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Farmers' awareness of climate change and intensity of its effects on food production in Southwest Nigeria

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Abstract: The awareness of climate change is the aggregate of knowledge and perception held by the society on climate change which perhaps affects their behaviour, quality of responses and reactions to the problems. The purpose of this study was to provide empirical information on the factors influencing climate change awareness and the intensity of the effects of changing climatic conditions on agricultural production in Southwest Nigeria. Three states were purposively selected across southwest Nigeria to ensure that the three local ecological zones in the area were covered. The states selected include Ekiti, Ogun and Oyo States. Data were collected with the use of structured questionnaire administered to 360 randomly sampled farm units. Data collected were analysed using descriptive statistics and binary probit model. The result of the probit model signified that farmer's age, education, farming experience, farm size, farming income and extension contacts are variables that significantly influenced farmers' awareness of climate change. The explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.712) was good and relatively high, indicating that the significant variables are responsible for about 71% variation in farmers' awareness of climate change phenomenon in the area. Effects of climate change include reduction in crop yield, drying up of rivers, lakes and streams and heat stress on crop and livestock were some of the serious effects of climate change on agricultural production in Southwest Nigeria.
Keywords: Climate change, Adaptation, Awareness, Food production

INTRODUCTION

Change in climate is one of the predominant factors that influence agricultural production. Climate change is an alteration in the climatic condition over a period of time due to the effects of natural variability and/or as a result of human anthropogenic activities (IPCC, 2001). The impact of climate change is global, but the most adverse effects is expected to be felt in developing countries, especially those in Africa (Nwafor, 2007; Jagtap, 2007). On country specific, Ayinde, *et al.* (2010) stated that the vulnerability of African farmers to the effects of climate change is expected to be most severe in Nigeria, due to their low coping capability. The effects of climate change cut across all the sub-sectors of Nigerian agriculture such as livestock, crop production, agroforestry, fishery, agricultural products processing and so on. For instance, climate change affects animal production through changes in pastures and forage crop availability, changes in the distribution of livestock diseases and pests; effects of weather and extreme events on animal health, growth and reproduction. The changes in temperature and precipitation might further alter arable and forest crop yields, water and nutrient budgets in the field thereby subjecting crops to stress. On the damages to aquatic lives, climate change will likely affect the metabolism, growth and distribution of many aquatic organisms as well influence diseases that afflict them. For agricultural processing, Enete, *et al.* (2013) reported that climate change has significantly affected cassava processing through poor storage quality of processed cassava products. In addressing this global threat, Tubiello and Rosenzweig (2008) stated that, a wide range of adaptation practices exist within farming system to help maintain or increase crop and livestock yields under climate change.

Climate change adaptation methods according to Nyong, *et al.* (2007) are those strategies that enable the individual or the community to cope with or adjust to the impacts of the change in climate. In agriculture, adaptation helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socioeconomic conditions including climatic variability, extreme weather conditions such as droughts, floods and volatile short term changes in local and large-scale markets (Kandlinkar and Risbey, 2000). Farmers' adaptation to the effect of climate change is often time shaped by their awareness of the changes in the climatic conditions (Amusa, 2014).

Climate change awareness is the aggregate of knowledge, attitudes or beliefs held by the society on climate change and global warming. According to Oruonye (2011), climate change awareness is a synthesis of the people's conception, interpretation and perceptions of climate change related issues which affect their behaviour, and the quality of responses and reactions to the problems. Nzeadibe, *et al,* (2011) stated that the perception of climate change governance by stakeholders, such as farmers, is important as perception (awareness) can shape the preparedness of these actors to adapt and change or modify their farm practices. In affirmation, Madddison (2007) noted that awareness of climate change is a necessary prerequisite for adaptation

practices by farmers. Farmers' perception of climate change is related to awareness level and availability of information on the phenomenon. The spatial behaviour and behavioural responses of individuals and communities are often framed around their awareness of climate change problems.

It is expected that improved knowledge through education and farming experience will positively influence farmers' awareness and decision to take up climate change adaptation measures. Improved education and disseminating strategies constitute important policy measures for stimulating awareness and local participation of farmers in various development and national resource management initiatives (Anley*et. al.,* 2007). Farming experience improves awareness of change in climate, the potential benefits and willingness to participate in local natural resource management of conservation activities. The coping capacity among Nigerian farmers like other developing countries is still low. This among other factors could be linked to the relatively low level of awareness of climate change in developing countries when compared with developed nations where people are more informed about issues surrounding climate change. The perceived relatively low level of awareness about climate change among farmers in developing countries is an impediment to effective implementation of common undifferentiated commitments to the convention on climate change and the protocol processes, particularly, the Clean Development Mechanism (CDM) (Oruonye, 2011). One of the major constraints encountered by farmers in adaptation is lack of adequate information and consequently low awareness of climate change.

Inadequate information about climate change among the farmers limits their level of awareness of the global phenomenon. Maddison (2007) submitted that preliminary evidences from a number of studies across African countries revealed that large number of farmers already perceive that the climate has become hotter and the rain has become less predictable and shorter in duration. Sofoluwe, *et al.* (2011) confirmed that most Nigeria farmers are already aware of the changes in climate. But despite this observation, there is still appreciable need for improved awareness among farmers and other major stake holders in natural resources exploitation and management about climate change.

Literature evident in Deressa *et al,* (2008) estimated determinant of farmers' choice of adaptation methods. The study of Gbetibouo (2009) investigated farmers' perceptions and adaptations to climate change, while Maddison (2007) focused on perception of and adaptation to climate change in Africa. These studies estimated the determinants of the discrete decision to adapt to climate change after being aware of the phenomenon but none indicated further the intensity of the effects of the climate change that prompted their awareness. Therefore, empirical-based information on the awareness and intensity of the effects of climate change on food production activities of farmers in southwest, Nigeria is imperative to help farmers build effective adaptive response to the impact of climate change. Specifically, the study identified major sources of awareness of climate change among farmers, determinants of farmers' awareness, and the intensity of the effects of climate change on agricultural production in Southwest Nigeria.

METHODOLOY

Study Area - The study was carried out in Southwest Nigeria. Southwest is made up of six states which include: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. Southwest Nigeria falls within latitudes 6^0 N, 4^0 S and longitudes 4^0 W, 6^0 E, covering about 114,271 kilometre square. The average annual rainfall of Southwest Nigeria ranges between 1,200 to 1,500mm with a mean monthly temperature range of 18^0- 24^0C during the rainy season and 30^0 - 35^0C during the dry season (Adepoju, *et al,* 2011). Southwest Nigeria is predominantly agrarian due to the rich alluvial soil in the area. Notable food crops cultivated in the area include: cassava, maize, yam, cocoyam, cowpea, vegetables and cash crops such as cocoa, kola nut, rubber, citrus, coffee, cashew, mango and oil palm. Livestock such as goat, pig, sheep and poultry are predominantly reared in the area.

Sampling and data collection - Multi-stage random sampling technique was used for selecting 360 farm units for the study. Three states were purposively selected in Southwest Nigeria to ensure that the three local ecological zones in the area were covered. The three states selected were Ekiti State from derived savanna, Oyo State from guinea savanna and Ogun State from rainforest belt. From each of the three states, two agricultural zones were randomly sampled. These were Zones I and II from Ekiti State, Ibadan/Ibarapa and Ogbomosho zones from Oyo State while Ijebu Ode and Abeokuta zones were selected from Ogun State. From each of the selected six agricultural zones, two local government areas (LGAs) were randomly selected. Random sampling technique was used to select two farming communities from each of the sampled 12 LGAs making 24 farming communities for the study. From each of the selected farming communities, random sampling technique was also used to select 15 farm households giving a total of 360 farm units. Data for this study were obtained from primary source through the use of structured questionnaire. Data were

collected with the assistance of five trained research assistants. Out of the 360 copies of questionnaire administered, 348 copies were retrieved from the respondents (farmers) representing 96.7% return rate.

Data Analysis - The data collected were analyzed with descriptive statistics (mean) using 4-point rating scale and binary probit model as detailed below.

To determine the intensity of the effects of climate change on agricultural production in southwest Nigeria, mean and standard deviation were employed using 4-point rating scale technique. The 4-point rating scale of the intensity of the effect of climate change was graded as Very Serious, (VS) = 4, Serious (S) =3, Less Serious (LS) =2 and Not Serious (NS) = 1. The mean ratings of the respondents based on the 4-point rating scale were graded using boundary limit as stated below:

Response Categories		*Ordinal values*	*Real limit values*
Very Serious	(VS)	4	3.50 – 4.00
Serious (S)		3	2.50– 3.49
Less Serious	(LS)	2	1.50 – 2.49
Not Serious	(NS)	1	1.00 – 1.49

Probit Model

Since the awareness of climate change was obtained from a dichotomous (discrete) choice question with Yes = (1) if aware of climate change or No = (0) if not aware, binaryprobit model was employed to estimate the determinants of farmers awareness of climate change in the study area.

The hypothesised determinants of 'awareness' of climate change in this study are:

$\mathbf{X_1}$= Gender of the Household Head; Dummy (1 if male, 0 otherwise),

$\mathbf{X_2}$ = Ages of Household head (years); Continuous (in number),

$\mathbf{X_3}$= Years of Education (in years); Continuous (in number),

$\mathbf{X_4}$= Household size; Continuous (in number of persons),

$\mathbf{X_5}$ = Years of Farming experience; Continuous (in number),

$\mathbf{X_6}$ = Farm size; Continuous (in number of ha),

$\mathbf{X_7}$ = Educated members; Continuous (in number of persons),

$\mathbf{X_8}$ = Farm income; Continuous (in Naira N),

$\mathbf{X_9}$ = Extension visits (in number); Continuous (in number of time per cropping season),

$\mathbf{X_{10}}$ = Membership of farmers cooperatives; Dummy (1 if membership of cooperative, 0 otherwise).

The explicit form of the binary probit model is specified as:

$Pr (Y = 1/X) = ß_0 + ß_1X_1 + ß_2X_2 + ß_3X_3 + ß_4X_4 + ß_5X_5 + ß_6X_6 + ß_7X_7$ .....+ e

Where:

Y = Dichotomous probability estimate with 1, if a farmer is aware of climate change and 0 if otherwise.

$ß_0$ = Intercept

ß1, …ß14= Coefficients of the independent variables.

X1,…X14= Determinants of farmers' awareness of climate change.

e = the stochastic error term.

RESULTS AND DISCUSSION

Sources of Farmers' Awareness of Climate Change in Southwest, Nigeria

Farmers' awareness of climate change phenomenon is shaped by a number of socioeconomic and institutional factors. Figure 1 presents multiple responses and percentage distribution of major sources of awareness of climate change among farmers in southwest Nigeria. The result shows that 79.02% of the farmers were aware of climate change through personal observation of variations in the indicators, 62.64% of the farmers indicated extension agents as their source of awareness of the phenomenon, 27.87% of the farmers indicated researchers as their sources of awareness, 22.41% got their information through friends, 20.11% through radio/television, 19.25% through farmers' cooperatives, 17.81% from newspapers, 5.46% through the internet while only 3.74% of the farmers got their information about climate change through politicians.

The findings of this study are in line with that of Adebayo, *et al* (2011) reported that there is a high level of climate awareness among farmers (90%) insouthwest Nigeria; and that their main sources of information about climate change arepersonal observation, personal contacts, family and friends as well as radio andtelevision.The study of Deressa, *et al*. (2008) showed that 81% of the farmers around Nile basin in Ethiopia personally noticed a decrease in the amount of rainfall or a shorter rainy season.The findings of this study also concur with the report of National Metrological Services Agency (NMSA) (2001) which showed that farmers through personal observation are aware of increasing trend in temperature and decreasing trend in precipitation.

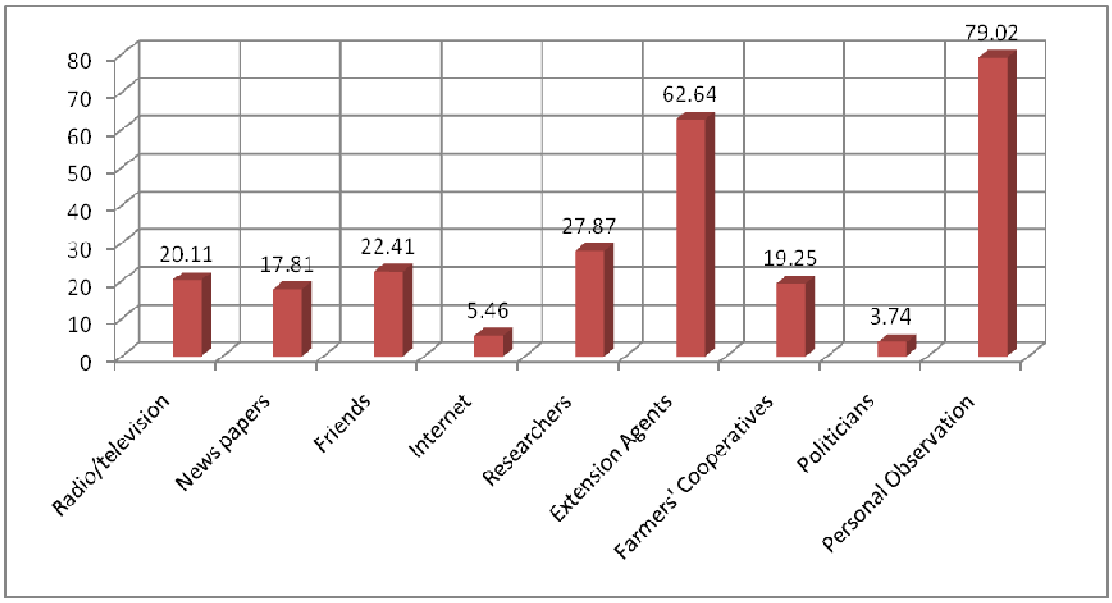

Figure 1: Percentage distribution of sources of awareness of climate change among farmers in Southwest Nigeria

The findings of this study also agreed with that of Maddison (2006) who in a study reported that the awareness of climate change appears to hinge on farmer's experience and the availability of extension services specifically related to climate change. In addition, Gbetibouo (2009) reported that farmers with access to extension services were likely to be aware of changes in the climate because extension services provide information about improved farm practices under the prevailing biophysical conditions such as climate and weather. This corroborates the fact that effective extension service delivery is a good avenue for farmers' increased awareness of climate change.

Socioeconomic Determinants of Farmers Awareness of Climate Change in Southwest Nigeria

The result of the binary probit model analysis on determinants of farmers' awareness of climate change presented in Table 1 shows that, the explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.712) was relatively high and seems good. By implication, the estimated independent variables in the model are responsible for about 71% variation in farmers' awareness of climate change phenomenon in the area. The overall goodness of fit as reflected by Prob>Chi^2 (0.000) was also good. In terms of consistency with *a priori* expectations on the relationship between the dependent variable (awareness) and the explanatory variables, the model seems to have behaved well. Out of the ten (10) explanatory variables specified in the model, six (6) were statistically significant at 1 and 5%.

The parameter estimates of the probit model only provided the direction of the influence of the explanatory variables on farmers' awareness of climate change and did not show the actual magnitude of change or probabilities in the coefficients. Thus, the marginal effects (dy/dx) from the probit model, which measure the expected change in probability of awareness of climate change with respect to a unit change in an independent variable was also presented in the table.

Age of the farmers (AGE) was positively and significantly related to awareness of climate change at ($p<0.01$). This implies that older farmers are more likely to be aware of the changes occurring in climatic and weather conditions over the years. The result of the marginal effect on age suggests that an additional unit in age of the farmers would result in 0.013 (1.3%) increase in probability of becoming aware of climate change in the study area. The findings of this study on influence of farmers age on climate change awareness is in line with the findings of Deressa, *et al* (2008) who found that the likelihood of perception of climate change is significant and positively related to farmers' age. Although, this finding disagreed with the result of Maddison (2007) who in their separate studies found out that farmers age has no significant relationship with awareness and perception of climate change.

Years of education (YRSOFEDU) of the farmers also positively and significantly related to awareness of climate change in southwest Nigeria at ($p<0.01$). This conformed with expectation as educated farmers are expected to be more aware of climate change through improved access to relevant farm information sources such as news media and

extension visits. The result of the marginal effect on years of education implied that an additional unit in years of education of the farmers would yield 0.041 (4.1%) increase in probability of becoming aware of climate change in the study area. This finding agreed with that of Gbetibouo (2009) who established that education of farmers was significantly although negatively related to perception of climate change in Limpopo Basin of South Africa. The findings of the study also agreed with the report of ACCCA (2010) that education improves awareness of the potential benefits from adaptation. Wozniak (1984) reported that research evidences have shown that education increases one's ability to receive, decode, and understand information relevant to making innovative decisions.

Table 1: Parameter Estimates and Marginal Effects of the Probit Model Analysis of Socioeconomic Determinants of Farmers' Awareness of Climate Change in Southwest Nigeria

Variables	Regression Estimated Coefficients (ß)	Std. Error	Marginal Effects Change in Prob. (dy/dx)	Std. Error
GENDERHHHD* (male 1, female 0)	0.67368 (0.26)	0.29771	0.14306 (0.26)	0.05469
AGE (number of years)	0.05409 (3.86)***	0.01423	0.01340 (3.80)***	0.00370
YRSOFEDU (number of years)	0.16604 (5.92)***	0.02873	0.04113 (5.78)***	0.00745
HHSIZE (number of persons)	-0.08717 (-0.15)	0.04046	-0.02159 (-0.15)	0.00999
YRSFMEXPR (number of years)	0.03067 (2.49)**	0.01234	0.00759 (2.49)**	0.00297
FMSIZE (in hectare (ha))	0.03335 (3.34)***	0.09753	0.01826 (3.34***)	0.02408
EDUMEMBERS (number of persons (adults))	0.10337 (1.66)	0.06230	0.02661 (1.66)	0.01565
INCOME (in naira ₦)	2.27576 (2.24)**	1.01696	0.06375 (2.24)**	0.25726
EXTVISITS (number of visits per season)	0.11437 (3.25)***	0.03516	0.02833 (3.25)***	0.00913
MEMCOOP* (member 1, non member 0)	-0.29878 (-1.18)	0.25230	-0.07135 (-1.18)	0.05837
CONSTANT	2.77765 (4.92)	0.56496		

Note: *** denotes $p \leq 0.01$, ** denotes $0.01<p\leq0.05$.
Figures in parenthesis () are z-ratios
LR $chi^2 = 269.29$; Pseudo $R^2 = 0.712$
Prob> $chi^2 = 0.000$
Number of Observation = 348
For the marginal effects, (*) dy/dx is for discrete change of dummy variable from 0 to 1
z and P>|z| correspond to the test of the underlying coefficient being 0

Years of farming experience (YRSFMEXPR) significantly and positively affected farmers' awareness of climate change at ($p<0.05$). This also conformed with *apriori* expectation as experienced farmers are expected to be more aware of climate change considering their long years in farming occupation. The positive relationship indicated that as years of farming experience of the farmers increase, there is likelihood for increase awareness of climate change. The result of the marginal effect shows that an additional one year increase in farming experience of the farmers would result into 0.007 (0.7%)

increase in probability of gaining awareness of climate change in the study area. The findings of this study on influence of farming experience on awareness of climate change agreed with the findings of Ayanwuyi, *et al*, (2010) on farmers perception of impact of climate changes on food crop production in Ogbomosho agricultural zone of Oyo State, Nigeria where the authors found out that years of experience in farming enterprise significantly and positively relate to perception of climate change. In addition, Hassan and Nhemachena (2008) found out that farming experience increases the probability of uptake of adaptation options through awareness because experienced farmers have better knowledge and information on changes in climatic conditions and crop and livestock management practices.

Farm size (FMSIZE) was positively and significantly related to awareness of climate change in southwest Nigeria at ($p<0.01$). In other words, farmers with more farm sizes are more likely to be aware of climate change than farmers with small farm holdings. It is therefore possible that large farm size may account for diverse effects of climate change on farmers which will on the long run increase the level of awareness through personal experience. The result of the marginal effect showed that an additional unit increase in farm size would lead to 0.018 (1.8%) increase in probability of becoming aware of climate change in the study area. In affirmation, Ayanwuyi, *et al.,* (2010) while estimating farmers' perception of impact of climate changes on food crop production found that farm size had significant and positive relationship with farmers' awareness of climate in Ogbomosho agricultural Zone of Oyo state, Nigeria. Although, the findings of this study technically disagreed with that of Deressa, *et al.,* (2008) who found out that farm size was significantly but negatively influenced the perception of climate change by farmers. The disagreement in the two findings could have been informed by the variation in locations and the land tenure systems practiced in the two study areas.

Farming income (INCOME) was significantly and positively correlated to the probability of being aware of climate change at ($p<0.05$). This suggests that higher income farmers are more likely to have access to farm related information than low income farmers. The result of the marginal effects relates that a unit increase in farm income will increase the probability of becoming aware of climate change by 0.064 (6.4%) percent. Farm households with higher income and greater assets are in better position to adapt after gaining awareness of new farming technologies. Farming income has significant effects on farmers access to information/awareness and consequently adaptation to climate change. Hence, Gbetibouo (2009) reported that poverty or lack of financial resources is one of the main constraints to adjustment to climate change; that about 60 percent of the respondents who did not adapt indicated lack of financial resources as the main constraint to adaptation. The results of the study of Shan (2009) showed that access to credit increases the likelihood that farmers will have access to current information and take up portfolio diversification to adapt to climate change.

The coefficient of the number of extension visits (EXTVISITS) was positive and significantly influenced farmer's awareness of climate change at ($p<0.01$). This also conforms with *apriori* expectation as number of extension visits to farmers are expected to increase awareness of the farmers about weather and climate related information. For instance, Oyebanji, (1996) stated that the aim of extension service is to provide farmers with the necessary education, skills and technical information to enable them take effective farm management decisions for enhanced daily farm practices. The marginal effects of the extension visits implied that a unit increase in extension visit to the farmers would increase the probability of becoming aware of climate change by 0.028 (2.8%). This corroborated the result of the study of Deressa, *et al* (2008) who found out that the likelihood of perceiving climate change is positively related to information on climate and farmer-to-farmer extension visits. Awareness is necessary prerequisite for adaptation to climate change. Therefore, the results of the studies of Hassan and Nhemachena (2008), Apata *et al.*, (2009) and Bryan, *et al*., (2009) indicated that access to extension services had a strong positive influence on adapting to climate change.

Intensity of the Effects and Signs of Climate Change on Agricultural Production in Southwest Nigeria

Literature suggests that climate change is already having significant negative impacts in Nigeria, and these impacts are expected to increase in the future. The result presented in Table 2 show some indices of intensity of the effects of climate change on agricultural production from the perception of farmers in southwest Nigeria. Two (2) out of the twenty three (23) identified effects of climate change on food production as presented in the table had mean values that fell within 3.50-4.00. These two effects with their respective mean values include: higher temperature and heat (3.58) and prolonged drought (3.51) on a 4-point rating scale. This implies that these two effects of climate change are perceived as having very serious impact on agricultural production in southwest Nigeria.

The result in the table shows further that, eleven (11) out of the twenty three (23) identified signs and effects of climate change on food production had mean values that ranged between 2.51 to 3.14 which fell within the real limit of number 2.50-3.49 indicating that the 11 effects are already having serious impact on agricultural production in the area.These variables with their corresponding mean values on a 4-point rating scale include: decreased rainfall amount (2.71), unusual heavy rainfall (2.55), increased cases of flooding (2.83), deceased soil moisture (2.51), reduction in crop yield (2.53), poor quality of stored farm produce as a result of heat (3.10), drying up of rivers, lakes and streams (2.88), increased drying up of seedlings after germination (3.14), heat stress on crop and livestock (2.62), increased soil erosion resulting from unusual heavy rains (2.73) and increased post harvest spoilage of harvested crops (2.87). The findings of this study conformed with that of Ozor and Nnaji (2011) who found that significant effects of climate change on agricultural production as perceived by farmers in Enugu state include: soil erosion, post harvest losses due to climate variability, decrease in yields of crops and animals, flooding, heat from high temperature, drought and decrease in soil moistures.

The findings of this study also corroborated the report of Tarhule and Woo (1997) which showed that drought is responsible for about 90% of famine events in northern Nigeria through effects on agricultural production. Findings of Ishaya and Abaje (2008) showed that the threat of climate change is more on health, food supply, biodiversity lost and fuelwood availability than on businesses and instigating of disaster; and it is the poor, who depend heavily on the natural resources that are mostly affected by incidence of climate change. The findings of this study also agreed with the findings of Adebayo, *et al* (2011) who found that in terms of climate change effects on farming enterprises, reduction in crop yield were reported by 60% of the farmers interviewed in southwest Nigeria while about 46.7% of the farmers also noted a general low level of farm productivity as a consequence of climate change.

Table 2: Mean Ratings of the Responses of Farmers in Southwest Nigeria on Intensity of the Signs & Effects of Climate Change on Agricultural Production (N= 348)

S/N	Signs & effects of climate change on agriculture	$\bar{X}$	SD
1	Decreased rainfall amount	2.71**	0.993
2	Unusual heavy rainfall	2.55**	0.831
3	Higher temperature and heat	3.58***	0.650
4	Heavy winds	2.22*	0.819
5	Increased cases of flooding	2.83**	0.952
6	Prolonged drought	3.51***	0.679
7	Increased desertification	2.37*	0.837
8	Increase in pest and disease problems	2.09*	1.084
9	Extinction of some crop species	1.79*	1.169
10	Deceased soil moisture	2.51**	0.859
11	Premature ripening of fruits	1.61*	1.144
12	Reduction in crop yield	2.53**	0.890
13	Poor quality of storage farm produce as a result of heat	3.10**	0.608
14	Stunted growth of crops	2.48*	0.938
15	Drying up of rivers, lakes and streams	2.88**	0.942
16	Increased drying up of seedlings after germination	3.14**	0.599
17	Heat stress on crop and livestock	2.62**	0.859
18	Intense weed growth	2.39*	0.995
19	Increased soil erosion resulting from unusual heavy rains	2.73**	0.831
20	Storage losses in roots and tubers	2.47*	0.913
21	Increased salinity/water pollution due to climate variability	1.79*	1.168
22	Decrease in fish population due to salinity, water level, ocean currents or speed	2.10*	0.952

23	Increased post harvest spoilage of harvested crops	2.87**	0.792

Note: *** Very Serious (VS)
** Serious (S)
* Less Serious (LS)

The result in Table 2 also shows that, the remaining (10) identified sign and effects of climate change on food production had mean values that ranged between 1.61 to 2.48 which fell within the real limit of number 1.50-2.49 indicating less serious effects of the climate change items on agricultural production in the area.These variables with their corresponding mean values on a 4-point rating scale include: heavy winds (2.22), increased desertification (2.37), increase in pest and disease problems (2.09), extinction of some crop species (1.79), premature ripening of fruits (1.61), stunted growth of crops (2.48), intense weed growth (2.39), storage losses in roots and tubers (2.47), increased salinity/water pollution due to climate variability (1.79) and decrease in fish population due to salinity, water level, ocean currents or speed (2.10). The finding of this study indicating less serious effects of heavy winds, increased desertification, increase in pest and disease, stunted growth of crops and intense weed growth among others on food production in southwest Nigeria disagreed with part of the findings of Ozor and Nnaji (2011) who found out that intense weed growth, incidence of pests and diseases and premature ripening had significant effects on agricultural production in Enugu State. The findings of the study on less serious effects of storm on agriculture in southwest Nigeria disagreed with the findings of Adebayo, *et al.* (2011) whose findings showed that farmers in swamp zone of southwestern Nigeria report concern about increased incidence of storms damaging boats, nets and increased incidence of boats capsizing during storms; resulting from the effects of climate change.

CONCLUSION AND RECOMMENDATIONS

From the results of this study, it can be concluded that a reasonable percentage of farmers in Southwest Nigeria are aware of climate change, even though, there is still room for intensified effort in awareness creation about the global phenomenon. Major sources of their awareness included personal observation, extension contacts, interaction with researchers in data collection process, friends and cooperatives. Internet, radio/television and newspapers are low sources of awareness of climate change among the farmers. The results of the probit model signified that age of the farmers, years of education, farming experience, farm size, farming income and number of extension visits are factors that influenced farmers' awareness of climate change. The intensity of heat, prolonged drought, decreased rainfall amount, unusual heavy rainfall, flooding, reduction in crop yield, drying up of rivers, lakes and streams and heat stress on crop and livestock among others are serious effects of climate change on agricultural production in Southwest Nigeria. Based on these findings, the study therefore recommends more awareness creation among farmers about climate change using media such as radio/television, newspapers, internet and farmers' cooperatives. Effort should be made by government at all levels towards capacity building of the farmers through improved education, extension visits and increase in income, improved access to credit and land ownership. In particular, agricultural extension services should be made more effective towards improved farmers' awareness and training on adaptive responses to the observed effects of climate change on food production activities of the farmers.

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