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Socio-demographic and Economic Dynamics of Climate Change and Adaptation: A Study on Rural Farmers in Oyo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors DDS and AA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DDS and BAO managed the analyses of the study as well as literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study explored the relationship between key socio-demographic and economic variables on climate change adaptation strategies of rural farmers in Oyo State, Nigeria. Three hundred (300) rural farmers were randomly selected from six (6) farming communities for the study. Multiple regression analysis was utilized to enrich understanding of relationships between socio-demographic variables and climate change. These variables: age, sex and marital status, size of households, religion, educational level, income source and social group belongingness were examined independently against the 16 adaptation strategies. The results showed high significance between some socio-economic variables and the adaptation strategy among farmers. The study revealed that age, gender, religious affiliation and social group belongingness showed significant relationships with coping strategies of the farmers. The study therefore recommends governmental and non-governmental activities directed towards enhancing capacities of agricultural extension services to address climate change susceptibility of rural farmers.

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1. INTRODUCTION

The well-being of rural populations in developing countries and for that matter Nigeria is intrinsically linked to agriculture. Agriculture is a dominant economic activity accounting for about 40% of GDP while employing about 70% of the Nigerian population [1] providing the largest source of employment for rural communities in Nigeria. The Intergovernmental Panel on Climate Change [2] defines "climate change" as "a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that which persists for an extended period, typically decades or longer. Climate change is shown to have affected rural food production, transportation, processing and storage [3]. The main objective of this study was to explored the relationship between key socio-demographic and economic variables on climate change adaptation strategies of rural farmers.

2. METHODOLOGY

The study sought to explore the relationship between the key socio-economic variables on the adaptation mechanism of the farmers in Oyo State. The climatic condition in Oyo State is tropical with notable dry season (November-March) and wet season (April-October) with a relatively high humidity.

Regression analysis was conducted in order to determine the independent variables related to the socio-demographic variables used in the study. These variables include the age, sex, marital status, size of households, religion, educational level, income source and social group belongingness. These variables were examined independently against the 16 adaptation strategies (independent variables) listed below.

V_1 = Change crop variety/species, V_2 = Build water harvesting schemes, V_3 = Implement soil conservation schemes, V_4= Diversification of crop types and varieties, V_5= Diversification of livestock types and Varieties, V_6= Changing planting dates, V_7= Changing size of land under cultivation, V_8= Irrigation, V_9= Reduce number of livestock, V_{10}= Diversify from farming to non-farming activity, V_{11} = Migration, V_{12}= Switching from Livestock to crops, V_{13}= Switching from crops to livestock, V_{14}= Religious beliefs or prayers, V_{15}= Use of shades and shelters &V_{16}= Use of insurance.

The regression model is given as $y=\beta_0 + \beta_1x_1 +\beta_2x_2 + \ldots \beta_kx_k + \alpha$, where "k" are our independent variables and we seeks to find which of the k variables are related or significantly influenced by *y*which is our socio-demographic variables. Our hypothesis for the test therefore states.

H_0: $\beta_0 = 0$, there is no significant relationship between the socio-demographic variable and adaptation strategy.

H_0: $\beta_0 \neq 0$, there is a significant relationship between the socio-demographic variable and adaptation strategy. For I = 1, 2, 3 … k.

3. RESULTS AND DISCUSSION

From Table 1 the coefficient of determination, R-square is 0.128, suggesting that 12.8% of the variation in the adaptation mechanism is explained by the farmers gender. It follows that about 88.2% of the variations are influenced by other variables not the farmer's gender. The coefficient of the variables showed weak and no relationship between the gender and the adaptation strategies of farmers. The F-test showed a test statistics of 2.306 and a P-value of 0.004 which imply that the test is highly significant. The best fit regression model for predicting adaptation in Oyo state in terms of gender is y = 1.224 + 0.184v11. It suggests that male farmers are more likely to migrate from the state than their female counterparts.

Table 2 showed the coefficient of regression R square of 0.056 suggesting that 5.6% of the variation in the adaptation strategies of the farmers in the Oyo states is explained by the age of the farmers. The remaining proportions of 94.4% are the contribution of other socio-demographic variables. The results show F test statistics of 0.926 slightly exceeding the p-value of 0.539 indicating weak significance in the test and the model. Table 2 showed a negative relationship, weak relationship and positive strong relationship among variable. The variables, v1 (Change crop variety/ species), v2 (Build water harvesting schemes), v3 (Implement soil conservation schemes) and v4 (Diversification of crop types and varieties) showed significance. Additionally, v8 (Irrigation), v10 (Diversify from farming to non-farming

activity), v11 (Migration) and v16 (Use of insurance) showed a strong positive relationship. The other variables like v14 and v15 recorded negative relationship. The best fit model stands at y= 0.345+0.984v1+1.548v2+1.102v3 +1.270v4 +1.435v8+1.788v10+3.656v11+2.885v16. There is proportionate change in the adaptation strategies for any change in the age of the farmers.

From Table 3 ten adaptation strategies were observed to be significant to the marital status of the respondents. Weak and negative relationship was observed among variables. The best fitted model is y=2.053v4+8.360v5+1.441v6+0.900v8+0.963v10 +2.356v11+10.233v12+4.244v13+1.429v14+4.1 90v15.

Table 1. Gender and adaptation strategies

Model		Unstandardized coefficients		Standardized coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.224	.484		2.529	.012
	V1	.070	.045	.103	1.573	.117
	V2	-.167	.143	-.107	-1.168	.244
	V3	.034	.061	.040	.556	.579
	V4	.049	.057	.059	.852	.395
	V5	.047	.157	.023	.298	.766
	V6	.058	.046	.081	1.263	.208
	V7	-.119	.070	-.138	-1.696	.091
	V8	.033	.055	.039	.600	.549
	V9	.051	.155	.025	.326	.744
	V10	-.088	.100	-.059	-.888	.376
	V11	.184	.090	.184	2.041	.042
	V12	-.017	.219	-.006	-.079	.937
	V13	-.174	.125	-.097	-1.391	.165
	V14	-.165	.051	-.236	-3.224	.001
	V15	-.022	.297	-.013	-.073	.941
	V16	.188	.237	.120	.795	.427

a. Dependent Variable: SEX

Table 2. Age and adaptation strategies of farmers in Oyo

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	.345	13.003		.027	.979
v1	**.984**	1.201	.056	.819	.413
v2	**1.548**	3.843	.038	.403	.688
v3	**1.102**	1.634	.050	.675	.501
v4	**1.270**	1.521	.060	.835	.405
v5	.487	4.221	.009	.115	.908
v6	-1.898	1.227	-.104	-1.547	.123
v7	-2.959	1.878	-.133	-1.575	.116
v8	**1.435**	1.492	.065	.962	.337
v9	.707	4.170	.013	.170	.866
v10	**1.788**	2.674	.046	.669	.504
v11	**3.656**	2.422	.142	1.509	.132
v12	-1.426	5.890	-.018	-.242	.809
v13	.779	3.364	.017	.232	.817
v14	-2.696	1.368	-.150	-1.970	.050
v15	-6.091	7.981	-.138	-.763	.446
v16	**2.885**	6.363	.071	.453	.651

Table 3. Marital status

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	-8.345	15.464		-.540	.590
v1	-2.944	1.427	-.135	-2.063	.040
v2	-.076	4.572	-.002	-.017	.987
v3	.014	1.944	.001	.007	.994
v4	**2.053**	1.809	.078	1.135	.257
v5	**8.360**	5.022	.129	1.665	.097
v6	**1.441**	1.456	.064	.989	.323
v7	-4.302	2.235	-.157	-1.925	.055
v8	**.900**	1.773	.033	.508	.612
v9	-23.647	4.962	-.365	-4.766	.000
v10	**.963**	3.180	.020	.303	.762
v11	**2.356**	2.882	.074	.818	.414
v12	**10.233**	7.007	.104	1.460	.145
v13	**4.244**	4.002	.074	1.060	.290
v14	**1.429**	1.626	.065	.879	.380
v15	**4.190**	9.492	.077	.441	.659
v16	.843	7.570	.017	.111	.911

Table 4. Size of household and adaptation

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	**4.600**	1.387		3.316	.001
V1	-.322	.133	-.161	-2.422	.016
V2	.064	.410	.014	.157	.876
V3	.074	.174	.030	.424	.672
V4	-.291	.180	-.116	-1.620	.107
V5	-1.013	.460	-.175	-2.201	.029
V6	**.364**	.138	.174	2.643	.009
V7	.165	.201	.067	.819	.413
V8	-.045	.159	-.018	-.280	.780
V9	.303	.511	.049	.593	.554
V10	-.015	.285	-.004	-.054	.957
V11	-.229	.260	-.081	-.883	.378
V12	-.817	.639	-.093	-1.278	.202
V13	-.326	.359	-.064	-.908	.365
V14	-.289	.147	-.144	-1.962	.051
V15	**2.678**	.857	.551	3.127	.002
V16	-1.192	.681	-.268	-1.752	.081

The regression coefficient R square is 0.117 suggesting that 11.7% of the difference in the adaptation strategies of the Oyo State farmers is explained by the marital status of the farmers. The f test showed a test statistic of 2.092 and a p-value of 0.009 which implies that the test is highly significant. The coefficient of marital status and the adaptation strategy showed negatives relationship (-8.345). We can infer that marital status in general has a no relationship on the adaptation. Moreover, a change in the marital status of the farmers in the Oyo state will have no impact on the coping strategies adopt.

Table 4 showed a best fit model of y=4.600 +0.364v6+2.678v15. The test suggests no relationship between some adaptation strategies and the size of the household since their p-values are far greater than the coefficient. The model suggests that as the size of household increases farmers use the following strategies v6 (changing planting dates) and v15 (use of

shades and shelters). The coefficient of 4.600 with a p-value of 0.001 indicates high significance among the household size and their coping strategies. The test showed R squared of 14.8% which implies that coping strategies of the Oyo farmers are influence by size of the household while the remainder is the results of other variables. The f test showed a test statistics of 2.618 and a significance of 0.001 supporting the finding to be highly true.

From Table 5 the best fitted model for the variables is y = 1.939+0.228v11+0.213v14+ 1.487 v15. It suggests that the variables V11 (Migration), V14 (Religious beliefs or prayers) and V15 (Use of shades and shelters) are the most significant variables influenced by the religion of the farmer. Other coping mechanism showed weak and negative relationship. The coefficient of 1.939 and a p-value of 0.016 showed the result is significant. The R squared showed 0.185 suggesting that 18.5% of the coping strategies used in the Oyo state by farmers are influenced by their religious affiliation. It follows that any change in the religion of the respondents with leads to a change in the strategy used. The F test supports this conclusion since it produced a significantly higher test statistics of 3.596 than the p-value of 0.00. The p-value of 0.00 showed the test is highly significant.

From Table 6, the R squared test of 0.043 indicating the 4.3% of the differences in the coping strategies are results of the educational level of farmers. Farmers with higher education are more likely to adapt to different mechanism other than the tradition strategies. The remaining 96.7% were results of other influencing variables other than education. The F-test showed a test statistic of 0.697 and a p- value of 0.796 which suggest that the test is not significant. The model coefficient of -4.899 exceeds the p-value of 0.706 supporting the conclusion. The best fit is y=1.870V5+1.702v8+4.802v11+2.675v13+0.443 v16. This variable showed very weak relationship as their matching p-values are very high.

From Table 7, the result showed no relationship among majority of the variables. Relationship was observed between v12 (switching from livestock to crop and v13 (Switching from crops to livestock). It produced coefficient stats of 0.838 and 0.341 respectively slightly higher than the p-values. A weak relationship was observed between the income source and the coping strategies showing a coefficient of 0.256. It follows that the sources of income influence the coping strategies adopted by the respondents. The model best fit stands at y=0.256+ 0.838v12+0.341v13. We can conclude that any change in the income source of the farmers leads to the change in the V12 and V13. The f-test showed test stats of 2.163 and a p-value of 0.007 supporting the conclusion. The R square test showed 0.120 indicating that 12% of the difference in the adaption strategies is explained by the sources of income of the farmers.

Table 5. Religion and coping strategies

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	**1.939**	.803		2.414	.016
V1	.031	.074	.026	.415	.678
V2	-.658	.237	-.244	-2.772	.006
V3	-.409	.101	-.279	-4.053	.000
V4	-.221	.094	-.155	-2.348	.020
V5	-.228	.261	-.065	-.873	.384
V6	-.147	.076	-.120	-1.938	.054
V7	.009	.116	.006	.080	.937
V8	-.282	.092	-.192	-3.058	.002
V9	-.602	.258	-.172	-2.336	.020
V10	-.111	.165	-.043	-.673	.502
V11	**.228**	.150	.132	1.521	.130
V12	.235	.364	.044	.645	.520
V13	.177	.208	.057	.850	.396
V14	**.213**	.084	.178	2.527	.012
V15	**1.487**	.493	.505	3.017	.003
V16	-.081	.393	-.030	-.206	.837

Table 6. Educational level and the coping strategy

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	**-4.899**	12.985		-.377	.706
V1	-.621	1.208	-.036	-.514	.607
V2	.661	3.845	.017	.172	.864
V3	-.775	1.656	-.035	-.468	.640
V4	-1.902	1.559	-.089	-1.220	.224
V5	**1.870**	4.219	.036	.443	.658
V6	-1.420	1.233	-.078	-1.152	.250
V7	-4.166	1.884	-.189	-2.211	.028
V8	**1.702**	1.489	.078	1.143	.254
V9	.205	4.165	.004	.049	.961
V10	.373	2.670	.010	.140	.889
V11	**4.802**	2.471	.186	1.943	.053
V12	-.473	5.885	-.006	-.080	.936
V13	**2.675**	3.360	.058	.796	.427
V14	-.051	1.386	-.003	-.037	.971
V15	-.070	7.994	-.002	-.009	.993
V16	**.443**	6.389	.011	.069	.945

Table 7. Income source and coping strategies

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	**.256**	1.271		.201	.841
V1	-.238	.117	-.133	-2.032	.043
V2	-.599	.376	-.146	-1.595	.112
V3	.343	.160	.154	2.151	.032
V4	.365	.149	.169	2.454	.015
V5	.295	.413	.055	.715	.475
V6	-.072	.120	-.039	-.602	.548
V7	.122	.184	.054	.665	.506
V8	.370	.146	.166	2.538	.012
V9	-.982	.408	-.184	-2.408	.017
V10	-.310	.261	-.078	-1.187	.236
V11	.029	.237	.011	.123	.902
V12	**.838**	.576	.104	1.455	.147
V13	**.341**	.329	.072	1.037	.301
V14	.115	.134	.063	.858	.392
V15	-.246	.780	-.055	-.315	.753
V16	.197	.622	.048	.316	.752

From Table 8, the model best fit for the results showed y = 1.881+0.587v2+0.291v5+195v6. The other variables showed negative and no relationship having higher significance values than the coefficient values. It implies that any change in the farmers belonging to a social group impact the coping strategies. This suggests that the following variables V_2 (Build water harvesting schemes), V_5 (Diversification of livestock types and Varieties) and V_6 (Changing planting dates) were influenced by the social groups of the respondent. The model coefficient of 1.881 exceeds the p-value of 0.009 supports the conclusion that the test is significant. The F-test produced a test statistics of 2.794 and a p-value of 0.00 overwhelmingly supports the conclusion that significant relationship exists between farmers belonging to social group and the use of the significant coping strategies. The results of regression coefficient R-squares showed a test stats of 0.154 suggesting that 15.4% of the differences in the coping strategies in the Oyo is explained by the difference in the social groups farmers belong to.

Table 8. Social group belongingness on the coping strategy

	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	**1.881**	.717		2.625	.009
V1	-.059	.066	-.058	-.885	.377
V2	**.587**	.211	.244	2.784	.006
V3	-.153	.089	-.121	-1.717	.087
V4	.053	.085	.042	.618	.537
V5	**.291**	.236	.097	1.234	.218
V6	**.195**	.068	.186	2.870	.004
V7	-.011	.103	-.009	-.109	.913
V8	.002	.082	.001	.021	.983
V9	.167	.263	.052	.635	.526
V10	-.280	.146	-.126	-1.915	.057
V11	-.318	.132	-.213	-2.402	.017
V12	.039	.328	.009	.119	.905
V13	.077	.184	.029	.416	.678
V14	-.048	.075	-.047	-.640	.523
V15	-.503	.440	-.190	-1.144	.254
V16	-.138	.348	-.057	-.396	.692

4. CONCLUSION

The degree to which people and for that matter rural farmers can cope with climate change is partly a function of their social-economic status. The results showed high significance between socio-economic variables and the adaptation strategy among farmers. Age, gender, religious affiliation and social group belonging showed significantly relationship. Age place a determining role in climate change coping strategies. Egyir et al. [4] found in their study in the coastal savannah and transitional zones of Ghana that younger farmers were more likely to adopt modern productivity- enhancing strategies (MPES) than older farmers. Climate change is not gender neutral. A study by on coping strategies and climate change in Ghana by Assan et al. [5] showed that gendered constructions could affect the abilities of males and females to cope with and adapt to adverse impacts of climate change on their livelihood activities and potentially worsen existing gender inequalities among farm households. Having an understanding gendered dimensions of existing coping strategies will significantly improve future strategies and processes.

The influence religion wields on human behavior cannot be overlooked [6,7]. Schuman et al. [8] argues that religious beliefs significantly influence a community's understanding and experience of climate change adaptation, indicating the need for an inclusion of such information in climate change adaptation education. The need to belong influences human emotions, thoughts and actions [9]. Social capital is a significant component of coping with the adverse impacts of climate change. When faced with significant changes in climate regimes and weather extremes in the future, different societies will adopt different strategies to make a sustainable transition which will be determined in part by their networks and social capital.

Educational level showed no significance and does not influence the coping strategies of the farmers. This finding is however contrary to studies done by FAO [10] and Wamsler et al. [11] which found that, the influence of people's level of education had direct effect on aspects that reduce risk, and mitigating effect on aspects that increase risk. This suggests that education plays a more determinant role in climate change coping strategy.

5. RECOMMENDATION

It is important to understand the socio-demographic and economic dynamics of climate change adaptation in especially rural communities where agriculture is usually the main occupation. The results of this study show there is a significant relationship between the socio-demographic variable and adaptation strategies adopted my farmers. The study therefore recommends governmental and non-governmental activities directed towards

enhancing capacities and increased numbers of agricultural extension services to address climate change susceptibility of rural farmers. This will provide the needed information to reduce vulnerabilities of rural farm households for improved livelihood.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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