally serve as determinants of adaptation strategies to climate change.

Conclusion and Recommendations:-

Climate change is a critical phenomenon with strong implications for socio-ecological, biophysical, human systems, and human development (Tarki, et. al., (2025). The need to adapt to the effect of climate change is therefore apt to avert to its ugly effect. Agriculture which is the major backbone of Nigerian economy has been witnessing major downturn due to climate change. Farm yield have shriveled, and farmers' livelihood now nosedived leading to food insecurity and poverty. Adoption of drought-resistant crop varieties, use of organic fertilizers and agroforestry etc. were some of the adaptation strategies adopted by farmers in the study area to mitigate climate shocks. Several factors influenced the adoption of these adaptation strategies such as extension contact, membership of cooperative societies, and access to income.

This study therefore recommends that;

- Climate change adaptation infrastructure should be provided by government and other stakeholders in the agricultural sector to farmers at affordable prices to enable access with ease.
- Extension services should be further intensified to provide the necessary training and other services needed by farmers, government and private extension service providers should be made to enforce this.

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