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FARMERS' ADOPTION OF CLIMATE CHANGE MITIGATION STRATEGIES AND THEIR EFFECTS ON LIVELIHOODS IN KADUNA STATE, NIGERIA

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ABSTRACT

The study analysed Farmers adoption of climate change mitigation strategies and their effects on livelihood in Kaduna State, Nigeria. The study utilized a sample of 85 respondents, applying descriptive statistics to analyze the objectives and employing a binary logit model to test the first hypothesis. Results showed that the average age, household size, farm size, and farm experience was 38.06 years, about 8 persons, 2.52ha. and 12.76 years respectively. Most (41.18%) farmers rating on level of adoption of adaptive strategies was low and this negatively affected the farmers income. Also, the farmers respectively earned N463,176.48 and N329,623.52 before and during effects of climate change. Farmers experienced a loss difference of N133,552.96. Most (54.2%) farmers agreed that climate change has high effect on their livelihood status due to low adoption rate of climate change mitigation strategies. Several factors like poverty and hunger (mean = 3.59) and farmers health challenges (mean = 3.52) affected adoption of climate change mitigation strategies, coupled with socio-economic factors like age, education, household size, farm size and farm income significantly influence climate change mitigation strategies. Conclusively, the farmers encountered a loss amounting to N133,552.96 of farm income to climate change which resulted to low livelihood status of the farmers. It was recommended that there should be adequate provision of improved resistant varieties of crops and animals to the reach of the farmers and there should also be provision of adequate and timely information regarding climate change adaptive strategies to the farmers through their extension agents.

Key words: Climate change, mitigation strategies, level of adoption, livelihood status, farmers,
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INTRODUCTION

Our environment has for some time now been affected by serious changes in climatic factors like rainfall, sunshine, wind, humidity and temperature. The changes in these climatic factors have

resulted in climatic change, otherwise known as climate change. It exacts a negative effect to our environment as well as humanity as evident in the sharp decline of agricultural productivity. This has resulted in widespread hunger, malnutrition, disease among farmers, and increasing poverty, particularly in Nigeria and across Africa (Damian and George, 2020). Damian and George (2020) highlighted that climate change impacts on our society are undeniable, as evidenced by desertification, rising flood levels—most notably in 2012 and again in 2022—and the occurrence of drought. All -of these have in no small measure affected man, his animals and crops. The threat of climate change has intensified, significantly impacting on the savanna region of northern Nigeria. This has led to a decline in socioeconomic activities, with the northeast and northwest being the most severely affected (Akande, 2017). Akande (2017) also acknowledged that the menace of climate change has generally generated some adverse effects on the lives of rural poor farmers, worsen food insecurity situation and the farmers socio-economic status. Saiful et al. (2019) stated that farmers' understanding of climate change effects on agriculture is severely lacking and they expressed fears that if appropriate measures are not taken, the situation is even bound to worsen.

To tackle the challenges posed by climate change, various mitigation strategies have been proposed to mitigate its effects. To this end, Yakubu et al. (2022) noted that the use of mitigation strategies can vary between farmers and is influenced by several factors, including land and farm management practices, farmers characteristics, livelihood strategies and farm-specific conditions. Livelihood refers to the various means by which people sustain themselves, survive, and thrive. It reflects how individuals organize to transform their environment to meet their needs through the use of technology, labor, knowledge, power, and social relationships (Yashodhara and Narasimha, 2015). Yashodhara and Narasimha (2015) further noted that livelihoods are influenced by broader economic and political systems. Yakubu et al. (2022) strongly emphasized the importance of farmers understanding and implementing acquired knowledge to overcome the menace of climate change. The knowledge may involve adjusting planting dates, diversifying crops, implementing irrigation, and using climate-tolerant varieties (Jallason, 2019). Morton (2007) stated that smallholder farmers along line with their livelihood and farm output is as at today facing serious challenges, and the challenges have not only reduced farm products but has also remained a threat to an already bad situation of food insecurity emanating from the ravaging effects of disease and pest, post-harvest losses, lack of capital, etc. From the foregoing, it becomes important to suggest that stakeholders efforts should be focused on assisting smallholder farmers in identifying effective mitigation strategies for their production systems and such should be directed toward helping these smallholder farmers identify effective mitigation production systems that are capable of overcoming the menace of climate change.

Objectives of the study

On a general note, the study examined farmers' adoption of climate change mitigation strategies and their effects on livelihoods in Kaduna State, Nigeria. Specifically, the objectives include;

i. examines the socio-economic characteristics of the farmers

ii. assess farmers level of adoption of mitigation strategies to reduce effects of climate change

iii. determine effects of climate change on the Livelihood Status Index (LSI) of farmers

iv. assert the level of farmers livelihood status, and;

v. identifies perceived challenges militating against farmers' adoption of climate change mitigation strategies in the area of study.

Hypotheses of the study:

Hoi: Farmers' level of adoption of climate change mitigation strategies is not significantly influenced by their socio-economic characteristics.

Hoii: Farmers' level of adoption of climate change mitigation strategies is not significantly related with their livelihood status.

MATERIALS AND METHODS

Area of study

Kaduna State was the area of study. It is amongst the northern states of Nigeria. Located at coordinates 10°20'N and 7°45'E, the State covers an area of 46,053 km², making it the fourth largest in land area among the thirty-six states of the country. Kaduna city, one of the 23 local government areas (LGAs) is the capital of Kaduna State (Okwuokenye and Petu-Ibikunle, 2021). Kaduna State is also ranked as the third most populous State in the country with an estimated size of about 9,032,200 as at 2022 (Kaduna State, Nigeria Population Statistics, 2022). The State's has its population mostly (about 80%) engaged in agriculture and that they depend on for their livelihood (Okwuokenye and Petu-Ibikunle, 2021). Hausa language is the spoken language but the official language is English language.

Sampling procedure and sampling size of the study

The study employed multi-stage sampling procedure which consists of several steps. Firstly, 2 agricultural zones were randomly selected in the state: Kaduna North and Kaduna Central. Two local government areas (LGAs) were then randomly sampled from each of the zones, thus making it four (4) LGAs. They were Chikun and Kajuru LGAs from Kaduna Central, while Zaria and Makarfi LGAs were randomly sampled from Kaduna North (stage 2). In Stage 3, three towns were randomly selected from each corresponding LGAs, which included: Narayi, Chikun and Sabon-Tasha towns selected from Chikun LGA; Kutana, Magani and Tantatu towns were randomly sampled from Kajuru LGA. The randomly sampled town from Zaria LGA were Dambo, Limanchi and Kufena LGAs, while Meyere, Ruma and Gimi were randomly sampled from Makarfi LGA. Stage 4 involved the random sampling of eight farmers from each of the towns, with a focus on active farmers living within the community (these were sourced from the extension agents serving in the 4 LGAs of study). The process produced ninety-six (96) farmers that were used for the study.

Following this was the administration of the question instrument to the farmers (stage 5). This function was carried out by the researcher and trained enumerators. After this was the retrieval of the question instruments from the farmers. Out of the retrieved questionnaires, eighty-five (85), accounting for 88.54%, were deemed suitable for the study's analysis.

Validation of research instrument and source of data

Question instrument validity was ascertained using the face content method, while reliability was determined through test-re-test method. It produced correlation coefficient of r-value of 0.69 which implies high reliability level of the instrument.

The study utilized primary data, which were collected using a structured instrument that included a questionnaire and an interview schedule.

Data analytical technique

Descriptive statistics were employed to assess the study's objectives, with Objectives 1, 2, 3, and 4 analyzed using percentages and means. Objective 5 was analyzed with a 4-point Likert scale. The scale ranged from "strongly agree" (coded 4), "agree" (coded 3), "disagree" (2) and "strongly disagree" (coded 1). It produced a weighted mean of 2.50 and it was determined as follows: {4+3+2+1} / 4 = 2.50. This was used to judge if the farmers agreed to the perceived factors as challenges (if weighted mean = $\geq$ 2.50) or not (if weighted mean < 2.50). The farmers Livelihood Status Index (LSI) were determined by analysing the farmers income before and during this period of climate change and this was accomplished using the Livelihood Status Index (Mohammed et al., 2019). The index presented a list of 38 potential benefits derived from the increased production and income experienced before the onset of climate change impacts. It is believed that social benefits they may have been denied or deprived of can negatively affect their farming operation and productivity, discourage knowledge sharing, discourage their farming activity, destroy relationship among the farmers and their neighbours, reduce income generation activities and limit diversification and can even impoverish farmers the more in their farming activities. The drawbacks in where financial considerations are considered include: outflow of money, cash unavailability, less deposits made in the bank, human capital development, reduction or falling of skill, health, amidst other factors.

Livelihood index was obtained using the model as:

$$LSI = \frac{\text{Number of livelihood factors benefited by } i^{th} \text{ respondent}}{\text{Total number of livelihood benefits}} \quad \text{---------- (1)}$$

Where: LSI = Livelihood status index.

Livelihood status index ranged as indicated: $\leq$ 0.25 = Very low livelihood; 0.26 – 0.49 = Low livelihood; 0.50 – 0.75 = Moderate livelihood; and > 0.75 = High livelihood.

Inferential statistics were employed to analyze the hypotheses. Hypothesis one was analysed using version 4 of IBM – SPSS statistical software. This involved using a Binary Logit model to analyze hypothesis one. The level of adoption was measured as a binary variable, taking values of 0 and 1 which respectively implies non-adoption and adoption of climate change mitigation strategies. The binary Logit model is expressed as shown below:

$Y_i = \propto + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \text{-----} \beta_n X_n + \mu_i$ ----------(2)

Where:

Y_i = Farmers level of adoption of climate change mitigation strategies (Adoption = 1; non-adoption = 0)

$\propto$ = The constant term in the model

$\beta i - - - - - \beta n$= The coefficients of the regressors

Xi ----Xn = i^{th}term of the explanatory variables

μ_i = The error term

The Wald Chi-Squared Test was employed to evaluate the independent variables and their influence on level of adoption of climate change mitigation strategies. This test was to ascertain if a set of variables is collectively significant for the model and also determines the significance of each the variable functioning in the model. Variables in the model were specified as;

Y_i = Level of farmers adoption of climate change mitigation strategies (Adoption = 1; non-adoption = 0)

Y_1 = Gender (dummy: male = 1; female = 0); X_2 = Age (years); X_3 = Education qualification (No formal educ. = 1, Primary sch. = 2, Secondary sch. = 3, ND/NCE = 4, HND/B.Sc = 5, M.Sc. = 5); X_4 = Marital status (single = 1, married = 2, divorced = 3, widow(er) = 4); X_5 = Farming experience (years); X_6 = Household size (number of people staying and feeding together); X_7 = Farm size (ha.); X_8 = Religious affiliation (Christianity = 1; Muslim = 2; Traditionalist = 3); X_8 = Farm income (₦).

Hypothesis 2 was analysed using Pearson Product Moment Correlation (r). The correlation coefficient measures linear association between interval variables (Okwuokenye and Urhibo, 2019). The value ranges between -1 to +1, where an "r" value of +1 indicates a perfect positive relationship, and an "r" value of -1 signifies a perfect negative linear relationship between X and Y. The formula is specified as:

$$r = \frac{n \sum XY - (\sum X)(\sum Y)}{\left(\sqrt{n \sum X^2 - (\sum X^2)}\right)\left(n \sum Y^2\right) - \left(\sum Y^2\right)}$$ ---------- Eq. 3

Decision Rule: 'r' generates coefficient estimates (X) and standard errors (E). The alternative hypothesis is accepted if there is a statistically significant effect of the parameter estimate, X

(farmers' level of adoption of climate change mitigation strategies), on variable Y (effects on farmers' livelihood status) and that the standard error is less than half the value of the parameter estimates.

RESULTS AND DISCUSSION

Results on socio-economic characteristics of the farmers is presented in Table 1. It revealed that majority (83.53%) of the farmers were males, while female farmers constituted about 16.47%. The result suggests that farming in the area is predominantly male-dominated, likely due to the cultural belief that women should remain in purdah, leaving men to assume the farming responsibilities. The predominance of males in farming aligns with reports of Abdullahi et al. (2015) who ascribed such to the people's belief that females shouldn't be subjected to hard work. The farmers' average age was approximately 38 years, with the modal age group being 30–39 years, accounting for 31.76% of the farmers. This suggests that the farmers are young and active, which indicates they are likely performing well in their farming activities. This finding is consistent with Vabi et al. (2020), who reported a similar age range (36–60 years) for farmers in comparable areas. Analysis of the farmers' educational levels revealed that approximately 74% were literate, with the majority (50.59%) having completed primary school education. The results indicate that the farmers are literate, enabling them to read, understand, and adopt farming technologies with minimal assistance when necessary. Okwuokenye, et al. (2023) concurred with this finding as they asserted that the farming activities of literates are usually enhanced by their educational level.

Results further revealed that most (54.12%) of the farmers were married, indicating that they are responsible and also implying that they have extra hands to assist them in their farm work. Dominance of married farmers in the business of farming was reported by Audu et al., (2019) and so therefore in line with this study. The farmers had an average household size of about 8% persons, with most (43.53%) of them having 5 – 8 persons. About 18.82% and 37.65% were respectively less than 5 and more than 8 persons respectively. The farmers are implied to have a large household size. The result was in conformity with that of Audu et al., (2019) which described farmers as having large household size in similar area.

The results regarding farm size indicate that the average farm size was 2.52 hectares, with the majority (38.82%) of farmers cultivating land between 2.1 and 3.0 hectares. Since most of them are into farming area that is less than 4.0 ha, it implies that they are small-scale farmers. This finding is supported by Okwuokenye and Petu-Ibikunle (2021), whose finding revealed that farmers typically operate on small-scale farms, often less than 4 hectares. The farmers' experience in agriculture showed that the majority (37.65%) had between 10 and 14 years of farming experience, with an average farming experience of 12.76 years. Impliedly, it could be asserted that the farmers have good level of experience in the business of farming. Similar farming experience was established by the findings of Okwuokenye and Abdurrahaman (2022). In line with the farmers religious affiliation, most (60.00%) of the farmers were Muslims, while the others were

into the practice of other religion. The dominance of farmers in Islamic religion is likely to the connected to the fact that it is a major language of the people in the State.

Farmers level of adoption of mitigation strategies to reduce climate change

Farmers level of adoption of mitigation strategies to reduce climate change was also analysed (see Table 2). Results however showed that majority (41.18%) of them have low level of adoption of mitigation strategies to reduce climate change. The result implies that farmers level of adoption is low and this may be as a result of either they were not aware or that they just didn't have what it takes to implement climate change mitigation strategies to curb climate change menace.

On a dichotomous consideration (see Table 3), the farmers indicated a low level (89.41%) of adoption of mitigation strategies to reduce climate change. Results of this study contradicts findings of Mulwa et al. (2017), which reported a positive and major scale-up in farmers adoption level of agricultural technologies and climate change mitigation strategies.

Effects of climate change on farmers livelihood status

Table 4 illustrates the effects of climate change on farmers' livelihood status, which is presented in two sections: the impact of climate change on farm income before and after its effects were felt. The results indicated that prior to the effects of climate change, most (35.29%) farmers earned income ranging from ₦480,000 to ₦599,000. Conversely, as the impacts of climate change began to affect their farm output, the income of most (29.41%) farmers fell within the range of ₦360,000 to ₦479,000. Average income of the farmers before the effects of climate change was ₦463,176.48, while during the impacts, it decreased to ₦329,623.52. The difference in income levels amounted to ₦133,552.96, attributable to climate change and its effects on agricultural production.

Difference between farmers livelihood status before and during climate change effects

Table 5 presents effects of climate change on the livelihood status of respondents before and during impacts of climate change. Expressed in the result was the fact that, majority (61.18%) of the farmers reported having a low livelihood status. The other faction (38.82%) noted that their status level was high. The dominance of farmers with low livelihood status is perhaps connected to effects of climate change on farm output. Results of Emaziye et al. (2022) concurred with this result.

Farmers' perceived challenges militating against farmers adoption of climate change mitigation strategies

Several perceived challenges were identified to be limiting the farmers from adoption of the mitigation strategies advanced to them by the extension agents serving them. These perceived challenges as shown in Table 6 and have been outlined according to their weighted mean value. Results revealed that poverty and hunger (mean = 3.59), health challenges on the part of farmers (mean = 3.52), poor access to improved resistant varieties of crops, animals and agro-chemicals

(mean = 3.48), lack of information (mean = 3.31) and lack of capital/lack of access to capital (mean = 3.28). Some of the other challenges militating against the performance of farmers in adopting climate change mitigation strategies include; low number of extension agents to farmers (mean = 3.24), poor infrastructural development (mean = 3.28), lack of motivation on the farmers part (mean = 3.17), high prices of agricultural inputs (mean = 2.73) and lack of training on the farmers (mean = 2.54). Through personal communication, the farmers stressed that these challenges go a long way in preventing them from adopting mitigation strategies that are capable of alleviating effects of climate change on farm output.

It is no news that the hunger situation of the people of the country is increasing. The hunger and poverty situation of the farmers makes it difficult for the farmers to comply with climate change adaptation strategies advanced to them by the extension agents. This claim was supported by Mustapha et al. (2012) asserted that many of the challenges farmers face in adapting to climate change are linked to poverty. They also noted that issues such as HIV/AIDS and malaria have a detrimental impact on farmers from adapting new technologies that are capable to mitigate against climate change. Unavailability or insufficiency to resistant varieties of crops and species of animals and agro-chemicals as well as motivation of the farmers were agreed by Anselm and Taofeeq (2010) as factors affecting the farmers and their farming activities. The farmers attributed the poor performance of their farming activities to inadequate human capital development. Anselm and Taofeeq (2010) agreed with the result when he stated that human capital development must be improved if any positive outcome on farm production is expected from the adoption of climate change mitigation strategies.

Factors influencing farmers' adoption of climate change mitigation strategies

Socio-economic variables are analysed and the results are presented in Table 7. It shows that five out of the nine variables—age, educational level, household size, farm size, and farm income significantly influenced farmers' level of adoption of climate change mitigation strategies. The model exhibited an R^2 value of 0.594, indicating that the explanatory variables accounted for approximately 59% of the variance in variable Y. The variables are explained as follows:

Age of the farmers (B = -0.358, SE = 0.124, and Wald = 7.093) had a negative coefficient and it significantly influenced the level of adoption of climate change mitigation strategies. This indicates that the level of adoption decreases as farmers grow older. Furthermore, farmers that are younger in age are more susceptible to adopt climate change mitigation strategies. This finding is supported by Ogunpaino et al. (2021), who identified age as an influencer to Nigerian farmers' decisions regarding the use and adoption of these strategies. Farmers educational level had a B-value of 0.431, a standard error of 0.021, and a Wald value of 5.441. This positive relationship is an indication of it having influence on level of adoption of climate change mitigation strategies. This indicates that the more educated a farmer is, the greater their likelihood of being aware of available strategies to mitigate the impacts of climate change. The assertion is aligned with reports

of Ndanitsa et al. (2021), which expressed that a higher level of education enhances farmers' reasoning and enables them to adopt innovations that help to overcome evils of climate change.

Farmers' household size was another factor that influences their adoption of climate change mitigation strategies. The B-value, SE and Wald value was 0.517, 0.230 and 0.6.934 respectively. The variable was positively signed and significant to influencing adoption of climate change mitigation strategies. This implies that level of adoption tends to increase with household size, meaning larger households will likely adopt these strategies at higher rates. This finding is consistent with Raju (2019), who noted that an increase in farmers' household size leads to greater adoption of climate change mitigation strategies. Farmers farm size (B = 0.881, SE = 0.342 and Wald value = 4.003) was found to be a positive influencer to adoption of climate change mitigation strategies. It implies that the larger farmers farm sizes are, the more likely are the farmers going to adopt the mitigation strategies. Larger farms are likely to have higher investments and the farmers wouldn't want their investments to go down the drain like that. The result is consistent with Damian (2020) who concluded that farm size plays major role in influencing farmers use of adaptation strategies and that such strategies help the farmers in overcoming the evils associated with climate change. The farm income of farmers (B = 0.236, SE = 0.019, and Wald value = 10.036) was found as a positive and significant influencer to adoption of climate change mitigation strategies. The implication is that farmers with higher farm income would adopt climate mitigation strategies more than those with lower incomes. Having more income allows farmers to access the financial resources necessary to implement strategies against effects of climate change. The finding corresponds with results of Ojo and Baiyegunhi (2018), who identified farm income as a significant factor that promote farmers adoption of climate change strategies.

Relationship between farmers level of adoption of climate change mitigation strategies and livelihood status

Table 8 illustrates the relationship between farmers' levels of adoption of climate change mitigation strategies and their livelihood status. This was analyzed using the Pearson Product Moment Correlation. Level of adoption was assessed based on the Livelihood Status Index (LSI), which involved analyzing farmers' farm income before and during the period of climate change impact. The impact of climate change on farmers' production and income was significant, with an estimated production loss of approximately ₦133,552.96 attributed to climate change effects. The extent of loss is likely linked to a low adoption of climate change mitigation strategies, which has contributed to a diminished livelihood status of farmers. It could therefore be concluded that, level of adoption of climate change mitigation strategies significantly affects farmers' livelihood status. Increased adoption of these strategies would help mitigate the effects of climate change on farmers' livelihoods. The results indicated that half of the parameter estimate value for variable X (the level of adoption of climate change mitigation strategies) was 0.3317 (calculated as 0.6634 / 2 = 0.3317). This value (0.3317) exceeds the standard error value (0.2417) for variable X. This suggests that variable X is statistically significant in its effects on farmers' livelihood status.

Based on the results, the alternative hypothesis (that the level of adoption of climate change mitigation strategies by farmers is significantly related to their livelihood status) was accepted in favor of the null hypothesis. The correlation coefficient (r) was -0.5893, indicating a negative relationship, meaning that as the level of adoption of climate change mitigation strategies increases, the negative effects on farmers' livelihood status decrease. This finding is supported by Emaziye et al. (2022), who found that farmers experience significant losses due to the effects of climate change, which consequently lower their livelihood status. They also noted that these losses could be mitigated if farmers adopt effective climate change mitigation strategies.

CONCLUSION

The results revealed that the farmers level of adoption of climate change mitigation strategies was low and this resulted to respectively having a mean income of ₦463,176.48 and ₦329,623.52 before and during the manifestation of the effects of climate change on farm income. The farmers thus encountered a loss amounting to ₦133,552.96 of their farm production to climate change and this resulted to a low livelihood status of the farmers. Several factors limited the farmers from adopting the climate change mitigation strategies and it was also concluded that farmers level of adoption of climate change mitigation strategies was negatively significant to farmers livelihood status. The study recommended thus;

Poverty and hunger level of the farmers needs to be addressed by simply grouping them into cooperatives where they can be obtaining some benefits or interventions from the government and through the medium have their hunger level ameliorated and therefore begin to increase their adoption rate of climate change mitigation strategies.

There should be adequate provision of improved resistant varieties of crops and animals to the reach of the farmers and such should be accessible, provided at reasonable subsidized prices.

Provision of adequate and timely information should be made available to the farmers through their extension agents. The information should be equipped with relevant inputs and technical know-how to ease its use by the farmers.

REFERENCES

Abdullahi, A.J., Atala, T.K., Akpoko, J.G. & Sanni, S.A. (2015). Factors Influencing Smallholder Farmers Participation in IFAD Community Based Agricultural and Rural Development Project in Katsina State. *Journal of Agricultural Extension, 19*(2),93 – 105

Akande, A. (2017). Geospatial Analysis on Extreme Weather Events in Nigeria. (1985 - 2015), Using Self-Organizing Maps, *Advances in Meteorology*. Retrieved at: https://doi.org/10.1155/2017/8576150. On 12th, June, 2018

Anselm, A. E. & Taofeeq, A. A. (2010). Challenges of Agricultural Adaptation to Climate Change in Nigeria: a synthesis from the literature. *The Creative Commons Attribution*. Facts Reports PP. 1-11.

Audu, A.I., Sa'adu, M., Tunwari, B.A. & Adedeji, O.E. (2019). The economic analysis of yam production in Taraba State, Nigeria. *Journal of Agriculture and Life Sciences*. *3*(1),43 – 53

Damina, F.T. & George, A.A. (2020). Socioeconomic factors influencing farmers' specific adaptive strategies to climate change in Telensi District of the Upper East Region of Ghana, *Journal of Ecofeminism and Climate Change, 2*(2),106 - 112

Emaziye, O.P., Emaziye, O. & Ufuoma N. U. (2022). Economic implications of climate change effects and awareness level among arable crops farmers in south-south, Nigeria. *World Journal of Advanced Research and Reviews*. 2022, *16*(01), 320–326

Jallason, N.P. (2019). Climate change perceptions and attitudes of smallholder adaption in North-western, Nigeria Drylands. *Social Science, 8*(31) http://app.dimension.ai/details/publiction/pub.1111649369

Kaduna State – Wikipedia (2016). Kaduna State-Wikipedia. Retrieved at: *https://en.m.wikipedia.org.* On 12th September, 2019

Kaduna (State, Nigeria) - Population Statistics, Charts, Map and Location, 2022. Retrieved at: *http://citypopulation.de>php.ni.*. On 25th April, 2022.

Mohammed, U., Umar, I.S., Olaleye, R.S., Salihu, I.T., Tsado, J.H. & Pelemo, J.J. (2019). Effects of forest resources utilisation on livelihood of rural farming populace in Kogi and Niger States, Nigeria. *Journal of Agriculture and Environment, 15*(1),77 - 86

Morton, J.F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Science,* 104, 19680 – 19685. Retrieved at: *https://www.scrip.org*> reference. On 25th October, 2022.

Mulwa, C., Marenya, P. & Kassie, M. (2017). Response to climate change risks among smallholder farmers in Malawi: A multivariate probit assessment of the role of information, household demographics, and farm characteristics. *Climate Risk Management*, 16, 208 - 221

Mustapha, S.B., Undiandeye, U. C. & Gwary, M.M. (2012). The role of extension in agricultural adaptation to climate change in the Sahelian Zone of Nigeria. *Journal of Environment and Earth Science 2*(6),48 - 58

Ndanitsa, M.A., Adetunji, A.O., Mohammed, D. & Ndako, N. (2021). Effects of agricultural credit delivery on income of arable farmers in Niger State of Nigeria. *Journal of Agripreneurship and Sustainable Development, 4*(1),10 - 32

Ogunpaino, O.R., Zainab, O.U. & Jolaosho, S. (2021). Impact of climate change adaptation on household food security in Nigeria. *Sustainability, 13*(14),14 – 72

Ojo, T. & Baiyegunhi, L. (2018). Determinants of adoption strategies to climate change among rice farmers in South-Western Nigeria: A Multivariate Probit Approach. *A paper presented at the 30th International Conference of Agricultural Economics* on the 28th August, VANCOUVER.

Okwuokenye, G.F & Abdurrahman, A. (2022). Impact of rural-urban migration among youth farmers of selected rural areas of Kaduna State, Nigeria. *Journal of Agriculture and Environment, 18*(1),13 – 26

Okwuokenye, G.F. & Petu-Ibikunle, A.M. (2021). Assessment of adoption of agrochemicals by Cucumber farmers in selected Local Government Areas in Kaduna State, Nigeria. *ADAN Journal of Agriculture*, *2*(1),59-69

Okwuokenye, G.F. & Urhibo, F.A. (2019). Performance of the agricultural development programme in Delta South. *Taraba Journal of Agricultural Research. 7*(1),18 – 27

Okwuokenye, G.F., Nwandu, I.P. & Ogbonna, S.I. (2023). small-scale farmers participation in community-based extension organizations: implications for increased productivity, income and food security in Kaduna State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science. 16*(4),38 – 49.

Raju, G. (2019). Assessing the impact of climate change on Indian agriculture: Evidence from major crop yields. *Journal of Public Affairs*, 20, (e2040), 1 – 7. Retrieved at: *https://doi.org/10.1002/pa.2040*On 5th February, 2022

Saiful, I., Mohammad, H.K., Shamin, S. & Mahasin, M. (2019). Farmers knowledge on climate change effect on agriculture. *Scientific Research,* 10(3),56 – 73

Vabi, M.B., Abdulqudus, I.A., Angarawai, I.I., Adogoba, D.S. Kamara, A.Y., Ajeigbe, H.A. & Ojiewo, C. (2020). Adoption and Welfare Impacts of Pearl Millet Technologies in Nigeria. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Patancheru, Telangana-India. *Technical Working Document*. ISBN 978-93-86527-04-2.

Yashodhara, B. & Narasimha, N. (2015). Development of A Scale to Measure the Livelihood Status of Farmers. *Mysore Journal of Agricultural Science, 49*(2), 408 - 412

Yakubu, D.H., Shetima, D.A., Maidoki, M.L., Abubakar, HH.N. & Ali, M.B. (2022). Factors affecting use of indigenous climate change adaptation strategies by farmers in Wurno and Tambuwal Local Government Area of Sokoto State, Nigeria. *Proceedings of the 27th Annual Conference of the Agricultural Extension Society of Nigeria.* Theme: Enhancing of E-Agricultural Extension Systems, Data 26 – 28th September, 2022. PP. 4 – 16

Table 1: Socio-economic characteristics of farmers of the study. n = 85

Socio-economic variables	Categories	Frequency	Percentage	Mean/Mode
Gender	Male	71	83.53	
	Female	14	16.47	Male
Age	10 – 19	7	8.24	
	20 – 29	16	18.82	
	30 – 39	27	31.76	
	40 – 49	19	22.35	
	50 – 59	11	12.94	
	60 – 69	5	5.88	38.06
Educ. status	No formal educ.	22	25.88	
	Primary educ.	43	50.59	
	Secondary educ.	14	16.47	
	Tertiary educ.	6	7.06	Pri. educ.
Marital status	Single	20	23.53	
	Married	46	54.12	
	Divorced/Separated	13	15.29	
	Widow(er)	6	7.06	Married
Household size	1 – 4	16	18.82	
	5 – 8	37	43.53	
	9 – 12	21	24.71	
	13 - 16	11	12.94	7.77
Farm size	0.1 – 1.0	8	9.41	
	1.1 – 2.0	21	24.71	
	2.1 – 3.0	33	38.82	
	3.1 – 4.0	11	12.94	
	4.1 – 5.0	8	9.41	
	5.1 - 6.0	4	4.71	2.52 ha.
Farm experience	0 - 4	9	10.59	
	5 – 9	17	20.00	
	10 – 14	32	37.65	
	15 – 19	12	14.12	
	20 – 24	9	10.59	
	25 – 29	6	7.06	12.76 years
Religious affiliation	Islam	51	60.00	
	Christianity	18	21.18	
	Traditionalist	11	12.94	
	Free thinker	5	5.88	Islam

Source: Field survey, 2023

Table 2: Farmers level of adoption of mitigation strategies to reduce climate change

Farmers level of adoption of mitigation strategies	Frequency	Percentage	Mean / Mode
Very high	8	9..41	
High	14	16.47	
Average	28	32.94	
Low	35	41.18	
Poor	-	-	
Total	85	100.00	Low

Source: Field survey, 2023

Table 3: Dichotomous consideration of farmers level of adoption of mitigation strategies to reduce climate change

Farmers level of adoption of mitigation strategies	Frequency	Percentage	Mean / Mode
Low	76	89.41	
High	9	10.59	
Total	85	100.00	Low

Source: Field survey, 2023

Table 4: Effects of climate change on farmers livelihood status

Annual farm income of farmers	Effect on farm income before climate change			Effect on farm income during climate change		
	Freq.	%	Mean	Freq.	%	Mean
<₦120,000	-	-		12	14.12	
₦120,000 – ₦239,000	4	4.71		13	15.29	
₦240,000 – ₦359,000	12	14.12		20	23.53	
₦360,000 – ₦479,000	28	32.94		25	29.41	
₦480,000 – ₦599,000	30	35.29		11	12.94	
₦600,000 and above	11	12.94		4	4.71	
Total	85	100.00	₦463,176.48	85	100.00	₦329,623.52

Source: Field survey, 2023; Difference of farm income before and during climate change (₦463,176.48 - ₦329,623.52 = ₦133,552.96)

T**able 5: Farmers livelihood status before and during effects of climate change**

Livelihood status level	Frequency	Proportions	Mean/Mode
- Low livelihood status (Due to climate change effects)	52	61.18	
- High livelihood status (After applying mitigation strategies)	33	38.82	
Total	85	100.00	Low livelihood status

Source: Field survey, 2023

Table 6: Farmers perceived challenges militating against the adoption of climate change mitigation strategies

Farmers perceived challenges militating against the adoption of mitigating strategies	**Mean**	**Standard Dev.**
- Poverty and hunger	3.59*	0.55
- Health challenges on the part of farmers	3.52*	0.56
- Poor access to improved resistant varieties of crops, animals and agro-chemicals	3.48*	0.65
- Lack of information	3.31*	0.52
- Lack of capital / lack of access to capital	3.28*	0.51
- Low number of extension agents to farmers	3.24*	0.55
- Poor infrastructural development	3.28*	0.53
- Lack of motivation	3.17*	0.48
- High prices of agricultural inputs	2.73*	0.67
- Lack of training on the farmers	2.54*	0.56
- Seeing improved technologies as a taboo	2.18	0.42
- Farmers not willing to grant extension agent's audience	2.01	0.31

Source: Field survey, 2023; Agreed (mean ≥ 2.50)

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Table 7: Socio-economic characteristics influencing adoption of climate change mitigation strategies

Socio-economic variables	B-coefficient	SE	Wald
Constant	0.849	0.316	0.173
Gender	0.653	0.539	0.045
Age	-0.358*	0.124	-7.093
Educational Level	0.431*	0.021	5.441
Marital status	0.562	0.538	1.003
Farming experience	0.623	0.334	2.048
Household size	0.517*	0.230	6.934
Farm size	0.881*	0.342	4.003
Religious affiliation	0.172	0.291	0.819
Farm income	0.236*	0.019	10.036
R^2	0.594		

Table 8: Relationship between farmers level of adoption of climate change mitigation strategies and livelihood status

Statistical variables	Parameter estimates
Parameter estimate of variable X	0.6634
Standard error of variable X	0.2417
Correlation coefficient "r"	- 0.5841
R^2	0.5893
Half of the parameter estimate of variable X	0.3317

Source survey, Field survey, 2023