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The perception of Climatic Change on Climatic Resilience Crop Cultivars among Arable Farmers in Adamawa state, Nigeria

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Author's contribution

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

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ABSTRACT

The study examines the perception of climatic change and climatic resilience crop cultivars among arable farmers in Adamawa State. With the specific objectives as to determine the socio-economics of arable farmers, examine the perception of change in temperature by farmers farming experience, examine the perception of farmers on rainfall pattern change due to climatic change, identify the source of information about climatic resilience crop cultivars, identify the varieties of climatic resilience crops cultivated by arable farmers, examine the farmer's perception on the effects of climatic change on arable crop production, determine the level of farmers adoption of climatic resilience crop cultivars and examine the socio-economic factors influencing the adoption of climatic resilience crop cultivar for effects of climatic change on arable production. Primary data was the main sources of data for the study collected through the use of well-structured schedule. Descriptive statistics (tables, frequency and percentage) and inferential statistics such as Chi-square, and Probit regression were used as analytical tools for the analysis of data. The study revealed that majority of the respondents are in their most active age (21-40years), hence their strength could be effectively utilized to increase agricultural production and majority of them were males with 49.0% were married. The study shows that the household size in the study area is relatively large and most (60.8%) of the respondents are educated (they can read and write) and this could be effectively utilized to boost arable production in the study area and 60.8% of the respondents were full-time farmers with a good farming experience which will help them to improve

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their production techniques and to increase their productivity. The study therefore, concluded that climatic change have significant effects on arable production which reduces potential yield and farmers were aware of the climatic resilience crop cultivars of which their sources of information on it were NGOs and other farm associate but their level of adoption is low and recommended that Farmer exposure to and knowledge of climate-resilient crop cultivars should be increased. This can be achieved through organizing more training on climate change adaptation and encouraging farmers to attend.

Keywords: Perception; climate; resilience; arable; cultivars.

1. INTRODUCTION

Global warming is placing unprecedented pressure on food producers, particularly small-scale farmers who rely on traditional crop cultivars under threat from changing climatic and environmental condition [1-3]. Researchers have been raising new climate-resilient crop varieties to ameliorate the huge loss made by millions of small-scale farmers in the tropics to produce cultivars, especially cereal and legume crops, which provide the most needed staple food in the tropics [4-7]. But, the must festinating question is, are these realistic solution for smallholder farmers in the segment of agricultural enterprise, the northern parts of Adamawa state of Nigeria is at the front line of desertification located between the desert and the Sahel Savannah putting the entire region at the climatic variation risk, characterized by strong wind storm at the beginning of raining season, prolonged dry season, and very short rain across the years [8,9].

Report has revealed that, in Mozambique and Tanzania, ~~that~~ the increase in their capacity to adopt to climatic variability through the application of sustainable intensification practices, through working with farmers to help them apply conservation practices such as crop resilient increase the yield of cereal crops such mission with minimum soil disturbance and inter cropping to simultaneously boost yield and protect their environment (Spore, June - August, 2018). This practice reduces soil degradation and improves soil moisture level carbon capture, they are increasing the yield of cereals such as Maize, Sorghum, and legumes [10-12].

According to the report of agriculture and food organization of the United Nations, the world population is expected to reach nine (9) billion people by the year 2050. This statistics means that by then farmers will have to increase food production by atleast 70%, if not more, meeting this demand and simultaneous preservation of natural resource and preventing environmental degradation is going to be a massive challenge [13-16]. If agriculture is to feed this growing population and provide the basis for economic growth and poverty reduction, then it must undergo radical change. Climatic change is likely to make this task much more difficult, however, small holder farmers who produce more than 70% of agricultural products in sub-Saharan Africa are particularly vulnerable to climatic variation as the rely on rain feed agriculture and have poor access to information of climatic resilient cultivars of seeds, Spore,2014. For these reasons, the post 2015 SDGs development agenda should focus on poverty eradication, while gene more quality, and boosting environmental resilience. Climatic change issues is one of the most serious threats to development, with the very existence of some states in Africa being at the risk including the north Eastern Nigeria which include Adamawa state, it is also very vital to agriculture as it implicitly implied in the SDGs agenda 13 [17-19]. To take urgent action to combat climatic change and its impact, but these issues is highly debatable. Therefore, this research is aimed at analyzing the perception of climatic change on climatic resilience crop cultivars among arable farmers in Adamawa state, Nigeria.

2. METHODOLOGY

2.1 Study Area

The study area is Adamawa State of Nigeria, located between latitude $9^0$30' and $11^0$35' North of the equator and $13^0$45 and $15^0$55 East of the Green which Meridian. Adamawa is bounded to the North by the Republic of Cameroon and to the East by Borno, State to the West by Taraba State and to the South by Gombe State. It has a land mass of 4728.77 kilometres square, and average population of about 4,248,4000 Adabayo [20].

2.2 Sampling

The research used purposive random sampling in Adamawa State, the research adopted the structure and the demarcation of the Adamawa agricultural development programme (AADP). This was because of its wide and comprehensive coverage of the rural farmers in the state.

In the first stage, of the study the whole five (5) agricultural zones of the state were identified and under each zone, two (2) extension blocks were randomly selected without bias. From each of the selected blocks, three (3) cells were purposively selected. In each of the selected cells five (5) extension units were randomly selected to get the required arable crop farmers respondents as the required sample for the study. Based on the number of cells that was identified the total of two hundred and seventy five (275) well-structured schedule was administered to the respondents for the study. Out of which, two hundred and fifty fivegavethe correct information for the analysis. Descriptive statistics such as Chi-square and Probit Regression was used as analytical tool to achieve the objectives of the study.

The Chi-square is expressed as:

2.3 Data

In the first stage of the data analysis, chi-square was used to examine the perception of the arable crop farmers on the use of the climatic resilience crops and Probit Regression model as express below:

Where:

X^2 = chi-square
Fo = observed values
Fe = expected values

The equation of the Probit Regression Model is assumed to be:

$$Y_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki} + v_i$$

And that $Y_i = 1 \text{ if } Y_i^* > 0 \text{ or } Y_i = 0$ otherwise.

Where:

Y_i = (adoption level)
X_1 = Age
X_2 = Sex
X_3 = Marital status
X_4 = Family size
X_5 = Level of education
X_6 = Farming experience
β_0 = Intercept or constant term

- β = represents a vector of unknown parameters and v represents a random disturbance term
- β V_i= Error term

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Respondents

Table 1 shows that 7.8% of the respondents were between the age bracket of less than or equal to 20 years, 47.9% of there were between 21–30years and 30.6% were between 31–40 years while 13.7% attained the age of greater than 40 years. This analysis reveals that majority of the respondents are in their most active age (21–40years), hence their strength could be effectively utilized to increase agricultural production. This study agrees with that of Onu et al. [21] who stated that majority (31.8%) of arable crop farmers in the federal capital territory, Abuja were young, between the ages of 31–48 years, which is the active productive age bracket. The study established that 71.4% of the respondents were males while only 28.6% of them were female. This shows that majority of sampled arable farmer in Adamawa State were male and 17.7% were single, 49.0% were married 7.8% were divorced and 25.5% were widow/widower with 25.1% of the them have family of 1–5 in the households, 48.6% have 6–10 persons. This analysis shows that the household size in the study area is relatively large and it could increase the supply of family labour for agricultural production and constituently reduce the cost of hiring labour especial for arable farming. The analysis is in line with the study of Shakirat et al. [22] who revealed that arable crop farmers were married (86.49 percent) with a mean household size of eight persons in a household which could provide labor in agricultural production.

The study indicated that 7.8% of the respondents had some form of informal education, 29.4% attained primary school and 43.1% attained secondary school while only 17.7% of them attained tertiary education. This means that majority (60.8%) of the respondents are educated (they can read and write) and this could be effectively utilized to boost arable production in the study area as reported by Shakirat et al. [22] farmers in South Western

Nigeria have a reasonable level of literacy in western education. A total of 60.8% of the respondents were full-time farmers, 24.3% were civil servants, and only 14.90% were traders. Less percentage of the respondents (40.2%) are part-time arable farmers, hence resources from primary occupation is expected to be channeled to arable production which will result to increased productivity and guarantee a surplus arable secured household. About 7.1% have less than or 5 years of farming experience, 13.3% have 6-10 years, 31.8% have 11–15years, 40.0% have 16–2years and 7.8% have above 20 years of arable farming experience. This indicates that majority of farmers (79.6%) have good number of years of farming experience which will help them to improve their production techniques and to increase their productivity.

Table 1. Socio-economic Characteristics of Respondents

Variables	Frequency	Percentage (%)
Age		
≤ 20	20	7.8
21–30	122	47.9
\31–40	78	30.6
>40	35	13.7
Total	**255**	**100**
Sex		
Male	182	71.4
Female	73	28.6
Total	**255**	**100**
Marital Status		
Single	45	17.7
Married	125	49.0
Divorced	20	7.8
Widow/widower	65	25.5
Total	**255**	**100**
Family Size		
1–5	64	25.1
6–10	124	48.6
11–15 and above	67	26.3
Total	**255**	**100**
Educational Attainment		
Informal Education	25	9.8
Primary Education	75	29.4
Secondary Education	110	43.1
Tertiary education	45	17.7
Total	**255**	**100**
Primary Occupation		
Full time farmer	155	60.8
Civil Servant	62	24.3
Business	38	14.9
Total	**255**	**100**
Farming Experience		
≤ 5	18	7.1
6–10	34	13.3
11–15	81	31.8
16–20	102	40.0
>20 years	20	7.8
Total	**255**	**100**

Source: Field Survey, 2021

3.2 Perception of Change in Temperature by Farmers Farming Experience

The analysis of the study revealed that 3.1% and 3.9% of the respondents who have less than 5 years family experience perceived there is no change and increased in the volume of temperature. 1.9% and 11.4% of farmers who have 6–10% years farming experience observed no change and increased in temperature, 0.8% and 31.0% of respondents with 11–15years of farming experience perceived no change and increased in temperature, 0.4% and 39.6% of farmers with 16.20%years in farming of arable crops have an idea of no change and increase in temperature and lastly, 7.8% of them who have more than 20 years farming experience perceived increased temperature. The above assertion revealed that most farmers (93.8%) perceived that there is an increase in temperature, which leads to an increase in heat making weather unfavorable for plants growth and development in the study area. This study is in line with study of Bewket et al. [23] who indicated that most farmers with short farming experience (< 10 years) observed no change in heat intensity where as farmers with more experience (> 10 years) perceived an increase in heat intensity.

3.3 Perception of Farmers on Rainfall Pattern Change due to Climatic Change

A good percentage of the respondents (91.7%) perceived change in the amount of rainfall. Among them 87.8% perceived decreased in the amount of rainfall and 5.2% perceived increase in the amount of rainfall. While 3.9% of the respondents perceived no change in the amount of rainfall. This analysis above signifies that there is decrease in the amount of rainfall which lead to decrease in the amount of agricultural output as reported by Bewket, et al. [23] that 60.7% of the respondents felt a decrease in the amount of rainfall in the Upper Catchment of Blue Nile, Ethiopia.

3.4 Farmers Perception on the Effects of Climatic Change on Arable Crop Production

All the variables listed in Table 4 below show that they were all significant at 5% significant level except increased frequency of flooding, which is not significant at all level, meaning that the all variables that were significant were perceived to be the effect of climatic change on arable crops production in the study area. They include reduced yield of crops with Chi-Square and *P*-value of 209-259 and 0.000, increased frequency of drought (251.016 and 0.000), increased heat stress on crops, increased incidence of pest and diseases, post-harvest losses and late fruiting of crops. The analysis in consonant with Onwuchekwa [24] because he reported that high temperature and increase incidence of pests and diseases in Imo State of Nigeria and that of study Ayanwuyi et al. [25] found that, the dominant impact of climate change include low yield of crop, ease of spread of pest and diseases attack on crops.

Table 2. Perception of Change in Temperature by Farmers Farming Experience

Farming experience in years	No change	Increase	Decrease
≤ 5	8 (3.1)	10 (3.9)	0
6-10	5 (1.9)	29 (11.4)	0
11-15	2 (0.8)	79 (31.0)	0
16-20	1 (0.4)	101 (39.6)	0
>20 years	0 (0)	20 (7.8)	0
Total	**16 (6.2)**	**239 (93.8)**	**0**

Source: Field Survey, 2021

Table 3. Perception of farmers on rainfall pattern change due to climate change

Rainfall pattern	Frequency	Percentage (%)
No change	10	3.9
Increase	13	5.2
Decrease	224	87.8
I don’t know	8	3.1
Total	**255**	**100**

Source: Field Survey, 2021

Table 4. Farmers Perception on Effects of Climatic Change on Arable Crop Production

Possible effects	Chi-square value	*P*-value
Reduced yield of crops	209.259	0.000**
Increased frequency of drought	251.016	0.000**
Increased effect of heat stress on crops	247.063	0.000**
Increased frequency of flooding	0.035	0.851
Increased incidence of pests and diseases	220.271	0.000**
Late fruiting of crops	209.259	0.000**

*Source: Computed results, 2021, ** = 5% significance level*

Table 5. Varieties of Climatic Resilience Crops Cultivated by Arable Farmers

Varieties	Frequency	Percentage (%)
Maize		
Sammaz-15	87	34.1
Oba-98	34	13.3
Admiral A. 2000SYN	11	4.3
Sammaz -17	123	48.3
Total	255	100
Rice		
Faro-44	84	32.9
Faro-52	62	24.3
Ex china	29	11.4
NERICA	6	2.4
Jamila	8	3.1
Don’t Cultivate	66	25.9
Total	255	100
Sorghum		
Samsorgh-46	37	14.5
Samsorgh-45	32	12.5
Farafara	92	36.1
Don’t cultivate	66	25.9
Total	255	100
Groundnut		
Kampala 16	79	31.0
Kampala 17	85	33.3
Danmit 23	5	2.0
Danmit 24	7	2.7
Danmit 27	11	4.3
Don’t Cultivate	68	26.7
Total	255	100
Cowpea		
IT89KD – 288	53	20.8
BOSOMA -46	71	27.8
SAM P-11	64	25.1
Don’t cultivate	67	26.3
Total	255	100
Soya beans		
TGX 1448-2E	62	24.3
TGX 1987-62F	33	12.9
TGX 1904-6F	40	15.7
Don’t Cultivate	120	47.1
Total	255	100

Source: Field survey, 2021

Table 6. Level of Climatic Resilience Crop adoption

Level of adoption	Frequency	Percentage (%)
Low adopters	163	63.92 or 63.9
High adopters	92	364.089 or 36.1
Total	**255**	**100**

Source: field survey, 2021

3.5 Varieties of Climatic Resilience Crops Cultivated by Arable Farmers

Highest proportion of respondents shows that 48.3% of farmers cultivate Sammaz-17 followed by 34.1% Sammaz-16, 46.3% 13.3% Oba-98 and only 4.3% farmers cultivate Admiral A 200SYN climate resilience crop varieties of maize. A total of 32.9% of farmers cultivate Faro-44, 24.3% cultivate Faro-52, 11.4% of farmers are into production of Ex China, 3.1% NERICA and only 2.4% cultivate Jamila variety of rice while 25.9% of the respondents are not into production of any rice variety. 36.1% of respondents cultivate Fara Fara climatic resilience crop variety of sorghum; 14.5% Samsorgh; 46 and 12.6% cultivate Samsorgh.45, while greater proportion (36.8%) of farmers do not cultivate any verities of sorghum. Majority (64.3%) of respondents are into production of Kampala-16 and Kampala 17 varieties of groundnuts, followed by 4.2% dannit.27, and only 2.7% and 2.0% cultivate Dannit; 23 and 24, while 27.8% farmers are into production of BOSOMA;46, 25.1% Sam P-11 and 20.8% cultivate IT89KD-288, while 26.3% of the respondents do not cultivate cowpea. High percentage (52.9%) of respondents in the study area cultivate TGX 1448-2E, TGX 1987-62 and TGX 1904-6F, 24.3% cultivate TGX 1448-2F improved variety soya beans, while 47.1% of farmers do not cultivate soya beans. The result above indicate that majority of farmers interviewed in the study area cultivate maize, followed by rice beans and groundnuts of climatic resilience crops.

3.6 Level of Climatic Resilience Crop Adaptation by Arable Farmers

The analysis of adoption level of resilience crop cultivars affirms that 63.9% of the respondents are low adaptors while 36.1% are high adopters. This shows that majority (63.9%) of arable farmers in the study area are low adopter of climatic resilience crop cultivate due to their beliefs and strictness to their traditional practice of production and also lack of farmers exposure of farmers to Climate-Resilient as revealed by Sally et al. [26] that the actual population adoption rate for climate-resilient varieties was still low at 6.3% due to incomplete exposure of farmers to Climate-Resilient Potato Varieties.

4. CONCLUSION AND RECOMMENDATIONS

It can be concluded from the study that climatic change have significant effects on arable production which reduces potential yield and farmers were aware of the climatic resilience crop cultivars of which their sources of information on it were NGOs and other farm associate but their level of adoption is low. Age, household size, level of education, and farming experience were that the most important variables that influence adoption of climatic resilience crop cultivars.

Based on the findings of this study the following recommendation are made:-

Farmer exposure to and knowledge of climate resilient crop cultivars should be increased. This can be achieved through organizing more trainings on climate change adaptation and encouraging farmers to attend.

Stakeholders should also organize participatory variety selection events for arable farmers to increasing their understanding of climatic resilience crop cultivars traits. Farmers should also be encouraged to acquire membership in farmer groups that address issues in arable farming. This will boost farmers' exposure to climatic resilience crop cultivars which is a necessary condition for adoption. Government should improve infrastructural facilities in arable growing areas to enable free flow of extension services for climatic resilience crop cultivars farming in general. The government should also establish more training centers and deploy more trained extension officers to avail information on climate change adaptation practices such us use of climatic resilience crop cultivars. Information can also be made available to farmers through electronic and print media.

Finally, to reap maximum benefits from adoption of climatic resilience crop cultivars, it is important for farmers to combine climate-resilient varieties with appropriate agronomic practices such as crop rotation, minimum tillage and soil conservation measures.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

(Please tick where necessary)

A. Socio economic characteristics of the respondents

i. **Age** (a) 21-30 ( ) (b) 31-40 ( ) (c) 41-50 ( ) (d) 51-60 () (e) Above 60( )
ii. **Sex:** (a) Male ( ) (b) Female ( )
iii. **Marital status:** (a) Single () (b) Married () (c) Divorced () (d) Widower ()
iv. **House hold size: (**a) Less than 5 ( ) (b) 6-10 ( ) (c) 11-15 ( ) (d) 16-20 ( ) (e) Above 21 ( )
v. **Educational attainment:** (a) Informal education ( ) (b) Functional literacy ( ) (c) Primary education ( ) (d) Secondary education ( ) (e) Tertiary education ( ) (f) Others (Specify please)…………………………………………
vi. **Primary occupation:** (a) Civil servant ( ) (b) Trading ( ) (c) Crop farming ( ) (d) Business ( ) (e) Artisan ( ) (f) Others (Specify please)…………………………………………
vii. **Farming experience:** (a) Less than 5 ( ) (b) 6-10 ( ) (c) 11-15 ( ) (d) 16-20 ( ) (e) Above 21 ( )

B. Are you aware of climatic change?

Yes ( ) No ( )

1. If yes to the above question, what is your perception of change in temperature based on your farming experience?
   No change ( )
   Increased ( )
   Decreased ( )
   I don't know ( )
2. What is your perception of farmers on rainfall pattern change due to climatic change?
   No change ( )
   Increased ( )
   Decreased ( )
   I don't know ( )

C. What is your perception on the effects of climatic change on arable crop production

Reduced yield of crops	( )
Increased frequency of drought	( )
Increased effect of heat stress on crops	( )
Increased frequency of flooding	( )
Increased incidence of pests and diseases	( )
Late fruiting of crops	( )

D. What are your sources of information on climatic resilience crop cultivars?

Government owned extension agent	( )
Non-governmental organizations	( )
Farm associates	( )
Farmers neighborhood	( )
Media	( )

E. Are you aware of climatic resilience crops in your area?

Yes ( ) No ( )

1. If yes what are the major climatic resilience crops cultivated in your area

i. Rice ( )
ii. Maize ( )
iii. Sorghum ( )
iv. Groundnuts ( )
v. Soya bean ( )
vi. Cowpea ( )

2. What variety of rice cultivar is cultivated in your area that is most climatetized in your area?

i. Faro 44 ( )
ii. Faro 52 ( )
iii. EX China ( )
iv. NERICA ( )
v. Jamila ( )

3. What improved variety of maize that are commonly cultivated in your area

i. Oba 98 ( )
ii. SAMMAZ 15 ( )
iii. Admiral A 2000SYN ( )
iv. EE, Quality protein Maize ( )
v. SAMMAZ 17 ( )

4. What improved variety sorghum is cultivated in your area?

i. Samsorgh 46 ( )
ii. Samsorgh 45 ( )
iii. KSV8 ( )
iv. Farafara ( )

5. What variety of groundnut do you cultivate in your area?

i. Damnit 23 ( )
ii. Damnit 24 ( )
iii.Kampala 16 ( )
iv.Kampala 17 ( )
v. Damnit 27 ( )

6. What variety of cow pea do you produce in your area?

i. IT89KD-288 ( )
ii. BOSOMA 46 ( )
iii. SAM P-11 ( )

7. What variety of soya bean do you cultivate in your area?

i. TGX1448-2E ( )
ii.TGX1987-62F ( )
iii. TGX1904-6F ( )

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