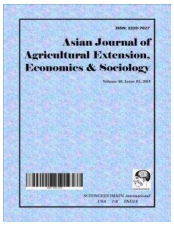

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Determinants of Knowledge and Attitude of Extension Professionals to Climate Change in Anambra State, Nigeria: A Multivariate Logistic Analysis

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aims: It ascertained the knowledge and attitude of extension personnel to climate change, the determinant factors and strategies for improving knowledge and altitude to climate change.
Study Design: A survey design was used for the study.
Place and Duration: The study was undertaken in Anambra State using all the extension personnel (93) in Anambra State Agricultural Development Programme. The study was conducted between 2013 and 2015.
Methodology: Data were collected using questionnaire and analysed by use of descriptive statistics and logistic regression.
Results: Results show that majority (63.4%) of extension professionals had high knowledge of climate change and 93.5% expressed favourable attitude to climate change. The multinomial logistic analysis shows that position and year of experience in extension organization were significantly (p= 0.05) related to knowledge of climate change. Similarly, the binomial regression shows that year of experience and years spent in school had significant relationship with attitude of extension

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professionals to climate change. The respondents perceived that knowledge and attitude could be improved and sustained through adequate funding (M=3.85), short courses (M=3.82), orientation programmes (M=3.76) and workshop/seminars (M=3.77) and others.
Conclusion: The study concludes that extension organizations should provide training opportunities for extension personnel to sustain positive attitude and improve knowledge on emerging issues in climate change. Institutions of higher learning should increase climate change content of curriculum for training prospective extension personnel to encourage early exposure and commitment to climate change issues. Favourable policy and institutional environments should be promoted by the government to increase responsiveness of extension organizations to climate change.

Keywords: Climate change; logistic regression; extension; adaptation; agriculture.

1. INTRODUCTION

Africa remains one of the most vulnerable continents to climate change because of multiple stresses resulting from political and economic conditions; and the continent's dependence on natural resources and weak adaptive capacity [1]. African economy is predominantly agrarian, rain-fed and fundamentally dependent on the vagaries of weather; and due to inability to cope given the level of poverty and low technological development, cropping capabilities by farmers are low [2,3,4]. The area suitable for agriculture, the length of growing season and yield potentials are expected to decrease due to climate change [1]. Many parts of Africa are suffering severe drought and floods which destroy roads and buildings and wipe out millions of hectares of farmlands [5]. These environmental problems result to low and unpredictable crop yields, which invariably make farmers more vulnerable [2,6]. It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change [7]. It is considered one of the serious threats to sustainable development, with the adverse impacts expected on the human health, food security, environment, and physical infrastructure [8]. Above all, between 75 and 250 million people may be exposed to increased water stress due to climate change by 2020 in Africa and this will adversely affect livelihoods in the region [9].

Available evidences show that Nigeria is already experiencing diverse ecological problems which have been directly linked to the on-going climate change. The southern ecological zone of Nigeria largely known for high rainfall is currently faced with irregularity in rainfall pattern, while guinea savannah is gradually experiencing increasing temperature [10]. The Northern zone faces threat of desert encroachment at a very fast rate per year occasioned by fast reduction in the amount of surface water, flora and fauna resources on land [11]. Kalejaite-Matti, et al. [12] observe that signs of desertification and savanalization are now becoming evident in Oyo, Osun, Ondo and some other parts of the south-western states of Nigeria which hitherto fell within rainforest. In the Sahel zone of northern Nigeria, the most pronounced climate change-related forms of land degradation are wind erosion and related sand dune formation, drought and desertification [13]. Furthermore, the southeast of Nigeria has experienced increased flooding and numerous gully erosion sites which have resulted to loss of arable farmlands, farmstead, economic tree, biodiversity and others [14]. Also cases of flooding which destroyed people's properties, building and lives were reported in Anambra, Bayelsa, Delta and Kogi States of Nigeria.

Adaptation to climate change is therefore an imperative for addressing vulnerability and building resilience for sustainable livelihoods and food security across the globe and Nigeria in particular. Thus, promoting the development and diffusion of technical know-how, sustainable and environmentally sound practices are important for improving and enabling adaptation to climate change [6]. Farmers need access to relevant information ranging from climatic information, weather forecasts, adaptive technology, innovations, or markets—through extension and information systems. Adaptation to climate change requires that farmers should be equipped with sufficient knowledge, skills and information on climate change, causes, effects and impacts; and ecological sound measures and strategies practically feasible in their locality for enhanced resilience. This calls for multi-stakeholder approach to measures, policies, strategies and responses aimed at addressing climate change phenomenon. Agricultural extension has a key role to play in changing the knowledge, attitude, resilience capacity and skills of the people (farmers) for efficient adaptation to climate change [15]. As information brokers, educators

and service provider to rural farmers, they occupy critical position in the forefront for agricultural adaptation to climate change. Above all, extension professionals need to mobilize and assist farmers and communities in implementing such policies and programs and managing disaster challenges. In essence they need to build farmers' abilities for planning, problem solving, critical thinking, prioritizing, negotiating, building consensus and leadership skills, working with multiple stakeholders, and, finally, being proactive [16]. Largely, performance of such pivot role is a function of their knowledge and attitude to climate change issues. The study assessed knowledge and attitude of extension professionals to climate change. The specific objectives were to;

1. Ascertain the level of knowledge and attitude of extension professionals to climate change;
2. Determine factors that influence level of knowledge of climate change among extension professionals;
3. Determine factors that influence attitude of extension professionals to climate change and
4. Identify strategies for enhancing knowledge and attitude of extension workers to climate change.

2. MATERIALS AND METHODS

The study was carried out in Anambra State. The state is located at the south-east region of Nigeria, between longitude 6^0 35'E and 7^0 21'E and latitude 5^0 38'N and $6^0$47'N. Anambra State has an estimated population of 4.18 million and land area of approximately 4,416 sq.km [17]. The climate can be generally described as tropical with two identifiable seasons, the wet and dry season. The average highest annual rainfall is about 1952 mm. The temperature pattern has mean daily and annual temperatures as 28°C and 27°C, respectively [18]. The vegetation consists of rainforest. The state is highly vulnerable to climate change. It is affected by gully erosion and flooding mainly in Onitsha and Anambra zones. The primary occupation of the people in the state is farming, though there is diversification into non-farm occupations such as petty trading, handicraft among others. The state has 21 local government areas (LGAs) and is divided into four agricultural zones namely; Aguata, Anambra, Awka and Onitsha zones.

The population of the study comprised extension personnel in Anambra State Agricultural Development Programme (ADP) which is the main public agency with government mandate for extension services. All extension personnel in Anambra State ADP were used for the study due to low population of the extension workers in the State.This gave a total of eleven extension personnel at the headquarters level, four Zonal managers, four zonal extension officers, 20 semester master specialists, 16 block extension supervisors, nine block extension agents and 35 extension agents at the zonal level. Thus, a total of 99 respondents was used. Data were collected by use of questionnaire. Information on the knowledge of climate change among extension professionals was deduced using 45 knowledge statements. The respondents responded to the questions by answering 'yes' or 'no'. One mark was assigned to each correct question, making a total of 45. Later the respondents were categorized based on their scores into:

High knowledge: 31-45.
Moderate knowledge: 16-30.
Low knowledge: 1-15.

The attitude of respondents to climate change was ascertained using attitudinal statements. The respondents indicated their agreement to the altitudinal statement on a five point Likert-type scale of strongly agree (5), agree (4), undecided (3) disagree (2) and strongly disagree (1). These values were later summed up to 15 and divided by 5 to give a mean score of 3.0 which was used for decision rule. Altitudinal statement with mean score of ≥ 3.0 was considered a favourable attitude and < 3.0 regarded as unfavourable altitude. The weighted values were reversed for every negative statement. Respondent's agreement with the favourable statement indicated positive attitude towards climate change, while agreement with unfavourable statements indicated negative attitude towards climate change.

Also, the altitudinal index of respondents was obtained based on the scale and the weighted values. The 20 altitudinal statements have a maximum score of 100 and a minimum score of 20 on five point Likert type scale. This gave a mid-point score of 60. Thus, respondents with scores mid-point and below (20-60) were tagged as the percentage of personnel with unfavourable attitude (less supportive) to climate change; while above mid-point (61-100) were

tagged as the percentage of farmers with favourable attitude (more supportive) to climate change.

Logit model was used to ascertain factors that influence knowledge and attitude of extension professionals to climate change. Logit model is a qualitative choice model used to model relationship between dependent variable (Y) and one or more independent variable (X) where the dependent variable (Y) is a discrete variable that represents a choice or category from a set of mutually exclusive choices or category. Categorical variables such as sex, marital status, secondary occupation, area of academic specialization will be coded in order to transform them into dichotomous variable. While the other variables such as age, number of years spent in school, years of experience, number of training received will be entered directly into the equation.

Specifically, multinomial logit model was used to determine factors that influence knowledge of climate change. Since the categorical responses are more than two; high knowledge, moderate knowledge and low knowledge having n (12) independent variable and k(3) categories of response variables. Assuming K as the base level, and π_j = the multinomial probability of an observation falling in the jth category. To find the relationship between this probability and the m explanatory variables (X_1, X_2…..X_m) the equation is as follows;

$$\log\left(\frac{\pi_j(x_i)}{\pi_k(\pi_i)}\right) = \beta_0 j + \beta_1 j x_1 i + \beta_2 j x_2 i + \ldots\ldots \beta_{mj} x_{mi}$$

j= 1, 2,...,(k-1); i=1,2,...n

Now since all the π s add to unity, we have

$$\log \pi j(xi) = \frac{\exp(\beta_0 j + \beta_1 j x_1 i + \beta_2 j x_2 i + \ldots\ldots \beta_{mj} x_{mi}}{1 + \sum_{j=1}^{k-1} \exp(\beta_0 j + \beta_1 j x_1 i + \beta_2 j x_2 j \ldots\ldots + \beta_{mj} x_{mi}}$$

Source: [19]

Where;

β_o = constant term,
β_n = coefficient effect of each variable
X_{ij} = independent variables
$\beta_0 + \beta_1$ = input
$\pi(x)$ = output
g(x) = the logit function of some predictor X
log = natural logarithm
$\pi(x)$ = probability of being a case
e = exponential function
y = dependent variable i.e the level of knowledge of climate change issues which is categorized into 3;

High knowledge = 3
Moderate knowledge = 2
Low knowledge = 1

X_1 = Sex (male = 1, female = 0)
X_2 = age (years)
X_3 = marital status (married =1, not married = 0)
X_4 = household size (actual no of household)
X_5 = secondary occupation (farming =1, non-farming =0)
X_6 = years spent in school (actual number of years in school)
X_7 = area of academic specialization (agricultural extension =1, others =0)
X_8 = position in extension organization (field agent = 1, None field staff =0)
X_9 = years of experience in extension work (actual number of years spent in work)
X_{10} = participation in climate change activities (outreach, fieldtrip, workshop,) (yes =1, no =0)
X_{11} = no of training received on climate change (actual no of training received)
X_{12} = no of contact with the agency on climate change (actual no of agencies)

Binomial or binary logistic regression was used to determine factors that influence attitude of extension professionals to climate change. The response variable has only two possible values; favourable and unfavourable attitude, that is the dependent variable has only two categories or cases (binomial). The outcome is coded as “0” and “1” where the target group (referred as a case) is coded “1” and the reference group (referred as a non- case) is coded “0” In this case the dependent variable (Y) is dichotomized into two (favourable attitude with value of 1 and unfavourable attitude = 0). A binary logistic model will be employed as follows:

The probability of favourable altitude = Pi = $\frac{\exp zi}{1 + \exp zi}$

Where z = a random variable that predicts the probability of the ith personnel having a favourable attitude towards climate change.

Therefore the model is expressed for individual personnel as = $Z_i = \ln \frac{p_i}{1-p_i} = \beta_o + \sum_{n-1}^{n} B_n x_{ji}$

thus summarized as

$$Z_i = Y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_n x_n + \varepsilon =$$

Y = Attitude of extension agents to climate change

β_o = constant term, β_n = coefficients

The explanatory variables are $X_{li\ldots\ldots}X_{ni}$=

X_1 = Sex (male = 1, female = 0)
X_2 = age (years)
X_3 = marital status (married =1, not married = 0)
X_4 = household size (actual no of household)
X_5 = secondary occupation (farming =1, non-farming =0)
X_6 = years spent in school (actual number of years in school)
X_7 = area of academic specialization (agricultural extension =1, others =0)
X_8 = position in extension organization (field agent = 1, none field staff =0)
X_9 = years of experience in extension work (actual number of years spent in work)
X_{10} = participation in climate change activities (outreach, fieldtrip, workshop) (yes =1, no =0)
X_{11} = no of training received on climate change (actual no of training received
X_{12} = no of contact with the agency on climate change (actual no of agencies)

Furthermore, the respondents were asked to indicate from the list provided, the possible strategies and the extent they think the strategies will help to achieve improve knowledge and attitude of extension agents for agricultural adaptation to climate change. A four point Likert-type scale of great extent (4), an extent (3), little extent (2) and very little extent (1) were used. The values were added up to get 10 which was later divided by 4 to get 2.5 (mean). Variables with mean values of 2.5 and above (≥2.5) were regarded as major strategies, while variables with mean score below (<2.5) were regarded as minor strategies improving knowledge and attitude of extension professionals.

3. RESULTS AND DISCUSSION

3.1 Knowledge of Climate Change among Extension Professionals

Majority (63.4%) of the respondents had high knowledge of climate change, while a lesser proportion (22.6% and 14.0%) had moderate and low knowledge, respectively (Fig. 1). Specifically, the extension agents (70%), technical (66.7%) and administrative staff (53.3%) had high knowledge of climate change. A significant proportion (20.0%, 23.7% and 2.5%) of technical, administrative and field staff had low knowledge of climate change, respectively. Responses to knowledge statement shows that majority of the extension professionals knew that climate change is caused by emission of greenhouse gases (86.0%), increased industrialization (83.9%), bush burning (79.6%), human activities (77.4%) and deforestation (71.0%) (Appendix 1). Surprisingly, a significant proportion (34.4% and 33.3%) perceived use of fertilizer and pesticides as the causes of climate change. Others (30.1%, 29.0%, 10.8% and 9.7%) perceived climate change as a punishment from God due to disobedient, sins of the world, animal manure and digestion process of ruminant animal, respectively. The low perception of fertilizer and animal manure as causes of climate change suggests gap in knowledge of the fact that application of fertilizer to vegetation leads to N_2O emission [6].

Similarly, the respondents perceived fourteen (14) out of the fifteen (15) items as effects of climate change. They were abrupt changes in weather condition (92.5%), rising sea level (84.9%), increased temperature (83.9%), change in season pattern (82.8%), increase flooding, erosion and change in availability of water/rainfall (81.7%), frequent heat waves and drought (78.5%), drying of rivers and lakes (73.1%) and others (Appendix 1). In another hand, the respondents perceived all (13) the knowledge statement on adaptation as climate change adaptation measures. These measures included dissemination of useful information and practice by extension to farmers (88.2%), change in the timing of farm operation (84.9%), afforestation and disaster management (82.8%), generating technologies and building capacity for mitigation and adaptation to climate change (80.6%), use of improved/resistant crop and animal varieties (77.4%), altering cropping pattern and management practices (75.3%) and others.

Overall, the respondents have knowledge of climate change causes, effects and adaptation measures. However, the low proportion that expressed poor knowledge of some anthropogenic activities like use of fertilizer, herbicides, poor handling of animal dung and ruminant digestion as causes of climate change suggest critical gap in knowledge. Of greater concern is the significant number that holds to the idea that climate change is as a result of God's wrath and sin. Responses within groups show divergent views on climate change phenomenon and consequently, the need for increase knowledge through training and orientation of professionals particularly extension agents. The verse knowledge of climate change could be attributed to the fact that the evidence of unpleasant impact of climate change abound in the southeast, Nigeria [14]. Anambra State is one of the states seriously affected by erosion and flooding due to climate change in the agro-ecological zone. The findings further confirm statement that climate change is one of the serious threats to sustainable development with the adverse impacts on the human health, food security, and physical environment [8]. The respondents may have been directly or indirectly affected by the negative impact/effect of climate change. Adequate knowledge of climate change issues is fundamental for the performance of extension roles for agricultural adaptation to climate change. According to Kahlor and Rosenthal [20] knowledge about climate change may lead to a more engaged citizenry and subsequently adaptation potential and resilience of farmers to climate change effects. Low knowledge among stakeholders could retard the adaptation potential, thereby increasing vulnerable to climate change effects.

3.2 Attitude of Extension Professionals to Climate Change

The respondents expressed favourable attitude towards all the attitudinal statements. These statements include: there is an evidence of climate change in Nigeria (M=4.41), adaptation to climate change is of vital importance and needs urgent attention (M=4.38), adaptation to climate change has potential for improved production, food security and poverty alleviation (M=4.30), climate change affect crop production very badly (M=4.30), building the capability of extension agents on climate change adaptation is importance (M=4.27), extension has vital role to play in climate change adaptation and mitigation (M=4.23) and others (Appendix 2). However, the high standard deviation shows dispersed views on climate change issues among the respondents.

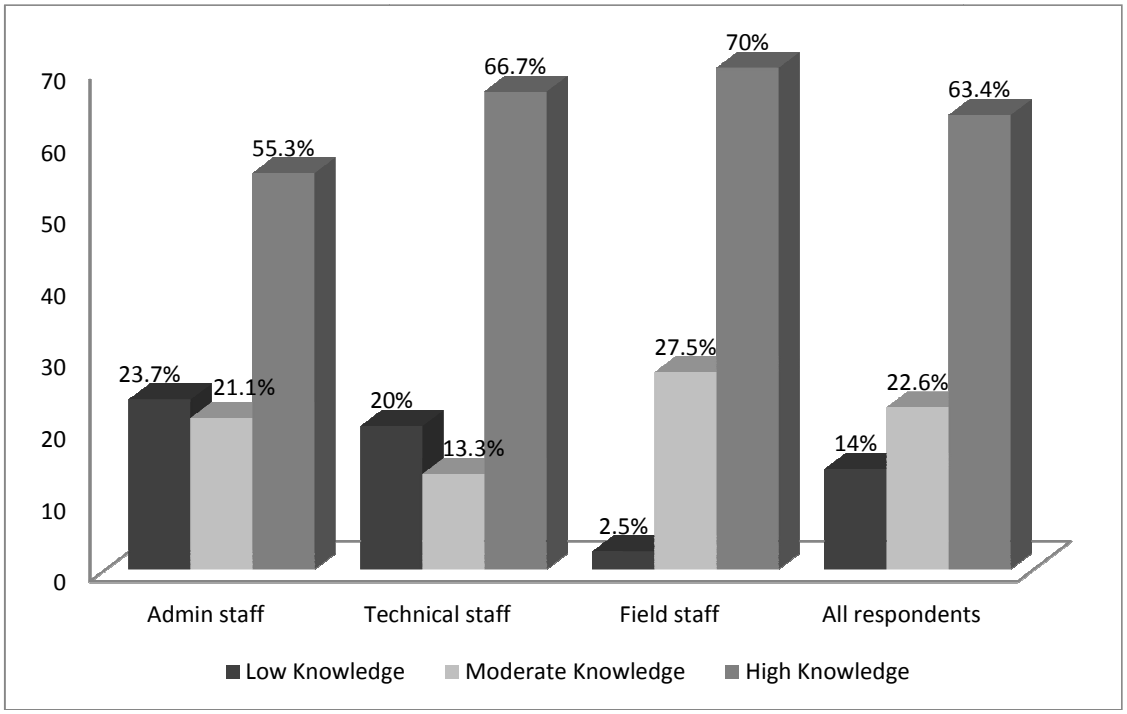

Fig. 1. Knowledge level of respondents on climate change

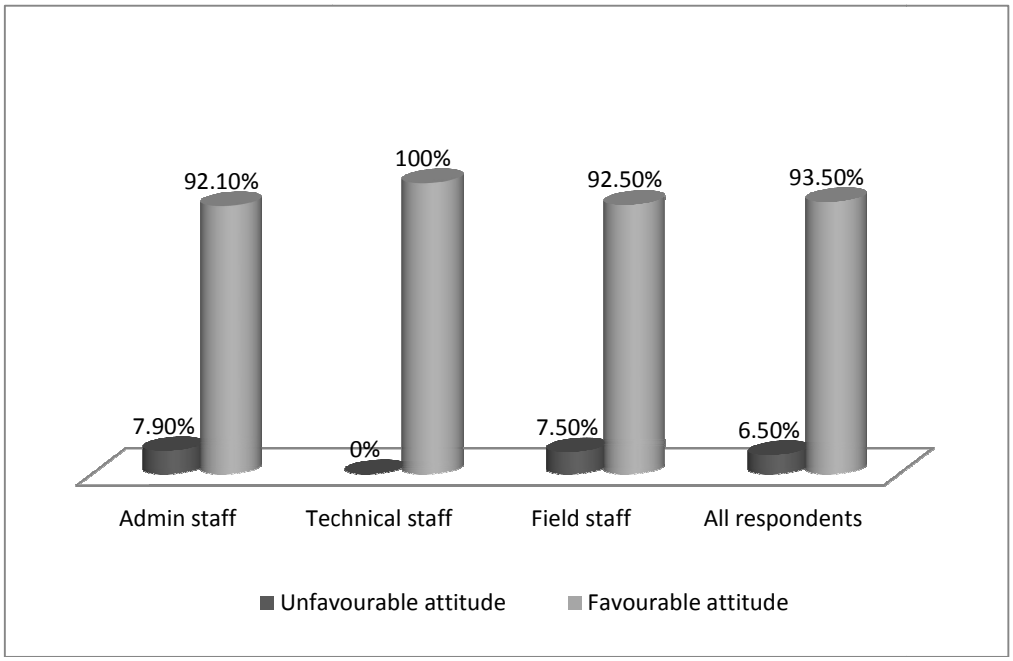

Fig. 2. Percentage distribution of respondents based on attitude to climate change

On the other hand, the technical (M=2.87) and field (2.92) staff expressed unfavourable attitude towards land use as cause of climate change. This suggests either lack of knowledge or disagreement with the fact that global increases in CO_2 concentration are primarily due to fossil fuel and land use change, while that of CH_4 and N_2O are primarily due to other anthropogenic activities in agriculture [9]. Generally, majority (93.5%) of the respondents had favourable attitude towards climate change, while 6.5% expressed unfavourable attitude. Specifically, all (100%) technical staff, 92.5% of the field staff and 92.1% of administrative staff showed positive attitude towards climate change. A lesser percentage (7.9%, 7.5%) of administrative and field staff showed negative attitude to climate change, respectively. This could be attributed to adequate knowledge of climate change phenomenon shown by the respondents. It suggests that extension workers are very much aware of climate change phenomenon and the challenge of adaptation. This is crucial given the critical roles of extension in building capacity of farm communities. According to Ozor and Nnaji [15], the primary role of extension is in the dissemination of innovations to targeted clientele ranging from farmers, pastoralists, fisher-folks, hunters, foresters, wine-tappers and other rural residents who depend on agriculture in one way or the other. Sustained positive attitude is fundamental to national and local actions to adapt and mitigate climate change in the country.

3.3 Determinants of Knowledge of Climate Change among Extension Professionals

The results of multinomial logistic regression showed that among the personal and institutional characteristics, the position of extension personnel in extension organization was significant and negatively (B= -5.844, *P= 0.01*) related to knowledge level of climate change (Table 1). This means that the probability that extension personnel will have low or high knowledge of climate change is a function of his position in the organization. This could be true because the position occupied determines the job description and the people served and possibly the degree of participation and commitment to climate change activities particularly at the grassroots. The frontline extension workers are closer and have more regular contact with farmers and ecological system of rural communities than the administrators and sometimes the technical workers. They receive and process feedback from farmers and could be more informed about challenges experienced by rural communities. Consequently, may be more responsive to climate change information and training

opportunities. Also the technical staff are continuously exposed to environmental and climate –related challenges due to their involvement in on-farm technology testing, field trips and diagnostic survey. Thus, knowledge of climate change is a function of familiarity of extension workers with the farming environment and related ecological problems which is dependent on the position occupied and the people served.

Similarly, year spent in extension organization was significant (B = 487, *P= 0.02*) and positively related to knowledge level of extension workers. The probability that extension personnel will have low or high knowledge of climate change is positively related to years of experience in extension work. In other words knowledge of climate change increases with the number of years in extension organization. Climate change is an aged- long phenomenon and its impacts in terms of decreasing crop yield, loss of marginal lands, increase pest and diseases, displacement, poverty etc on communities are evident and a global concern. The experienced extension workers may likely have higher knowledge of climate change because of their commitment and involvement in delivering emerging technologies, information, farmers' experimentation and practices for adaptation and sustainability of ecosystem. Besides, greater number of years could affords extension workers opportunity for training, attendance to workshops, conference, interaction and access to information on climate change.

The number of trainings and involvement in climate change activities had no significant relationship with the probability of having low or high knowledge by extension workers. This is possible because most extension organizations especially the public extension systems are yet to evolve climate- related activities and trainings or integrate climate information/role in the portfolio of extension services. The perception and responsiveness to the expected role for agricultural adaptation to climate change is still at a very low ebb, perhaps due to multi-dimensional problems confronting the system. Moreover there are less chances of exposure to climate change issues at pre-service training of extension professionals because of poor incorporation of climate science in universities curriculum. Besides, access to such training could be hampered by poor funding and institutional supports to extension system in Nigeria.

Age, sex and marital status were not significantly related to the knowledge level of the extension workers, though younger extension workers are expected to be more proactive and responsive to change, particularly change in climate change. Also sex and marital characteristics could explain the probability of low or high knowledge of climate change by extension workers because male extension workers are often believe to have greater access to information through print media, television and radio because of less tight personal schedule, unlike the female counterpart who traditionally operate very busy and extra curriculum- packed schedules. Also the married extension workers have lower rate of job mobility, more experience on the job and possibly greater exposure to climate change challenges than younger ones who most often display high mobility in search of greener pasture.

Furthermore, the year spent in school and area of specialization of extension professionals were not significantly associated with knowledge level of climate change. The finding is not surprising because most institutions of higher learning and disciplines have not adequately reflected climate change issues in the curriculum; though there has been much emphasis and promotion of curricula review to increase climate change content of courses offered in universities. This is in accordance with general recommendation that climate change issues should be infused into curricula of universities as a matter of urgency [21].

3.4 Determinants of Attitude of Extension Professionals to Climate Change

Results of the binomial regression analysis showed that year spent in school was significant (B = 0.398, *P = 0.04*) and positively related to the attitude of extension workers to climate change. In other words, the probability that extension professionals will have positive altitude to climate change adaptation challenges is a function of the number of years spent in school. Ideally, the number of years in school explains the level of education, exposure, knowledge and information about emerging issues like climate change and probably attitude and commitment to change. The more educated the extension professionals, the more they may be positively disposed and committed to climate change issues and challenges.

Also year spent in extension work is an important explanatory variable for attitude of extension workers. The results show that it was significant

but negatively (B = -0.503, P= 0.03) associated with attitude of extension workers. This means that the probability of displaying favourable attitude for agricultural adaptation to climate change decreases with increase in number of years in extension work. This is surprising because it is expected that as the year of experience increases, the more informed, abreast and committed the extension worker to issues that mares or enhance livelihood of the clients within the context of emerging challenges. However, where there is low morale, motivation and poor career advancement opportunities as is common in most public extension systems, the reverse may be the case and hence unfavourable altitude to climate change and related issues irrespective of years of experience in extension work. In another hand, year spent in extension could also translate to higher administrative position, where the personnel though knowledgeable about issues of climate change but may have little or no direct involvement and subsequently could display low perception and unfavourable attitude.

Table 1. Multinomial logistic regression of influence of personal and institutional factors on knowledge of climate change

Knowledge scores grouped[a]		Logistic coefficient (B)	S. E	Wald	P-value	Odd ratio [Exp(B)]
Low Knowledge	Intercept	-21.561	4.668	21.335	.000	
	Participation in Climate change activities	.412	2.445	.028^{NS}	.866	1.509
	Number of trainings on Climate change	-.185	1.254	.022^{NS}	.883	.831
	Number of contact	-19.353	4514.841	.000^{NS}	.997	3.935E-9
	Age	.006	.039	.020^{NS}	.887	1.006
	Household size	.488	.312	2.441^{NS}	.118	1.628
	Years spent in extension	.487	.208	5.482***	.019	1.628
	Marital status	14.230	.000	.	.	1.514E6
	Secondary occupation	2.454	1.687	2.117^{NS}	.146	11.635
	Area of specialization	-.757	1.672	.205^{NS}	.651	.469
	Position in extension organization	-5.844	2.086	7.852***	.005	.003
	Sex	-3.036	1.822	2.776^{NS}	.096	.048
	Years spent in school	-.280	.164	2.893^{NS}	.089	.756

**** indicates significant at 5% level of probability. NS shows non-significant*

Table 2. Binomial regression of personal and institutional factors associated with attitude of extension workers

		Logistic coefficient (B)	S.E.	Wald	P-value	Odd ratio [Exp(B)]
Step 1	Sex	.916	1.618	.321^{NS}	.571	2.499
	Age	.027	.047	.333^{NS}	.564	1.028
	Marital status	5.820	3.372	2.978^{NS}	.084	337.094
	Household size	-.636	.437	2.119^{NS}	.145	.529
	Secondary occupation	1.841	1.742	1.117^{NS}	.290	6.303
	Years spent in school	.398	.198	4.044***	.044	1.488
	Number of contact	.077	.676	.013^{NS}	.910	1.080
	area of specialization	2.693	2.241	1.444^{NS}	.229	14.777
	Number of training on Climate Change	.331	.569	.339^{NS}	.560	1.393
	Position in extension organization	-2.323	1.677	1.919^{NS}	.166	.098
	Participation in Climate .Change activities	-7.249	3.983	3.312^{NS}	.069	.001
	Years spent in extension organisation	-.503	.231	4.729***	.030	.605
	Constant	9.885	4.888	4.089	.043	1.964E4

**** indicates significant at 5% level of probability. NS shows non-significant*

Other explanatory variables namely sex, marital status, participation in climate change activities, training, and others have no significant relationship with probability of positive attitude towards climate change. This is probably true because extension worker whether male or female, married or unmarried, administrative or field workers may not have been adequately exposed or participated in any climate change training or activities given the general low capacity and involvement of extension system in climate issues.

3.5 Strategies for Enhancing Knowledge and Attitude of Extension Agents to Climate Change

Table 3 indicates that all (100%) the variables listed were considered as effective strategies required to enhance knowledge and attitude of extension professionals to climate change. These strategies were adequate funding of extension services (public system) (M=3.85), provision of short-courses (M=3.82), employment of trained/qualified extension

Table 3. Mean scores based on strategies for enhancing extension professionals knowledge and attitude to climate change

Strategies	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Adequate funding of extension services (public system)	3.84*	.37	3.93*	.26	3.83*	.64	3.85*	.49
orientation courses for extension agent for attitude change	3.76*	.49	3.80*	.41	3.75*	.49	3.76*	.48
Provision of short-course for extension agent on climate change	3.84*	.37	3.80*	.56	3.80*	.61	3.82*	.51
Employment trained/qualified extension agents	3.71*	.52	3.80*	.56	3.82*	.45	3.77*	.49
Availability of functional and reliable weather forecasts/climate information stations	3.63*	.63	3.87*	.35	3.58*	.71	3.65*	.64
Provision of needed input and infrastructures	3.34*	.85	3.80*	.56	3.56*	.60	3.51*	.72
Institutional and policy support for researches on climate change	3.55*	.65	3.87*	.35	3.60*	.74	3.62*	.66
Collaboration with other agencies	3.58*	.64	3.60*	.51	3.10*	.90	3.38*	.78
Provision of logistic supports for field staff	3.65*	.63	3.60*	.63	3.58*	.71	3.61*	.66
Availability of functional policy instrument on climate change mitigation and adaptation	3.47*	.76	3.73*	.46	3.30*	.76	3.44*	.73
Inclusion of climate change issues into school curriculum (secondary, high institutions)	3.50*	.73	3.60*	.63	3.55*	.71	3.54*	.70
Organizing/attendance to workshops conferences, seminars etc.	3.76*	.54	3.93*	.27	3.73*	.64	3.77*	.55
Presences of climate change related policies in rural development.	3.39*	.76	3.40*	.51	3.25*	.78	3.33*	.73
Promoting indigenous knowledge in research-extension system	3.50*	.73	3.47*	.64	3.30*	.72	3.41*	.71
In-services training of extension agents	3.62*	.68	4.00*	.00	3.56*	.88	3.66*	.73

workers (M=3.77), organizing/attendance to workshops conferences, seminars etc (M=3.77), orientation courses for extension workers for attitude change (M=3.76), in-services/in house training of extension staff (M=3.66), availability of functional and reliable weather forecasts/climate information stations (M=3.65), institutional and policy support for researches on climate change (M=3.62), and others. Both categories of extension professionals shared similar views on the effective strategies for enhancing knowledge and attitude. The low standard deviation further indicates homogeneity of perception within categories. Climate science education is fundamental in building competence of stakeholders for adaptation, particularly among extension professionals as educators and broker of information/technologies to the most vulnerable group in the population. Ernst, et al. [22] opine that increase in general education could help develop technological capability in the workforce especially for climate change. This could be achieved through certificate short course, conferences/seminars, in-house training of extension agents. National Research Council [23] recommends that the federal government should establish a national task force that includes formal and informal educators, government agencies, policymakers, business leaders, and scientists, among others, to set national goals and objectives, and to develop a coordinated strategy to improve climate change education and communication. In service training, workshops, conferences etc makes for gap in knowledge and keep workers abreast of emerging issues in related subject areas. It may also require that curricular content, teaching materials, methods and delivery approaches be designed in such a way as to equip students who are the future extension workforce with necessary skills and knowledge to tackle climate change global challenges and their interpretation in specific local situations [24].

Favourable policy and adequate funding of extension and research organisations are indispensable for provision of essential infrastructure, working environment and fostering linkages required for acquisition of relevant knowledge. Strong linkages with stakeholders like research, education and private/NGOs are apt to develop contextualized information; enhanced access to appropriate adaptation technologies as well as information flow, learning and cooperation necessary for the required competence. According to Collins and Ison as cited by Bartels, Furman, Diehi, Royce, & Doure et al. [25] stakeholders network and participatory processes have been proposed as venues and mechanisms for repeated knowledge sharing, dialogue and learning about climate change and adaptation. Furthermore, policy and funding should be such that promote adequate logistic supports, encourage positive attitude, interest and commitment of extension. Presence of functional climate change policy with provisions for capacity building and training of stakeholders at all levels is required.

4. CONCLUSION

Climate change stands a formidable challenge to food security, sustainable livelihood and poverty reduction in the country. Building adaptive capacity and resilience of farmers and their communities is a priority for all stakeholders, particularly extension workers. Generally, extension workers showed high knowledge and favourable attitude to climate change issues. However, low knowledge of some critical causes of climate change such as use of fertilizer and pesticides suggests gap in knowledge. Years of experience, years spent in school and position in extension organization are critical determinants of extension professionals' knowledge and disposition to climate change issues and should be considered in targeting extension workers for training. Extension professionals opined that knowledge and attitude to climate change could be improved and sustained through in service training, workshops, attendance to conferences, seminars, policy, and institutional supports to extension organizations. The study recommends that extension organizations should provide training opportunities for extension personnel to sustain positive attitude and improve knowledge on emerging issues in climate change. Institutions of higher learning should increase climate change content of curriculum for training prospective extension personnel to encourage early exposure and commitment to climate change issues. Favourable policy and institutional environments should be promoted by the government to increase responsiveness of extension organizations to climate change.

DISCLAIMER

The instrument for data collection was validated and approved by team of researchers and experts before administering to respondents. They represent the research ethics committee of the department.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

Appendix 1. Percentage distribution of respondents according to knowledge on causes of climate change

Knowledge questions on causes of climate change	Administrative staff	Technical staff	Field staff	All respondents
	Percentage (%)(n=38)	Percentage (%)(n=15)	Percentage (%)(n=40)	Percentage (%)(n=93)
Signs of end of the world causes climate change	21.7	33.3	45.0	33.3
Deforestation causes climate change	**63.2**	**73.3**	**77.5**	**71.0**
Sins of the world causes climate change	15.8	46.7	35.0	29.0
Bush burning causes climate change	**71.1**	**73.3**	**90.0**	**79.6**
Use of fertilizer causes climate change	18.4	**53.3**	42.5	34.4
Use of pesticides causes climate change	21.1	46.7	40.0	33.3
Punishment from God due to disobedient is the cause of climate change	13.2	46.7	40.0	30.1
Human activities like burning of fossil fuel causes climate change	**65.8**	**80.0**	**87.5**	**77.4**
Agriculture/Land use causes climate change	**50.0**	**60.0**	**60.0**	**55.9**
Increased industrialization causes climate change	**76.3**	**80.0**	**92.5**	**83.9**
Emission of greenhouse gases like CO2 causes climate change	**76.3**	**93.3**	**92.5**	**86.0**
Natural decay of waste water, crop and animal causes climate change	36.8	**60.0**	**65.0**	**52.7**
Digestion process of ruminant animals causes climate change	5.3	6.7	15.0	9.7
Storage and spreading of animal manure causes climate change	5.3	33.3	7.5	10.8
Respiration and volcanic eruptions causes climate change	**57.9**	46.7	**62.5**	**58.1**

Multiple response

Appendix 2. Percentage distribution of respondents according to knowledge of effects of climate change

Knowledge questions on effects of climate change	Admin staff	Technical staff	Field staff	All respondents
	(%)(n=38)	(%)(n=15)	(%)(n=40)	(%)(n=93)
Abrupt changes in weather condition are caused by climate change	89.5	93.3	95.0	92.5
Increase flooding and erosion	**68.4**	**100**	**87.5**	**81.7**
Increase in pest, insect, disease and weed infestation	28.9	40.0	37.5	34.4
Drying of rivers and lakes	**65.8**	**73.3**	**80.0**	**73.1**
Reduction in soil nutrient and poor yield of crops i	**52.6**	**66.7**	**72.5**	**63.4**
Increased temperature	**76.3**	**100**	**85.0**	**83.9**
Frequent heat waves and drought	**68.4**	**80.0**	**87.5**	**78.5**
Change in availability of water/rainfall	**71.1**	**73.3**	**95.0**	**81.7**
Rising sea level	**73.7**	**100.0**	**90.0**	**84.9**
Change in season pattern	**73.7**	**80.0**	**92.5**	**82.8**
Soil drainage (leaching)	44.7	**53.3**	**67.5**	**55.9**
Shrinking of ice sheet	**55.3**	**60.0**	**52.5**	**54.8**
Ocean acidification	**55.3**	**80.0**	**70.0**	**65.6**
Change in wild life behavior	39.5	**60.0**	**62.5**	**57.3**
Increase in food insecurity and malnutrition	**50.0**	**60.0**	**62.5**	**57.0**

Multiple response

Appendix 3. Percentage distribution of respondents according to knowledge of adaptation to climate change

Knowledge questions on adaptation measures	Admin staff	Technical staff	Field staff	All respondents
	(%)(n=38)	(%)(n=15)	(%)(n=40)	(%)(n=93)
Change in the timing of farm operation	89.5	73.3	85.0	84.9
Use of improved/resistant crop and animal varieties	68.4	73.3	87.5	77.4
Afforestation is an adaptation measure	76.3	80.0	90.0	82.8
Prompt and intensive weeding	26.3	86.7	62.5	51.6
Irrigation	63.2	66.7	72.5	67.7
Alteration in the location of cropping activities	60.5	66.7	75.5	67.7
Building competence of extension workers on climate change	68.4	66.7	82.5	74.2
Generating technologies for adaptation	71.1	80.0	90.0	80.6
Dissemination of useful information and practices	81.6	100.0	90.0	88.2
Investment on stakeholder's forum	76.3	80.0	85.0	80.6
Improving soil organic content	60.5	66.7	77.5	68.8
Community awareness and disaster management	81.6	100.0	77.5	82.8
Altering cropping pattern and management practice	73.7	66.7	80.0	75.3
Safeguarding water resources	71.1	73.3	70.0	71.0
Diversifying economic activities	68.4	80.0	75.0	73.1

Multiple response

Appendix 4. Mean scores based on attitude of extension professionals to climate change

Attitudinal statement	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Climate change is not scientific jargon	4.13*	1.02	3.87*	1.36	3.61*	1.26	3.87*	1.20
Climate change is not a punishment from God	4.18*	.87	3.87*	.99	3.55*	1.29	3.87*	1.11
Agricultural production is affected by climate change	4.39*	1.03	4.27*	1.10	3.95*	1.32	4.18*	1.18
Human activities cause climate change	3.65*	1.44	4.43*	.85	3.84*	1.00	3.85*	1.20
Agricultural practice causes climate change	3.14*	1.48	3.53*	1.41	3.30*	1.24	3.27*	1.36
Building the capability of extension agents on climate change adaptation is of importance	4.32*	1.30	4.20*	1.08	4.26*	.95	4.27*	1.11
Climate change affect crop production very badly	4.47*	.86	4.27*	.70	4.15*	.71	4.30*	.78
Adaptation to climate change is of vital importance and needs urgent attention	4.29*	1.09	4.47*	.52	4.44*	.64	4.38*	.84
Increase in pest disease and weed infestation is caused by climate change and should be addressed	3.25*	1.32	3.40*	1.06	3.59*	1.12	3.42*	1.19
Extension has vital role to play on climate change adaptation and mitigation	4.11*	1.11	4.27*	1.03	4.35*	.75	4.23*	.96
Land use has an effect on climate	3.61*	1.15	2.87	1.12	2.92	1.04	3.19*	1.14
Climate change can be mitigated or adapted to	3.92*	1.26	3.20*	1.01	3.69*	1.00	3.71*	1.13
Awareness of climate change effect, causes, adaptation and mitigation among farmers is very relevant.	4.13*	1.04	4.13*	.52	4.21*	1.13	4.16*	1.01
Generating technologies for climate change adaptation should be research/extension priority	4.03*	1.28	4.13*	.99	4.23*	.74	4.13*	1.03
There is an evidence of climate change in Nigeria	4.43*	.96	4.36*	.50	4.41*	.75	4.41*	.81
Extension system should not concentrate on transferring knowledge/technologies for increase production and income of farmers rather than educating farmers on climate change phenomenon	3.82*	1.43	3.93*	.88	4.10*	1.05	3.96*	1.19
Farmers need technologies for climate change adaptation rather than credit for increased production.	3.54*	1.24	3.33*	1.23	3.67*	.96	3.56*	1.12
Concern on formulating climate change policy should be evidence based or society oriented rather than political motivated	3.97*	1.24	3.13*	1.36	3.77*	1.06	3.75*	1.21

Attitudinal statement	Admin staff		Technical staff		Field staff		All respondents	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Irregularities in rainfall, increased temperature and cases of flooding are associated with change in climate	4.03*	1.40	4.00*	.93	4.05*	1.03	4.03*	1.17
Adaptation to climate change has potential for improved production, food security and poverty alleviation	4.34*	.78	4.80*	.41	4.08*	.87	4.30*	.89

Favourable attitude

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