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ADAPTIVE CAPACITY OF FARMERS TO CLIMATE-INDUCED SHOCKS UNDER FADAMA III ADDITIONAL FINANCING IN KADUNA STATE, NIGERIA

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ABSTRACT
The study estimated the effects of Fadama III Additional Financing on the adaptive capacity of farmers to climate-induced shocks in Kaduna State, Nigeria. Through a multistage sampling technique, a total of 180 respondents (90 Fadama beneficiaries and 90 non-beneficiaries) were carefully selected. A questionnaire was developed for primary data collection. Data collected were analyzed using descriptive statistics such as mean, standard deviation, z-test, and inferential statistics such as Ordinary Least Squares and quantile regression techniques. The results of the descriptive statistics showed that the mean farm income of beneficiaries was ₦617,191.01, higher than that of non-beneficiaries (₦100,694.12). The mean credit accessed by the beneficiaries was ₦215,441.57 higher than that of non-beneficiaries (₦22,634.11). The index of access to technologies was high for beneficiaries (0.93) but relatively low for non-beneficiaries (0.27). The overall mean rating of the adaptive capacity of beneficiaries to climate-induced shocks was very high (3.54±0.49) relative to non-beneficiaries (2.55±0.65) on a 4-point rating scale. Variables that significantly influenced the adaptive capacity of the farmers for both OLS and quantile regression estimates included: Fadama beneficiary status (that is, being beneficiaries or non-beneficiaries), farm income, access to credit, access to technologies, education, and extension contacts. Based on the findings, the study recommended a more inclusive approach in government agricultural programmes and projects to capture more farmers for improved adaptive capacity in the face of the ravaging climate-induced shocks.

Keywords: *Fadama* III, additional financing, climate change, adaptive capacity, Kaduna State

INTRODUCTION

There have been consistent efforts by successive Nigerian governments through various intervention programs to improve agricultural production and close the widening food demand and supply gaps. *Fadama* is a Hausa word, or *Akuro* and *Ani-Nmiri* in Yoruba and Ibo Languages respectively to mean low-lying flood plains, usually water-logged during the rainy season but retain moisture during the dry season with easily accessible shallow groundwater making it suitable for all-round farming. The National *Fadama* Development Project (2009) described *Fadama* as irrigable land usually low-lying and floodplain areas underlined by shallow aquifers and found along Nigeria's river system.

Fadama is a project of the Federal Government of Nigeria through the pooled World Bank Loan to finance the development of *Fadama* lands by introducing small-scale irrigation in states with *Fadama* development potential (Ariyo, *et al,* 2021). The *Fadama* project was well conceived and structured into three phases with the mandate of improving the productivity, income, and overall welfare of smallholder farmers. Hence, the first National *Fadama* Development Project (*Fadama* I) was trial tested between 1993 and 1999 in seven northern states. The success of the trial testing encouraged the Federal Government to seek more financial support from funding agencies and the second National *Fadama* Development Project (*Fadama* II) was initiated and extended to 12 additional states of the federation. In order to sustain the gains of *Fadama* I and II projects, FADAMA III Additional Financing was instituted as a national project covering the entire 36 states including FCT Abuja to consolidate the achievements and gains of the National *Fadama* Development Project. Badiru (2013) noted that the *Fadama* III Additional Financing was initiated with a core mandate of alleviating the poverty situation of rural farmers and increasing the income of users of rural land and water resources on a sustainable basis.

It is imperative to state that the daring effects of climate change is threatening Nigerian agriculture and undermining the sustainable achievement of the objectives of the *Fadama* Development Project. The Intergovernmental Panel on Climate Change (IPCC) (2007) viewed climate change as a change in the state of the climate that can be identified by using statistical tests, by change in the mean and the variability of climatic properties that persist for an extended period of decades or longer. Climate change is a fundamental threat to global food security, sustainable development, and poverty eradication. The effects of climate change-induced shocks cut across all sub-sectors of agriculture such as livestock, crop production, forest and biodiversity, fishery, and agricultural products processing. The persistent droughts and flooding, off season rains and dry spells are some of the climate-induced shocks that have sent growing seasons out of orbit, in countries that are dependent on rain-fed agriculture like Nigeria (Olaniyi, Funmilayo and Olutimehin, 2014). Kaduna State is not exempted from the ravaging threats of climate change (Ishaya and Abaje, 2008). Similarly, Adams (2019) shared that climate-induced shocks on agriculture are evident in a number of ways which include an increase in average temperatures, unpredicted rainfall, climate extremes (e.g heat waves), increase in pests and diseases, severe drought, increase in atmospheric carbon dioxide, rising sea level and torrential flooding among others.

In addressing this global threat of climate change, a wide range of adaptation measures exist within farming systems to help farmers sustain or increase food production in the face of the daring climate-induced shocks. The success of farmers to build a strong adaptive capacity to climate-induced shocks is a function of physical, technological, financial, and human capital available to farmers to effectively cope with associated threats and shocks (African Development Bank, 2017). Agricultural funding is crucial to a sustainable fight against the devastating effects of climate change at the farm household level. For instance, Karsten, Vanek, and Zimmerer (2021) noted that the implementation of efficient irrigation practices through improved agricultural funding is one of the strategies for increasing the resilience of the agricultural system to the impact of climate change. Similarly, the report of USAID (2021) pointed out that increased climate financing will help to enhance the capacity of developing countries to effectively implement climate change-related projects. However, after almost a decade of initiating the FADAMA III Additional Financing project, several research efforts have been made to evaluate its effect or impact on income, productivity, resource use efficiency, and poverty/welfare status of *Fadama* users/beneficiaries as evident in Iwala (2014), Ogbonnai and Nwaobiala (2014), Osondu, et al, (2015), and Abdul and Muddassir (2021). It is imperative to note that, there is no research effort available to the researchers that attempted or captured the impact of the *Fadama* project on the adaptive capacity of farmers to climate change-induced shocks. Hence, this research examined the effects of FADAMA III Additional Financing on the adaptive capacity of farmers to climate-induced shocks in Kaduna State to bridge the existing information gaps in knowledge. Specifically, the study cross-tabulated the socio-economic characteristics of the beneficiaries and non-beneficiaries and examined their respective levels of adaptive capacities and determinants of the adaptive capacity of the respondents.

METHODOLOGY

The study was carried out in Kaduna State, North-west Nigeria. The state is made up of 23 Local Government Areas (LGAs) with administrative headquarters in Kaduna town. The 2020 projected population of Kaduna State was 9,476,053 with 4,790,241 males and 4,685,812 females (Kaduna State Government, 2015).

The study adopted a multi-stage sampling in selecting 180 respondents for the study. The first stage was the random selection of three LGAs (Kaduna North, Chikum, and Kagarko) in the state. These LGAs were among the LGAs with a high concentration of *Fadama* users in the state. At the second stage of the sampling, two farming communities with existing *Fadama* Associations were purposively selected from each of the three LGAs making a total of six communities for the study. The purposive selection was to avoid sampling a community without *Fadama* Association. The third stage was the composition of the sampling frame for the study. Through the *Fadama* Coordinating Units and Kaduna State ADP, the lists of *Fadama* beneficiaries (users) and non-beneficiaries in each of the selected farming communities were obtained. The obtained lists formed the sampling frame for the study. In the fourth stage, 15 *Fadama* beneficiaries (users) and 15 non-beneficiaries were randomly selected from the obtained sampling frame in each of the six concerned communities making a total of 180 farmers (90 *Fadama* beneficiaries and 90 non-beneficiaries).

The instrument for data collection was a structured questionnaire. Data collected were analyzed using descriptive statistics such as mean, standard deviation, z-test, and relevant inferential statistics such as OLS and quantile regression techniques.

In determining and comparing the levels of "Adaptive Capacities" of the two groups of farmers to climate-induced shocks, items of climate-induced shocks were developed for rating by the farmers. The adaptive capacities of *Fadama* beneficiaries and non-beneficiaries to indicators of climate-induced shocks were assessed on a 4-point rating scale to determine and compare how high or low their ability to adapt to the identified shocks was. Hence, the farmers were asked to rate their level of adaptive capacity to the identified climate-induced shocks on a 4-point scale of Very High (VH) = 4, High (H) = 3, Low (L) = 2, and Very Low (VL) = 1. Therefore, mean values between 1.00 - 2.49 were interpreted as "Low Adaptive Capacity", mean values between 2.50 – 3.49 were interpreted as "High Adaptive Capacity" while mean values of 3.50 – 4.00 were interpreted as "Very High Adaptive Capacity".

Test of significance ($p<0.05$) difference in the mean Adaptive Capacity of beneficiaries and non-beneficiaries to climate-induced shocks was achieved using Z-test statistics.

Ordinary Least Squares (OLS) and quantile regression estimation techniques were used to estimate the determinants of farmers' Adaptive Capacity to climate-induced shocks. The Adaptive Capacity (Y) of an *ith* farmer is the overall mean value obtained by each farmer. The implicit form of the regression model used is stated as follows:

$$Y = f\ (X1, X2, X3, X4, X5, X6, X7, X8, X9, U \ldots\ldots\ldots\ldots (2)$$

Where:

Y = Mean value of Adaptive Capacity of the *ith* farmer.

X_1 = Fadama Beneficiary Status (1 if a beneficiary, 0 if non-beneficiary)

X_2 = Farm Income (in Naira)

X_3 = Access to credit (in Naira)

X_4 = Farm size (in hectare)

X_5 = Access to farm modern technologies such as irrigation (1 = if Yes, 0 = if No)

X_6 = Access to improved farm inputs such as seedlings (1 = if Yes, 0 = if No)

X_7 = Education (number of years spent in school)

X_8 = Farming experience (number of years)

X_9 = Extension contact (number of visits)

U = Stochastic error term.

The Quantile regression as used by Enete (2013), given a random variable *Y* with a probability distribution function:

F(y) = Prob (Y ⩽ y), the Tth quantile of Y is defined as the inverse function.

Q(T) = invf {y: F(y) ≥T}, where 0 < T < 1.

For a random sample $\{y_1, \ldots, y_n\}$ of Y, the sample median is the minimize of the sum of absolute deviations:

$$\frac{\min}{ER} \sum_{i=1}^{\infty} (Iy_i - \check{s}I) \ldots\ldots\ldots\ldots (3)$$

In general, the Tth sample quantile ƺ(T), which is the equivalent of Q(T), may be formulated as the solution of the optimization problem:

$$\frac{\min}{ER} \sum_{i=1}^{\infty} \mathrm{p} - (Iy_i - \check{s}I) \ldots\ldots\ldots\ldots (4)$$

Where pT(z) = z(T - I(z < 0)), 0 < T < 1. I (·) denotes the indicator function. The linear conditional quantile function, Q(T|X = x) = X″**β**(T), can be estimated by solving:

$$\beta(T) = \text{argmin } \beta \xi R n \sum_{i=1}^{\infty} p - (I y_i - \check{s} I) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (5)$$

Therefore, for any quantile T ξ (0, 1), the quantity **β**(T) is called the Tth regression quantile. The case T = 1/2, which according to Chen (2005), minimizes the sum of absolute residuals and corresponds to median regression.

RESULTS

Adaptive Capacity Variables of the Farmers

The results in Table 1 present cross-tabulations of adaptive capacity variables of the farmers against their *Fadama* beneficiary status (beneficiary and non-beneficiary). In the Table, the mean farm income of beneficiaries was ₦617,191.01 while that of non-beneficiaries was ₦100,694.12. The mean credit accessed by the beneficiaries was ₦215,441.57 while that of non-beneficiaries was ₦22,634.11 (mostly through informal sources). The index of access to technologies was high for beneficiaries (0.93) but relatively low for non-beneficiaries (0.27). The average years of education of the *Fadama* beneficiaries were higher (12.89) but comparatively low for the non-beneficiaries (5.25). Hence, it could be deduced that education plays a major role in farmers' participation in the project. In affirmation, Etwire, et al (2013) in a study equally found that the number of years in school, access to production credit, and agricultural extension service are factors that significantly determine farmers' participation in agricultural projects in Ghana. An average *Fadama* beneficiary in the study area has about 14 extension contacts in the last farming season while an average non-beneficiary has just two (2.01) extension contacts within the same farming season. The results indicated that the *Fadama* beneficiaries in the study area were better positioned to build sustainable adaptive capacity to climate-induced shocks than non-beneficiaries. Sanusi and Gado (2021) in a study found that the *Fadama* III intervention project has a significant positive effect on the livelihoods of the beneficiaries. Iwala (2014) assessed the economic impact of the *Fadama* project in Ondo State and found that the average annual gross margin of *Fadama* beneficiaries (participants) had increased by 28.57%.

Table 1: Cross-tabulation of adaptive capacity variables against the *Fadama* project beneficiary status of the respondents.

	Beneficiaries (n = 89)		Non-beneficiaries (n = 85)				
ADAPTIVE CAPACITY VARIABLES	$\overline{X}$	**SD**	$\overline{X}$	**SD**	z	**df**	**P-value (sig.)**
Farm Income (₦)	617191.01	250511.52	100694.12	90728.27	17.92	172	0.000***
Access to credit (₦)	215441.57	120956.76	22634.11	38460.75	14.03	172	0.000***
Farm Size (ha)	3.93	1.46	3.38	1.91	0.85	172	0.394
Access to technologies	0.93	0.25	0.27	0.45	12.10	172	0.000***
Access to improved farm inputs	0.88	0.33	0.65	0.49	2.52	172	0.032**
Years of Education	12.89	3.19	5.25	3.54	16.93	172	0.000***
Years of Experience	32.90	13.88	33.18	12.79	-1.61	172	0.110
Extension Contacts	13.97	6.29	2.01	2.30	16.50	172	0.000***

Note: $\overline{X}$ = Mean; **SD** = Standard Deviation; ***Sig. at p <0 .01; **Sig. at p <0 .05.
Source: Field Survey, 2021.

Adaptive capacity of the farmers to climate-induced shocks

The result in Table 2 showed that the mean ratings of adaptive capacities of the *Fadama* beneficiaries were very high on 10 of the 15 identified climate-induced shocks. Hence, the beneficiaries had a very high adaptive capacity to cope with prolonged drought (3.77±0.74), drying up of water bodies (3.62±0.59), frequent pest and disease outbreaks (3.59±0.73), premature ripening of fruits (3.63±0.67), drying up of plants (3.64±0.85), stunted growth of crops (3.75±0.67), heat stress on crop and livestock (3.53±0.58), reduction in crop yield (3.50±0.65) and increased erosion due to desertification (3.85±0.35).

Table 2: Mean ratings of adaptive capacities of the Fadama beneficiary and non-beneficiary farmers to climate-induced shocks.

SN	Climate-induced shocks	Beneficiaries Mean ($\overline{X}$)	Non-beneficiaries Mean ($\overline{X}$)
1	Prolonged drought	3.77*** (0.74)	2.11* (0.64)
2	Unusual heavy rainfall	3.43** (0.54)	2.41* (0.84)
3	Increasing temperature and heat	3.38** (0.92)	2.00* (0.65)
4	Torrential flooding	3.05** (0.83)	2.65** (0.50)
5	Increased desertification	3.38** (0.80)	1.87* (0.76)
6	Drying up of water bodies (rivers, lakes, pond or streams)	3.62*** (0.59)	3.07** (0.75)
7	Frequent pest and disease outbreak	3.59*** (0.73)	3.50*** (0.70)
8	Premature ripening of fruits	3.63*** (0.67)	1.97* (0.85)
9	Drying up of plants	3.64*** (0.85)	2.34* (0.80)
10	Stunted growth of crops	3.75*** (0.67)	2.89** (0.46)
11	Heat stress on crop and livestock	3.53*** (0.58)	2.23* (0.83)
12	Reduction in crop yield	3.50*** (0.65)	2.45* (0.62)
13	Intense weed growth	3.71*** (0.69)	3.02** (0.84)
14	Storage losses due to excessive heat	3.34** (0.74)	2.42* (1.08)
15	Increased erosion due to desertification	3.85*** (0.35)	3.43** (0.76)
	Overall mean	**3.54*** (0.49)**	**2.55** (0.65)**

Note: Figures in parentheses represent the standard deviation.

*** indicates Very High; ** High (H); * Low adaptive capacity to the shocks.

Source: Field Survey, 2021.

On the other hand, the adaptive capacity of the non-beneficiaries was only very high to cope with frequent pest and disease outbreaks (3.50±0.70), and high in coping with stunted growth of crops (2.89±0.46), intense weed growth (3.02±0.84) and increased erosion due to desertification (3.43±0.76). The overall mean rating of the adaptive capacity of beneficiaries to shock was very high (3.54±0.49) relative to non-beneficiaries (2.55±0.65). The low mean values of adaptive capacities of the non-beneficiaries could be linked with their non-participation in enjoying various incentives extended to farmers by the fadama project. Cinner, et al (2018) noted that effort to minimize the impacts of climate change has made governments, development agencies, and civil society organizations embark on substantial investments in improving farmers' capacity to adapt to climate change. One such efforts in the Nigerian context is the *Fadama* project

Mean Comparison of Adaptive Capacities of *Fadama* Beneficiaries and Non-beneficiaries to Climate-induced Shocks

Table 3 presents the results of the test of significant difference in the mean adaptive capacities of *Fadama* beneficiaries and non-beneficiaries to climate-induced shocks in Kaduna State.

Table 3: Z-test Statistics of significant difference in the mean adaptive capacities of *Fadama* beneficiaries and non-beneficiaries to climate-induced shocks

Variables	N	$\bar{X}$	SD	DF	Std. Error	t-cal	t-tab	P-value (sig.)	Rmks
Beneficiaries	89	3.54	0.49						
				172	0.032	16.28	1.96	0.000	S*
Non-beneficiaries	85	2.55	0.65						

Note: S* = Significant at 0.05.

The result of z-test statistics showed that the t-calculated (t-cal) value of 16.28 was significantly higher than the t-table (t-tab) value of 1.96 at 172 degree of freedom. This indicated that there was a significant ($p<0.05$) difference in the mean adaptive capacities of *Fadama* beneficiaries and non-beneficiaries to climate-induced shocks. The result of t-test indices in the study of Osondu, et al (2015) showed that the *Fadama* III programme impacted positively and significantly on beneficiaries. Oladunni in Sanusi and Gado (2021) equally found that the *Fadama* III project had a significant impact on the income and livelihood of participating rural households.

Determinants of adaptive capacity of the farmers

In estimating the factors that influenced the adaptive capacity of the farmers to climate-induced shocks, Ordinary Least Squares (OLS) and quantile regression analyses were used. The result of the analysis as presented in Table 4 showed that six of the nine explanatory variables were significant for both the OLS and quantile regression cases except for the 25th quantile where farm size was in addition significant at 10% which was considered too weak. Variables that significantly influenced the adaptive capacity of the farmers include *Fadama* beneficiary status, farm income, access to credit, access to farm technologies, education, and extension contacts.

Table 4: Ordinary Least Squares and Quantile Regression Estimates of Determinants of Adaptive Capacity of Farmers to Climate-induced Shocks.

	Linear Regression	**Quantile Regression Estimates**		
Regressors	**OLS**	**25th Quantile**	**50th Quantile**	**75th Quantile**
CONSTANT	3.267319 (8.15)***	3.462792 (8.99)***	3.260509 (6.01)***	3.576011 (7.80)***
Fadama* Beneficiary Status	0.4934059 (7.33)***	0.528866 (8.54)***	0.7113017 (8.91)***	0.8464134 (9.15)***
Farm Income	1.137541 (3.59)***	1.303072 (4.38)***	2.364530 (4.87)***	2.734497 (4.98)***
Access to Credit	1.086320 (4.60)***	1.120632 (4.13)***	1.536567 (4.46)***	2.697632 (2.26)**
Farm Size	0.0058293 (0.73)	0.0225123 (1.86)*	0.0137302 (1.34)	0.0013021 (0.27)
Access to Technologies	0.0239552 (2.50)**	0.0341308 (3.02)***	0.1350579 (3.37)***	0.3276736 (3.83)***
Access to Inputs	0.0404041 (0.29)	0.0450484 (0.22)	0.3076439 (1.55)	0.0850431 (0.06)
Education	0.4856543 (3.79)***	0.6026401 (4.23)***	0.8748310 (4.37)***	0.9231187 (4.51)***
Farming Experience	-0.0052461 (-1.14)	0.0028149 (0.37)	-0.0036601 (-0.55)	-0.0003820 (-0.07)
Extension Contacts	0.0584757 (2.61)**	.0601963 (2.74)**	0.0565429 (2.60)**	0.0883325 (3.77)***
R^2/Pseudo R^2	0.7691	0.7293	0.7345	0.7512
Observations	174	174	174	174

Note: Figures in parentheses are t-ratios.
*** denotes sig. at 1%; ** denote sig at 5% while * denotes sig. at 10%
Source: Field Survey, 2021.

The *Fadama* beneficiary status (1 if a beneficiary, 0 if non-beneficiary) was positive and highly significant (1%) with farmers' adaptive capacity with climate-induced shocks. The quantile regression estimates showed that the positive impact of being a beneficiary of *Fadama* consistently increased the adaptive capacity of farmers from the 25th through the 50th to the 75th quantile. Kabobah, Nukpezah, and Ntiamoa-Baidu (2018) argued that access to physical capital such as irrigation facilities and engagement in dry season gardening will appreciably increase farmers' adaptive capacity to climate change threats. Sanusi and Gado (2021) pointed out that the *Fadama* III intervention project has a significant positive effect on the livelihoods of the beneficiaries.

Farm income was positively and significantly (1%) related to the adaptive capacity of farmers to climate-induced shocks. The positive impact of farm income on the adaptive capacity for the quantile regression increased from the 25th through the 50th, though declined for the 75th quantile. Access to credit was also highly significant at 1% and positively signed with the adaptive capacity of farmers for both the OLS and quantile regression estimates. Arimi (2014) noted that the climate change adaptation ability of farmers is positively influenced by their access to capital. Similarly, Adeagbo, et al (2021) in a study established that household income tends to contribute positively to the decisions to adopt climate change adaptation strategies by farmers. Farmers' access to improved farming technologies was highly significant (1%), positively signed, and consistently increased with their capacity to adapt to climate-induced shocks for 25th, 50th, and 75th quantiles. The coefficient was also positively signed with adaptive capacity for OLS but significant at (5%). Asian Development Bank (2014) reported that the climate change impact already being experienced can effectively be addressed through increasing technology transfer to facilitate adaptation and improve the adaptive capacity of farmers. The potential role of adaptation technologies in response to the risks and shocks associated with climate change in the farming system is huge.

Level of education was positive and highly significant at 1% in the OLS case and was also highly significant for the 25th, 50th, and 75th quantiles in an increasing trend. Educated farmers are more likely to be exposed to relevant climate change adaptation information, knowledge, and strategies, hence improving their adaptive capacity. Eneji, et al, (2021) submitted that environmental education is a crucial tool for the acquisition of relevant knowledge, awareness, and attitude that encourage the participation of rural farmers in mitigating and preventing climate change effects in their farming activities. The frequency of extension contacts was positive and significant at 5% with farmers' adaptive capacity for the OLS, 25th, and 50th quantiles but highly significant (1%) in the case of the 75th quantile. Adeagbo, Ojo, and Adetoro (2021) reported that farmers' access to extension services is a vital human capital that keeps farmers informed on changes and modern agricultural practices in the farming system. Feleke, et al, (2016) identified access to information through extension contacts as one of the major factors influencing the adaptive capacity of farmers. Adeagbo, et al (2021) maintained that access to extension services provides farmers with quality information on how to best tackle climate change and its effects on their farms.

CONCLUSION

The study estimated the effects of FADAMA III Additional Financing on the adaptive capacity of farmers to climate-induced shocks in Kaduna State, Nigeria. Data were collected from carefully selected *Fadama* beneficiaries and non-beneficiaries in the study area. From the findings of the study, it was concluded that *Fadama III's* additional financing has improved the socioeconomic profiles of beneficiaries to develop adaptive capacities to cope with climate-induced shocks in their daily farming activities. The study, therefore, recommended (i) a more inclusive approach in government agricultural programmes and projects to capture more farmers for improved adaptive capacity in the face of the ravaging climate-induced shocks and (ii) further efforts must be made to improve farmers' access to relevant resources, training, education and technologies to build a society of farmers with adequate capacity to mitigate the effects of climate-induced shocks.

References

Abdul, W. S, and Muddassir, A. G. (2021). The Impact of Fadama III Development Project on Livelihoods in Kware Local Government Area of Sokoto State. *International Journal of Management Studies and Social Science Research,* 3 (5), 194 – 206.

Adams, O. K. (2019). Impact of Climate Change on Agricultural Production in Nigeria. *International Journal of Scientific and Engineering Research*, 10 (3), 257 – 265.

Adeagbo, O. A., Ojo, T. O and Adetoro, A. A. (2021). Understanding the Determinants of Climate Change Adaptation Strategies among Smallholder Maize Farmers in South-west, Nigeria. *Heliyon,* 7 (2), 1 – 10.

African Development Bank (2017). *Farmers' Vulnerability to Climate Shocks: Insights from the Niger Basin of Benin.* Abidjan, Côte d'Ivoire: African Development Bank.

Arimi, K. S. (2014). Determinants of climate change adaptation strategies used by fish farmers in Epe Local Government Area of Lagos State, Nigeria. *J Sci Food Agric,* 94 (7), 1470 – 1476.

Ariyo, O. C., Usman, M. B., Alabi, O. F., Olagunju, O. E and Omodona, S. (2021). Determinants of Productivity among Beneficiaries and Non-Beneficiaries Farmers of Third National Fadama Development Project in Kaduna North Local Government Area of Kaduna State, Nigeria. *Ethiopian Journal of Environmental Studies & Management* 14(5): 654 – 664.

Asian Development Bank (2014). *Technologies to Support Climate Change Adaptation in Developing Asia.* Mandaluyong City: Asian Development Bank.

Badiru, I. O. (2013). *Fadama* III Beneficiaries' Adherence to Project Guidelines in Ogun State, Nigeria. *Journal of Agricultural Extension,* 17 (1), 61 DOI:10.4314/jae.v17i1.6

Chen, C. (2005). An introduction to quantile regression and the QUANTREG procedure", Proceedings of the Thirtieth Annual SAS Users Group International Conference, SAS Institute Inc., Cary, NC.

Cinner, J. E., Adger, W. N., Allision, E. H., Barnes, M. L., Brown, K., Cohen, P. J., Gelcich, S., Hicks, C. C., Hughes, P. T., Lau, J., Marshall, N. A and Morrison, T. H. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change,* 8 (1), 117 – 123.

Eneji, C-V. O., Onnoghen, N. U., Acha, J. O and Diwa, J. B. (2021). Climate change awareness, environmental education and gender role burdens among rural farmers of Northern Cross River State, Nigeria. *International Journal of Climate Change Strategies and Management,* 13 (4/5), 397 – 415.

Etwire, P. M., Dogbe, W., Wiredu, A. N., Martey, E., Etwire, E., Owusu, R. K and Wahaga, E. (2013). Factors Influencing Farmer's Participation in Agricultural Projects: The case of the Agricultural Value Chain Mentorship Project in the Northern Region of Ghana. *Journal of Economics and Sustainable Development,* 4 (10), 36 – 43.

Feleke, F. B., Berhe, M., Gebru, G and Hoag, D. (2016). Determinants of adaptation choices to climate change by sheep and goat farmers in Northern Ethiopia: the case of Southern and Central Tigray, Ethiopia. *Springerplus,* 5(1), 1692 - doi: 10.1186/s40064-016-3042-3.

IPCC. (2007). Climate Change Impacts, adaptation and vulnerability' Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom: Cambridge University Press.

Ishaya, S and Abaje, I. B. (2008). Indigenous People's Perception on Climate Change and Adaptation Strategies in JEMA'A Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning*, 1(8), 138 – 143.

Iwala, O. S. (2014). The role of Development Organizations in the rural and agricultural transformation of Nigeria: The Case of EU-MPP6 in Ondo State. In Proceedings of 16th Annual Congress of the Nigeria Rural Sociology Association (NRSA) on

Powering agricultural and rural transformation process in Nigeria. Bowen University, Iwo, Pp 209 - 217.
Kabobah, L., Nukpezah, D and Ntiamoa-Baidu, Y. (2018). Adaptive Capacity of Farmers to Climate Change in the Kassena Nankana Municipality of Ghana: Implications for Climate Adaptation Strategies. *West African Journal of Applied Ecology*, 26(SE), 14 – 26.
Kaduna State Government. (2015). *Kaduna State Population Dynamics, Projection and Estimate 2015 – 2030.* Kaduna: Kaduna State Government.
Karsten, H., Vanek, S and Zimmerer, K. (2021). How Farmers Adapt to Climate Change. Retrieved 21st November 2022 from https://www.e-education.psu.edu/geog3/node/1169
National Fadama Development Project. (2009). *The Paradigm shift under Fadama Development Project. Abuja: National Fadama Development Project.* Abuja: National *Fadama* Development Project.
Ogbonnai, M. O and Nwaobiola, C. U. (2014), Effect of *Fadama* III Project On Rural Farm Women Production In Gombe State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 10(1), 13 – 18.
Olaniyi, O. A., Funmilayo, O. A and Olutimehin, I. O. (2014). Review of Climate Change and its Effect on Nigeria's Ecosystem. *International Journal of Environment and Pollution Research*, 2 (3), 70 – 81.
Osondu, C. K., Ezeh C.I., Emerole C.O and Anyiro C.O (2014). Comparative analysis of technical efficiency of small holder *Fadama* II and *Fadama* III cassava farmers in Imo State. *The Nigeria Journal of Rural Extension and Development*, 8(1), 26 - 37.
Sanusi, A. W and Gado, M. A. (2021). The Impact of Fadama III Development Project on Livelihoods in Kware Local Government Area of Sokoto State. *International Journal of Management Studies and Social Science Research*, 3 (5), 194 – 206.
United States Agency for International Development [USAID] (2021). Building Capacity for Climate Change Adaptation in the Pacific. Retrieved 21st November 2022 from https://www.usaid.gov/pacific-islands/our-stories/dec-2021-building-capacity-climate-change-adaptation-pacific