Journal of Science of Agriculture, Food Technology and the Environment Vol. 21 No. 1, 2023 & 202416-48
Available online: jsafeacademicjournal.com

ASSESSMENT OF AGRIBUSINESS INVESTORS' PERCEPTION TO CLIMATE CHANGE EFFECTS IN SOUTHEAST, NIGERIA

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ABSTRACT

The assessment of climate change adaptation has been widely researched but the assessment of agribusiness investor's perception to climate change effects in southeast Nigeria seems not to be fully explored. A multistage sampling procedure was adopted in the collection of data from three hundred and sixty (360) agribusiness investors using structured questionnaires. Both descriptive and inferential statistics were employed to realize the objectives of the study. The results of the analysis showed that majority of the agribusiness investors in southeast Nigeria were mostly males of an active mean age of 54 years. The study revealed that majority of agribusiness investors were married thereby making them the principal investors in the key areas of agribusiness on educational attainment, the study identified investors that completed senior secondary school as the major players in both farm input supply (23.6%) and farm production (21.9%) The mean household size of the agribusiness investors was 7 persons. Meanwhile, agribusiness investors who have stayed above 15years were more in agro-processing. However, majority of the agribusiness investors belong to cooperative societies and have access to climate information. Agribusiness investors in the area rightly perceived the direction of changes in climatic variables, Result of multinomial regression showed that age, educational attainment, household size, agribusiness experience, marital status, membership of cooperative society, access to climate information and access to credit were all positive and statistically significant on the choice of climate change adaptation strategies. With Pseudo R^2 of 0.949 and the P-value of 0.0000, it is posited that socio-economic characteristics of agribusiness investors have significant effects on the choice of climate change adaptation strategies. The result showed further that economic/managerial, socioeconomic, infrastructural and institutional were the major constraints to climate change adaptation Based on the findings, it is recommended enlightenment program on climate change to sensitize investors on the effects and sustainable adaptation strategies to be adopted in combating climate change.

Key Words: Agribusiness Investors, Perception, Climate Change

INTRODUCTION

The earth is surrounded by a layer of gases that act like the glass wall (earth's blanket) and ceiling of a green house. These greenhouse gases are necessary to sustain life on earth. They let the sun's rays enter but stop much of the heat from escaping, keeping the planet warm enough to sustain life. However, man's activities have resulted to change in

the earth environment. The change is rapidly emerging as a global critical development issue affecting many sectors in the world and is considered to be one of the most serious threat to sustainable development. Globally, an unprecedented increase in greenhouse emissions has led to increased climate change impact. Climate change therefore, refers to all changes in climate be it as a result of human activities or natural variations (Intergovernmental Panel on Climate Change [IPCC], 2001).

The problem that we face today is that the blanket of greenhouse gases that occurs naturally in the troposphere is quickly getting thicker as a result of increase emissions of greenhouse gases and this result in the rapid warming of the world's climate. Over the past 100 years, the earth's average surface temperature has risen by around 0.74^{o}C Most scientists agree that global temperature will rise further (by how much, depends on future emissions of greenhouse gases) and if the temperature rise is high, changes are likely to be so extreme that it will be difficult to cope with them. There are likely to be more instance and frequent extreme weather events, like floods and hurricanes, and sea levels could rise further (Ifeanyi-obi, Etuk, and Jike-wai, 2012)

Climate change is a long-term change in the average weather patterns that have come to define the earth's global climate (Shaftel, 2016). The change in climate and temperature prevalent today are either caused by human factors or natural factors (Shahzad, 2017). Research conducted by Poschumus (2019), showed that most of these changes in the global climate are connected with a little variation in the earth's orbit that changes the level of energy coming from the sun to the earth. According to Papass (2020), climate change and global warming that occurred in the past century until now are caused by humans.

Climate is crucial to the Nigerian agribusiness investors. If action is not taken, the impact of the change will continue to cause severe effects on livelihoods in Nigeria. Poschumus, (2019), posited that temperature will continue to rise in the northern part of Nigeria, thereby causing variability in the increase in rainfall. The north will have less and erratic rainfall, which will lead to drought, whereas in the south, they will have more intense rainfall, which will result in floods. According to IPCC (2001), global climate is fast changing in the history of modern civilization because of human activities.

Perception refers to beliefs or opinions often held by many people based on how things seem to them (Yakubu*et al.* 2021). Agribusiness investor's ability to perceive climate change is a key precondition for their choice to adapt to climate change.

According to Food and Agriculture Organization [FAO], (2019), many sectors will suffer from the change in climate, but agribusiness sector will face the deadliest. The researcher maintained that agricultural industry is threatened by droughts, floods, land degradation, and soil salinity. The change in temperature and precipitation patterns is seriously affecting agribusiness activities in Nigeria as well as damaging non drought tolerant or heat tolerant crops. Change in climate affect the yield of agricultural production, the earnings from production, the quality of food, the storage, processing and distribution of the produce, the food price, as well as food security (Chukwuezie 2017; Smith 2012; and Siwar 2009). According to World Bank (2019), the continuous increase in global temperature and the increase in rainfall have a significant effect on the food production value chain. The bank also noted that, given the prediction of early cessation of rainfall in northern Nigeria, it will cause short planting season which will result in food scarcity. To address

this seeming gap, agribusiness investors should critically look into the causes of climate change with the hope of determining its effects on agribusiness investments.

Investment into agribusiness can be categorized into three components generally known as agribusiness tri-aggregates. The tri-aggregate include: farm input supply, farm production and agro-processing/distribution. Hence, Ezike, Nwibo and Odoh (2009), posited that agribusiness connotes the process by which agricultural inputs are supplied or purchased and processed for eventual distribution to the target markets, as one fully integrated business concern, which is simultaneously adjusting to the changes that are constantly occurring in the global business environment. This is similar to the view of Wills (2009), who considered agribusiness as the off-farm link in agro-food value chain, which provides input to the farm sector, and it links the farm sector to consumers through the handling, processing, transportation, marketing and distribution of food and other agricultural products. It therefore, plays an important role in economic development in Nigeria. Pawa (2013) revealed that agribusiness concerns in Nigeria constitute 70% of businesses operating in the country.

Agribusiness investors also known as agripreneurs are those that undertake a variety of activities in agricultural sector, they represent the innovators who drive change in the economy by serving new agricultural markets or creating new ways of doing things, and as such should be proactive, curious, determined, persistence, visionary, hardworking, honest; and have integrity with strong management and organizational skills (Bairwa, Lakra, Kushwaha, Meena and Kumar, 2014). An agribusiness investor, recognizes agricultural opportunities or unmet needs and takes the risk to pursue it. Gray (2002), on the other hand defines an agribusiness investor as an individual who

manages an agribusiness with the intention of expanding the business and with the leadership and managerial skills necessary for actualizing those goals.

In Nigeria, like many other developing countries of Africa, agribusiness sector is more vulnerable and adversely affected by change in climate conditions (Barber *et al*, 2003; Nigerian Environmental Study Action Team, 2004) However, it seems nothing have been established on how agribusiness investors perceive the effect of climate and it adaptation measures in southeast Nigeria. This therefore, justifies the need for this study to also assess these issues to the fore in southeast Nigeria, as a criterion for developing climate adaptation strategies to ameliorate the effects.

The Southeast region of Nigeria is known for its agricultural potential, contributing significantly to the nation's food production and economic growth. However, agribusiness investors in this region are facing significant challenges and uncertainties due to the impacts of climate change.

In order to address the problem, the study:

(i) described the socio-economic characteristics of agribusiness investors;

(ii) categorized agribusiness investors in relation to how they perceive climate change;

(iii) analyzed the effect of agribusiness investors' socio-economic characteristics on the choice of climate change adaptation strategies;

(iv) analyzed the constraints to climate change adaptation among agribusiness investors in the study area.

Hypothesis

Ho: socio-economic characteristics of agribusiness investors have no

significant effects on climate change adaptation strategies.

METHODOLOGY

The study area

The study area is Southeast, Nigeria. The area is one of the six geopolitical zones in Nigeria and consists of five States namely: Abia, Anambra, Ebonyi, Enugu and Imo States. The area lies by latitude $05^0 55'$ and $07^0 10'$ North and longitude $06^0 50'$ and $08^0 30'$East. With a projected population of over 28.4 million people (National Population Commission, 2020) situated in a land area of approximately 58,214.7 km^2. The area is bounded in the south by AkwaIbom and Rivers states, in the North by Benue and Kogi States, west by Delta State and east by Cross River State. The area has Ibo as the predominant ethnic group and Igbo language as the main language of the people, although there exist many dialects peculiar to the people.

The area is located within the humid tropical rain forest and derived savannah belt of Nigeria with two main seasons: the rainy season which begins from April to October and the dry season begins in November and ends in March. The mean annual rainfall ranges from 1520mm to 2030mm. It has a warm and humid climate. The area is traversed with several major and minor rivers such as river Niger, Anambra River, Imo River, Adada River and Ebonyi River. Oguta and Nike lakes are the major lakes present in the area.

The area is also known for its endowment with abundant natural resources such as coal, limestone, iron-ore, crude oil, lead, zinc and natural gas (Ojiako and Nwode 2014). Agriculture is the mainstay of her economy and has a vast agricultural land that supports the growth of crops such as rice, yam, cassava, maize, bambara nut as well as various varieties of fruits and vegetables. The agricultural activities conform to the tri-

aggregate of agribusiness which include; farm input supply, farm production and farm processing and distribution/marketing of processed products.

Sampling Technique

A multistage sampling procedure was used in the selection of agribusiness investors in the study area.

Stage 1: From the five States of the Southeast geo-political zone (Abia, Anambra, Ebonyi, Enugu and Imo), three States (Ebonyi, Anambra and Abia), were purposively selected based on the high level of agribusiness activities in those States.

Stage 2: From the three selected States, two agricultural zones were randomly selected.

Stage 3: Then two Local Government Areas (LGAs) were purposively selected from the randomly selected six agricultural zones of the States, which gave a total of 12 LGAs. The choice of purposive sampling here was based on the level of agribusiness activities going on in the area.

Stage 4: From each of the purposively selected 12 LGAs, thirty (30) agribusiness investors were purposively selected to give a total of three hundred and sixty (360) respondents which constituted the sample size.

Model Specification:

Multinomial Logit Model (MLM)

This was used to establish the effect of socio-economic characteristics of agribusiness investors on the choice of climate change adaptation strategies. According to Magombo, *et al*. (2011), MLM model for choice of adoption practices which specify the relationship between the probability of choosing an adoption option and the set of explanatory variables.

The MLM Model was stated as follows:

Assuming Y takes values $y_1, y_2..., ym$on some scale, where $y_1 < y_2 < ... < y_m$. It is believed that the observable variable is a categorized version of a continuous latent variable U such that

$Y = y_i \Leftrightarrow \alpha_{i-1} < U \leq \alpha_i, i = 1,...,m$ ……. 1

where $-\infty = \alpha_0 < \alpha_1 < ... < \alpha_m = \infty$. It is further assumed that the latent variable U is determined by the explanatory variable vector **x** in the linear form $U = -\beta' \mathbf{x} + \epsilon,$ where β is a vector of regression coefficients and is a random variable with a distribution function F. It follows that

$\Pr\{Y \leq y_i|\mathbf{x}\} = F(\alpha_i + \beta^0\mathbf{x})$

The formular of the Multinomial Logit Model (MNL) is given below;

Pr (Yi = j) = e βj xij, j = 0,1,2, 3..., 10…….. 2

1 +Σ e β m x ij

m = 0

Pj = Pr(Yi = j) = e βj xij, j = 0,1,2,3,10…….. 3

1 +Σ e β m x ij m = 0

Where: Pr (Yi=ji) is the probability of choosing either of the adaptation options set aside. The reference category or based category is on adaptation options as the reference or, J is the number of climate change adaptation options in the choice set, Xi is a vector of the predictor (exogenous) socio-economic factors (variables) βj is a vector of the estimated parameters. The probability response is stated as follows; where:

P = Response Probability (J = 0, 1,2,3, ---10).

Y = Choice of Adaptation Category; J = 1, 2 ….10;

1= Diversification

2= Changing the breeds of livestock

3= Improve water management

4= Enhanced infrastructure and storage facilities

5= Supply of heat during cold weather,

6= Risk management and insurance

7= Climate-smart technologies

8= Improve soil management

9= Planting of flood resistant/tolerant crop

10 = No adaptation

The implicit functional form of the explanatory variables for the regression model is

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9 + X_{10} + ei)$ ……. 4

Where Y = Choice of Adaptation category (J =0,1,2,3, ---10)

X_1 = Sex of the investor (male = 1 and 0 otherwise)

X_2 = Age of the investor (years)

X_3 = Educational attainment (years)

X_4 = Household size (in number)

X_5 = Agribusiness experience (years)

X_6 = Membership of cooperative organization (yes = 1 and 0 otherwise)

X_7 = Access to climate information (access = 1, otherwise=0)

X_8 = Access to credit (access = 1, otherwise = 0)

X_9 = Annual income (naira)

X_{10} = Marital status (married = 0, single = 1, separated = 2, widow/(er) = 3, and divorced =4)

ei= Error term

Regressors Model; Bq = β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, β_9, β_{10} = Respective parameter estimates of the explanatory Variable, while β_{0i} is the constant term.

Factor Analysis

Based on the factors considered, the Principal Component Analysis (PCA) or Factor Loading was adopted for the study and by the application of Kaiser's rule of thumb. (Kaiser developed a rule of thumb of 0.4 as a minimum loading weight which a factor can have before it can be isolated as being positive to the attribute in question), the factor model was expressed mathematically as: $Yi = \beta io + \beta i_1F_1 + \beta i_2F_2 + \beta i_3F_3 + ...+ \beta inFn + ei$ ……..... 5

Where, Yi= dependent variable, Bi = parameters or loadings. Hence, B_1 – Bn is the

loading of variable Yi on factors, Fn., $F_1 - Fn$ = intending variables

Likert rating scale

Mean Scores analysis derived from a 4-Point Likert-type rating scale was used to analyze objective ii. The mean score was derived using the following formula;

$$X = \frac{\sum fn}{Nr} \quad \text{= for decision point} \quad \ldots\ldots 6$$

Where,

X = Mean score of each response option

∑ = Summation

F = frequency of each response option

n = Likert value of response options

Nr = Number of respondents to each option

However, response option was ranked as follows: 4 = Very High, 3= High, 2 = Low, 1 = Very low.

Decision rule: 4 + 3 + 2 + 1 = 10/4 = 2.5

From the calculation shown above, an item was accepted if the mean score is ≥ 2.5 and rejected if the mean score was < 2.5

Test of Hypothesis

P-value was used to test the null hypothesis which states that socio-economic characteristic of agribusiness investors have no significant effect on climate change adaptation strategies

P-value Formula:

The formula for testing a proportion is based on the z statistic. The formula is stated as follows:

$$\boldsymbol{Z} = \frac{\widehat{\boldsymbol{P}} - \boldsymbol{P_0}}{\sqrt{\boldsymbol{P_0}\frac{(\boldsymbol{1}-\boldsymbol{p_0})}{\boldsymbol{n}}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

where,

$\widehat{\boldsymbol{P}}$ is the sample proportion

$\boldsymbol{P_0}$ is the hypothesized proportion

$\boldsymbol{n}$ is the sample size

P value = p (z ≥ a)

RESULTS AND DISCUSSION

Socio-economic Characteristics of Agribusiness Investors.

The socio-economic attributes of an individual have been identified to have contributed significantly in shaping his/her behaviour. The socio-economic attributes of the agribusiness investors were therefore analysed in this section and result presented in table 1.

Sex: The study revealed that male investors were more active in certain agribusiness activities more than their female counterparts. This was attested by 30.0%, 17.2% and 15.6% male agribusiness investors that were into farm input supply, farm production and agro-processing/distribution respectively. This implied that male investors constitute a greater proportion of those involved in agribusiness activities in Southeast Nigeria. The finding is in line with Onubuogu and Esiobu (2014) who reported that male constitute a greater proportion of gender involved in agribusiness in Imo State, Nigeria.

Age: Age of agribusiness investors, showed that investors within the age bracket of 41-50 years are more in farm input supply (13.3%), investors within the age bracket of 31-40 years are more in farm production (11.1%), while investors within the age bracket of 41-50 are more in agro processing (17.5%) It also revealed a mean age of 54 years. Hence, they are of productive age. This corroborated the findings of Nwibo and Alimba (2013) that agribusiness activities in South-East Nigeria were dominated by the active investors who were within the age bracket of 40-59 years.

Marital status: Married investors have been observed to be the principal investors in the key areas of agribusiness as justified by 29.2%, 20.6%, and 31.9% of them that engaged in farm input supply, farm production and agro-processing/distribution respectively. This implied that the combined

knowledge of husband and wife will result in taking good decision to invest in agribusiness. This was justified by Adinya (2011), who reported that agricultural producers marry so as to utilize the potentials of family labour.

Educational attainment: Educational attainment, showed that educational attainment of an individual has a way of shaping the type of agribusiness activity one ventures into. On this premise, the study identified investors that completed senior secondary school (23.6%) as the major players in farm input supply, which is also the major players in farm production (21.9%) whereas, primary school certificate holders (21.7%) have been identified to be the major players in agro processing. Again farm input supply component has the highest number of investors that hold the tertiary education certificate (8.6%). These findings are justified as farm input supply demand higher academic proficiency than farm production that can be performed by anyone whether educated or not as it involves production of arable crops and rearing of animals. This finding however, disagreed with Olagunju, Adesigan and Ezekiel (2007), who revealed that 80% of fish agribusiness investors in Oyo state had tertiary education.

Household size: The study revealed that majority of agribusiness investors who were into farm input supply (19.2%) have the least family size ranging from 1-5, majority of investors that are into agro-processing/distribution (22.5%) have 6-10 family size. Whereas, farm production (16.4%) recorded the highest number of household that have more than 10 members. The mean household size of the agribusiness investors was 7 persons. The findings were in tandem with Ojemade, Edeh and Onemolease (2008) who opined that agricultural production activities are labour intensive and large households can help to reduce labour cost. Again, this is in line with the report of

Esiobu*et al.* (2014), who reported that large household size is a proxy to labour availability, ensure ease adaptation and resilience to climate change and reduce the cost of labour.

Agribusiness Experience: The results from the analysis showed that agribusiness investors that have stayed 1 - 5 years were more in farm production (14.4%), those who have stayed 6 - 10 years were more in farm production (17.2%) and agro-processing (15.6%). Whereas, agribusiness investors (2.2%) who have stayed above 15years were more in agro processing. This finding corroborate withDeressa*et al*. (2018) who revealed that investors with high years of experience is more efficient, having better knowledge of farming conditions and climate situation and hence, expected to be effectively resilient and efficient managers of climate change in the area. This finding also corroborate withNwibo and Alimba (2013) who revealed that investors with greater years of experience were involved in the supply of seedlings and fertilizers that has been inputs for farm production.

Annual income: The income level of an individual plays a great role in shaping the type of agribusiness activity one could venture into. From the analysis, the average annual income was ₦1,226,944.44. Meanwhile, from the cross-tabulation result, it was observed that majority of agribusiness investors with annual income above ₦2,000,000 were mainly into farm input supply. This finding is justified on the ground that the supply of farm inputs such as fertilizer and other agrochemicals is capital intensive, hence, requires a heavy startup capital. However, investors with an annual income ranging from ₦500,001 - ₦1,000,000 engaged mainly in farm production and agro-processing/distribution. Thus, the finding justified Nwibo and Alimba (2013) who reported that agribusiness investors with lower annual income invested more in farm

production, processing, distribution and marketing of agricultural products.

Membership of cooperative: From the analysis, majority of the agribusiness investors belong to cooperative societies, as attested by 22.5%, 27.8% and 14.2% for farm input supply, farm production and agro processing/distribution respectively. This implied that investors in the area will synergize information about climate change and adaptation measures effectively. The finding collaborated with Esiobu, Nwosu and Onubuogu (2014) who asserted that membership of cooperative society afford farmers the opportunity of sharing information on modern farming practices and project a collective demand.

Access to climate Information: From the analysis, majority of the agribusiness investors have access to climate information, as attested by 30.6%, 25% and 22.2% for farm input supply, farm production and agro processing/distribution respectively**.** This implied that majority of the investors have access to climate information possibly through mass media, which is very common in the area. This would afford them opportunity of combating climate change menace. This finding is justified by Ajayi (2009), who revealed that mass media were the major information sources for farmers on climate change.

Access to farm credit: From the analysis, majority of the agribusiness investors have access to credit, as attested by 25%, and 22.2% for farm input supply and farm production respectively**.** However, 27.8% of agro processing component had no access to credit in the area. This implied that investors in the area have relative access to credit, this will no doubt influence their climate change adaptation strategies. The finding disagreed with Mhlanga (2010) who opined that commercial banks in Sub-Sahara Africa lend less than 10 percent of their total credit to the agricultural sector.

Table 1: Cross-tabulation of Socioeconomic Characteristics of the Agribusiness Investors

Socio-economic variables	Category	Farm input suppliers	Farm producers	Agro processors	Mean
Sex	Male	108(30)	62(17.2)	56(15.6)	
	Female	12(3.3)	58(16.1)	64(17.8)	
Age (years)	≤ 30	6(1.7)	1(0.3)	2(0.6)	
	31 – 40	26(7.2)	40(11.1)	12(3.3)	
	41 - 50	48(13.3)	26(7.2)	63(17.5)	
	51 - 60	19(5.3)	34(9.4)	27(7.5)	54
	Above 60	21(5.8)	19(5.3)	16(4.4)	
Marital status	Single	10(2.8)	31(8.6)	2(0.6)	
	Married	105(29.2)	74(20.6)	115(31.9)	
	Widowed	5(1.4)	15(4.2)	3(0.8)	
Education attainment (years)	Primary Education	2(0.6)	7(1.9)	78(21.7)	
	JSS Completed	2(0.5)	14(3.9)	21(5.8)	
	SS Completed	85(23.6)	79(21.9)	18(5.0)	
	Tertiary Education	31(8.6)	20(5.6)	3(0.8)	
Household Size	≤ 5	69(19.2)	20(5.6)	14(3.9)	
	6-10	41(11.4)	41(11.4)	81(22.5)	7
	Above 10	10(2.8)	59(16.4)	25(6.9)	
Experience (years)	≤ 5	21(5.8)	52(14.4)	37(10.3)	
	6-10	62(17.2)	54(15)	56(15.6)	7
	11-15	31(8.6)	8(2.2)	19(5.3)	
	Above 15	6(1.7)	6(1.7)	8(2.2)	
Annual Income (₦)	≤ 500,000	9(2.5)	42(11.7)	40(11.1)	
	500,001 - 1,000,000	14(3.9)	48(13.3)	50(13.9)	
	1,000,001 - 1,500,000	12(3.3)	7(1.9)	18(5.0)	1,226,944.44
	1,500,001 – 2,000,000	32(8.9)	13(3.6)	7(1.9)	
	Above 2,000,000	53(14.7)	10(2.8)	5(1.4)	
Membership of cooperative society	Yes	81(22.5)	100(27.8)	51(14.2)	
	No	39(10.8)	20(5.6)	69(19.2)	
Access to climate Information	Yes	110(30.6)	90(25)	80(22.2)	
	No	10(2.7)	30(8.3)	40(11.1)	
Access to farm credit	Yes	90(25)	80(22.2)	20(5.6)	
	No	30(8.3)	40(11.1)	100(27.8)	

Source: Field Survey, 2024; Figures in parenthesis are percentage

Agribusiness Investors' Perception of Climate Change

The three investment areas of agribusiness - farm input supply, farm production and agro-processing, were assessed with relation to their level of perceptions to climate change using mean score analysis and result presented in Table 2.

Result of mean score analysis presented in Table 2 revealed that farm input suppliers'perceptions of climate change was increase in rainfall intensity (2.67). This probably because farm input suppliers tend to be challenged heavily by increase in rainfall, which invariably disrupt agribusiness activities in the area. This finding is in line with Falaki*et al.* (2013), who revealed that there is an increasing trend in rainfall amount as corroborated by majority of the farmers' perception.

For farm producers, result of mean score analysis presented in Table 2 revealed that farm producers'perceptions of climate change were: increase in temperature (3.67), increase in flooding (3.83), increase in wind storm (3.67), increase in sunshine (2.83), increase in drought (3.75), early cessation of rainfall (4.00) and late onset of rainfall (4.00). This implied that farm producers in southeast perceived climate change in form of increase in wind storm, increase in sunshine, increase in drought, early cessation of rainfall and late on set of rainfall. This finding is in agreement by Fosu-mensehe*t al.*(2012), who revealed that 92% of the respondents perceived increased temperature in climate change.

For agro-processors, result of mean score analysis presented in Table 2 revealed that Agro-processors''perceptions of climate change were: increase in wind storm (3.75) and increase in rainfall intensity (3.92). This could be as a result of devastating effects posed by climate change elements such as wind storm and increase rainfall intensity to agro-processing activities. This finding is in line with that of Ugwuoke*et al.*(2012)

Table 2: Mean Score Result of Agribusiness Investors' Level of Perception of Climate Change

Perceptions of climate change	Input Supply	Farm Producers	Agro-processors
Increase in temperature	1.25(R)	3.67 (A)	1.00(R)
Increase in flooding	1.08(R)	3.83(A)	1.17(R)
Increase in wind storm	1.83(R)	3.67(A)	3.75(A)
Increase in rainfall intensity	2.67(A)	2.00(R)	3.92(A)
Increase in sunshine	2.25(R)	2.83(A)	1.00(R)
Increase in drought	1.00(R)	3.75(A)	1.00(R)
Early cessation of rainfall	1.33(R)	4.00(A)	1.83(R)
Late onset of rainfall	1.00(R)	4.00(A)	1.00(R)

Source: Field Survey, 2024; Weighted Mean = 2.5; A = accepted, R = rejected

Effect of Agribusiness Investors' Socio-economic Characteristics on the Choice of Climate Change Adaptation Strategies

Socio-economic characteristics of individual has a way of influencing his/her choice of climate change adaptation strategy. Therefore, table 3showed the result of multinomial regression that was used to determine the effect of agribusiness investors' socio-economic characteristics on the choice of climate change adaptation strategies. The result showed that -2 log likelihood was 457.772. The likelihood ratio Chi Square of 963.019 with a P-value of (0.000) gave a good impression that the dependent and independent variables included in the model had good fit. The Pseudo R^2 which was 0.949 and greater than the level of probability ($p>0.05$) or 5% was high enough in providing sufficient explanation about the model. Hence, a suggestion that the socio-economic characteristics of the investors have significant effects on the choice of climate change adaptation strategies.

Age (X2): The age of the investors had a positive and significant effect on the choice of adapting to risk management and insurance, changing the breed of livestock and improve water management to climate change in the area. This implied that agribusiness investor's age was positively related to the likelihood of the choice of various adaptation strategies. Onubuogu and Esiobu (2014) attest to these findings when

they observed, in their respective studies, that there was a positive relationship between age of the household head and the adoption of various adaption strategies.

Educational attainment (X3): Educational attainment had a positive and significant effect on the choice across all adaptation strategies to climate change in the area. An increase in the educational attainment of agribusiness investor will increase the probability of choosing various climate change adaptation strategies. The probable reason for the positive relationship is due to the fact that educated investors have more knowledge of climate change and are already aware of various adaptation strategies that could be employed to combat the negative impact of climate change in the area. These findings are confirmed by the research undertaken by Fadine and Barjolle (2018), where they revealed that education enhance the farmers' ability to receive and comprehend climate information relevant to making innovative decisions in their agribusiness activities.

Household size (X4): Household size had a positive and significant coefficient on the choice of Improve soil management, planting of flood resistant/tolerant crop and supply of heat during cold weather large household size increases the likelihood choice of the above adaptation strategies to climate change in the area. The reason for this relationship is that large household size which is normally associated with a higher labour endowment would enable a household to accomplish various farm production tasks especially at the peak of the farming seasons. Tizale (2007) and Ndambiri*et al.* (2018), revealed that, household size is a proxy to labor availability. Therefore, larger households are likely to have a higher probability to adopt new agricultural practices that will help to address climate change effects.

Agribusiness experience (X5): Agribusiness experience had a positive and significant

effect on the choice of risk management and insurance, improve soil management, climate smart technology, supply of heat during cold weather planting of flood resistant/tolerant crop, improve water management in the area. The result showed that experienced agribusiness investor has an increased likelihood of choosing many adaptation strategies. The findings are similar to those arrived at by Nhemachena and Hassan (2007); Deressa*et al*. (2018) that agribusiness experience enhances the probability of uptake of various adaptations as experienced investors have better knowledge and information on changes in climatic conditions and farm management practices. Since the experienced agribusiness investors have high skills in farming techniques and management, they may be able to spread risk when faced climate variability than less experienced investors.

Membership of cooperative organization (X6): Membership of cooperative organization had a positive effect and statistically significant to agribusiness investors' choice of risk management and insurance, improving soil management, improving water management, enhancing infrastructure and storage facilities and climate-smart technology. This implied that investors in the area will synergize information about climate change and adaptation strategies effectively, which will increase their chances of adaptation. The finding corraborated with Esiobu, Nwosuand Onubuogu (2014) who asserted that membership of cooperative society afford farmers the opportunity of sharing information on modern farming practices and project a collective demand on climate adaptation.

Access to climate information (X7): Access to climate change information had a positive and significant effect on the choice of improving soil management, improving water management, planting of flood

resistant/tolerant crop. It implies that access to climate information has increased the probability of choosing various adaptation strategies. Information on climate variables like temperature amount, relative humidity, rainfall amount and sunshine duration has really helped agribusiness investors in the area of production processing and marketing of input. A number of studies confirm these results such as those by Maddison (2006) and Onubuogu and Esiobu (2014) who have separately opined that investors' access to information on climate change is likely to enhance their probability to perceive climate change, and hence adopt of new technologies and take-up adaptation techniques.

Access to credit (X8): Access to credit had a positive and significant coefficient on the choice of risk management and insurance, improving soil management, enhancing infrastructure and storage facilities and climate-smart technology. This implied that the higher the access to credit the higher the choice of adaptation strategies. This is in line with the findings of Deressa*et al.* (2018) and Onubuogu and Esiobu, (2014), who revealed that inadequate fund is one of the main constraints to adjustment to climate change.

Annual income (X9): Annual income had a positive and significant coefficient at various level on the choice of risk management and insurance, changing the breeds of livestock, improving soil management, improving water management, planting of flood resistant/tolerant crop, enhancing infrastructure and storage facilities, climate-smart technology. This is because investors with higher annual income have a tendency to adapt easily to climate change, than investors with less annual income, as adaptation options is expensive to be implemented (Knowler and Bradshaw, 2007). This observation is similar to that by Onubuogu and Esiobu (2014) who opined that investors' income has a positive

relationship with the adoption of agricultural technologies

Marital status (X10): The coefficients of marital status had a significant and positive effect on the choice of adapting risk management and insurance as well as changing the breeds of livestock. This implies that investors who are married are more likely to be aware of climatic conditions as well as the knowledge of various adaptation strategies that they could employ to adapt effectively, efficiently and steadily to change in the climatic conditions in the area. This observation is similar to that by Ndambiri*et al.* (2018) who opined that marital status has a positive relationship with the adoption of agricultural technologies which help agribusiness investors to counteract the negative impact of climate change.

Table 3: Multinomial Result of Effect of Agribusiness Investors' Socio-economic Characteristics on their choice of Climate Change Adaptation Strategies

Socioeconomic variables	Choice of climate change adaptation strategies															
	Risk management and insurance		Changing the breeds of livestock		Improve soil management		Improve water management		Planting of flood resistant/tolerant crop		Enhancing infrastructure and storage facilities		Climate-smart technology		Supply of heat during cold weather	
	Coef. (β)	Wald	Coef. (β)	Wald	Coef. (β)	Wald	Coef (β)	Wald	Coef. (β)	Wald	Coef. (β)	Wald	Coef. (β)	Wald	Coef. (β)	Wald
Sex	1.387		1.216		0.386		0.318		-22.947		0.675		-0.533		0.562	
	(1.163)	1.422ns	(2.283)	0.284ns	(0.464)	0.692ns	(0.437)	0.530ns	(23.163)	0.981ns	(10.163)	0.004ns	(7.398)	0.005ns	(3.958)	0.020ns
Age	0.026		0.074		0.179		0.199		0.082		0.064		0.072		0.019	
	(0.015)	3.004*	(0.041)	3.258*	(0.194)	0.851ns	(0.071)	7.856*	(0.103)	0.634ns	(0.081)	0.624	(0.154)	0.219ns	(0.125)	0.023ns
Educational attainment	1.519		0.592		1.516		5.195		1.08		1.036		1.174		3.471	
	(0.625)	5.907*	(0.316)	3.510*	(0.919)	2.721**	(2.999)	3.001*	(0.313)	11.906*	(0.588)	3.104*	(0.622)	3.563*	(1.761)	3.885*
Household size	0.096		0.840		1.088		1.189		0.232		0.232		0.343		1.509	
	(0.283)	0.115ns	(0.711)	1.396ns	(0.488)	4.971*	(1.237)	0.924ns	(0.093)	6.223*	(0.222)	1.092ns	(0.815)	0.177ns	(0.737)	4.192*
Agribusiness experience	0.384		0.041		0.518		0.539		0.941		-0.192		0.517		0.117	
	(0.206)	3.475*	(0.343)	0.014ns	(0.237)	4.777*	(0.289)	3.478*	(0.478)	3.878*	(0.238)	0.651	(0.317)	2.660**	(0.067)	3.049*
Annual income	0.011		0.324		0.533		13.323		0.532		0.325		1.342		0.013	
	(0.004)	7.563*	(0.125)	6.718*	(0.284)	3.522*	(8.342)	2.551**	(0.251)	4.492*	(0.164)	3.927*	(0.474)	8.016*	(0.015)	0.751ns
Marital status	4.547		11.931		5.211		-4.171		3.991		6.027		5.088		-4.081	
	(1.835)	6.140*	(5.681)	4.411*	(4.355)	1.432ns	(2.883)	2.093ns	(3.896)	1.049ns	(3.947)	2.332ns	(4.097)	1.542ns	(3.649)	1.251ns
Membership of cooperative society	0.811 (0.494)	2.695**	3.586 (3.484)	1.059ns	1.563 (0.892)	3.070*	12.879 (4.776)	7.272*	1.91 (3.615)	0.279ns	5.68 (3.476)	2.670**	16.762 (8.320)	4.059*	18.571 (85.044)	0.048ns
Access to climate information	0.727 (2.957)	0.060ns	1.994 (3.385)	0.347ns	0.912 (0.407)	5.021*	1.575 (0.906)	3.022*	2.46 (0.988)	6.189*	2.237 (2.966)	0.569ns	-0.948 (3.870)	0.060ns	-4.041 (4.031)	1.005ns
Access to credit	1.708		1.802		1.102		13.018		0.571		0.939		0.250		0.421	
	(0.906)	3.554*	(4.119)	0.191ns	(0.681)	2.619**	(53.164	0.060ns	(1.189)	0.231ns	(0.388)	5.857**	(0.142)	3.100*	(0.705)	0.357ns
Intercept	5.89		-1.767		-2.636	4.907	5.309	3.417	1.306	7.689	1.405	69.116	-5.008	0.380	11.232	11.155
	(2.169)	7.374	(0.495)	12.743	(1.190)		(2.872)		(0.471)		(0.169)		(8.126)		(3.363)	

Source: Field Survey, 2024; the figures in parenthesis are standard errors; ns = not significant; ** and * = significant at 5% and 1% level of probability respectively;

Constraints to climate change adaptation in the study area

Agribusiness investors face diverse challenge in their entrepreneurial investment, with respect to climate change adaptation. Table 6 shows the result of the varimax rotated component matrix on constraints to climate change adaptation in the study area. Kaiser's (1958) rule of thumb that variables with 0.4 or more coefficient have high loading may be used in naming a factor (Nwibo and Okorie 2013). Based on items that clustered and loaded high, four (4) factors were identified and extracted, namely; economic/managerial constraints (Factor I), socioeconomic constraints (Factor II), infrastructural constraints (Factor III) and institutional constraints (Factor IV). These four components represent the principal factors and constraints to climate change adaptation in Southeast, Nigeria. Each factor was given a denomination that best described or characterized the set of variables contained in it.

Economic/managerial constraints:

High insurance premium (0.587)

The result from the study showed high insurance premium as one of the constraints to climate change adaptation strategies in southeast Nigeria. This implied that elevated insurance premium will increase the cost of insuring agribusiness investment, which can strain the limited financial resources of investors. The financial burden may divert funds away from other critical areas. High cost of insurance premium can create a cycle of vulnerability, preventing agribusiness investors from making necessary adaptations to cope with the increasingly unpredictable effects of climate change. This is consistent with the findings by Bullock and Steinback (2023), who revealed that the current distribution of insurance premium per liability in crop insurance programme is very high.

Poor access to climate information (0.557)

The result from the study showed that poor access to climate information is one of the constraints to climate change adaptation strategies in southeast Nigeria. Agribusiness investors rely on accurate and timely climate information to make informed decisions about agribusiness activities. Without access to this information, investors may miss critical opportunities to optimize their practices for changing climate conditions. By addressing these constraints to access and ensuring that investors have the necessary climate information, they would be better positioned to adapt to the challenges posed by climate change and enhanced their resilience. This in line with the findings by Khatum and Roy (2012), who opined that lack of awareness and access to information as major problem to climate change adaptation measures.

Nonchalant attitude of investors towards climate change mitigation (0.694)

The result from the study showed that nonchalant attitude of investors towards climate change mitigation is one of the constraints to climate change adaptation strategies in the study area. Nonchalant attitude often comes with a resistance to changing established practices. Agribusiness investors may continue to rely on traditional farming methods that are less resilient to climate variability, which hinders their ability to adapt to changing conditions.

Lack of quality education (0.674),

The result from the study showed that lack of quality education is one of the constraints to climate change adaptation strategies in southeast Nigeria. without proper education, agribusiness investors may be unaware of the various adaptation strategies available to them. They may not know about climate resilient crop varieties, innovative technologies that could help them cope with

changing conditions. This is justified by the research undertaken by Fadine and Barjolle (2018), where they revealed that education enhance the farmers' ability to receive and comprehend climate information relevant to making innovative decisions in their agribusiness activities.

low quality processing equipment (0.689)

The result from the study showed that low quality processing equipment is one of the constraints to climate change adaptation strategies in southeast Nigeria. This implied low quality equipment may require more frequent more frequent repairs and maintenance, incurring additional costs and labour. These financial burden can divert resources away from other critical areas, such as investing in climate resilient practices. A study by Khatum and Roy (2012), reported poor asset quality as constraints to climate adaption measures.

Low quality input (0.684).

The study has shown that low quality input is one of the most important constraints faced by agribusiness investors in the area. The significance of input in agribusiness development, most especially those engaged in farm production cannot be over emphasize, unfortunately, so many investors were unable to access quality input due to high cost in the study area. This is in line with the findings by Onyebinama (2004), who revealed that farm input markets face several constraints that borders on accessibility affordability of quality inputs.

Socioeconomic constraints:

poor knowledge of diversification (0.702)

The result from the study showed that poor knowledge of diversification is one of the constraints to climate change adaptation strategies in southeast Nigeria. knowledge of diversification strategies is crucial for building resilience against climate impacts. Agribusiness investors lacking this understanding may not employ techniques

that could help buffer against yield losses in the face of unpredictable weather patterns, leading to greater vulnerability.

Lack of information on alternative markets (0.825)

The result from the study showed that lack of information on alternative markets is one of the constraints to climate change adaptation strategies in southeast Nigeria. This challenge stems from the difficulties in accessing and utilizing information regarding other markets for their products by agribusiness investors. This finding conforms to FAO (2001) that market-oriented production requires the use of a real-time market information service.

Poor knowledge on growing resistant varieties (0.833)

This study has shown that poor knowledge on growing resistant varieties was one of the most important constraints faced by agribusiness investors, in the bid to adapt to climate change in the study area. Growing resistant varieties that can withstand climate change effect, will guarantee higher yield and promote agribusiness growth. Unfortunately, some of the farm producers in the study area have poor knowledge relating to growing resistant varieties.

Limited farm land (0.798).

The result from the study showed that limited farm land is one of the constraints to climate change adaptation strategies in southeast Nigeria. Limited farm land correlates with lower economic means. Agribusiness investors may lack the financial resources necessary to invest in technologies or practices that promote climate change adaptation.

Infrastructural constraints:

Poor road network (0.708)

Poor road network is one of the infrastructural related factor affecting climate change adaptation strategies. This has frustrated a lot of agribusiness investors with

bright ideas and the corresponding spirit to adapt to climate change adaptation strategies that will promote agribusiness growth. This finding is in conformity with Beuran*et al.* (2015), who revealed that poor quality of roads and bridges in most sub-Sahara Africa countries have been the major handicap to effective transportation of produce from the rural areas to various markets, resulting in high post-harvest losses and rendering agribusiness investments less profitable.

Poor storage facilities (0.834)

The result from the study showed that poor storage facilities is one of the constraints to climate change adaptation strategies in the study area. This implied limited options for storage and preservation. This is particularly important as agribusiness investors attempt to manage unpredictable harvests due to climate change, as the ability to store food for longer periods is crucial for balancing demand and supply. This is in line with the findings by Ewebiyi and Meliudu (2013), who identified lack of infrastructural facilities as a constraints militating against climate change adaptation.

Inefficient marketing information (0.602).

The result from the study showed that inefficient marketing information is one of the constraints to climate change adaptation strategies in southeast Nigeria. Free flow of market information is vital for agribusiness growth and development. Poor marketing information constrained marketing system especially in changing climate that has irregular fluctuations in agribusiness investors output and prices. This is in line with the findings of Esiobu and Onubuogo (2014), who revealed poor information on marketing as a major impediment to agricultural products marketing in Nigeria.

Institutional constraints:

high interest rate on credit (0.604)

The study revealed that high interest rate is one the constraints to climate change adaptation strategies in the study area. The

strength attached to borrowing as one of the climate change adaptation measures has been defeated by high interest rate. The finding corroborates with Mhlanga (2010) who opined that commercial banks in Sub-Sahara Africa lend less than 10 percent of their total credit to the agricultural sector.

Poor government policy (0.604)

Poor government policy has been established from the analysis as one of the constraints to climate change adaptation strategies. Like policy on taxation, policy on importation, among others. This has hindered agribusiness growth and affected climate change adaptation measures meant to promote agribusiness development. This finding is consistent with Nwibo and Alimba (2013) who revealed that the height of taxes and the complexity of the tax system which were characterized by extortion were identified as having negative effect on agribusiness and investment decisions.

lack of technical know-how (0.555).

The result from the study showed that lack of technical know-how is one of the constraints to climate change adaptation strategies in the study area. Lack of technical know-how can lead to resistance against adopting new practices or technologies. Investors may stick to traditional methods out of unfamiliarity with new approaches, even when those methods could potentially offer better adaptation strategies.

Table 6: Varimax Rotated Matrix Result on Constraints to Climate Change Adaptation in the Study Area

Constraints	Economic/ managerial constraints	Socioeconomic constraints	Infrastructural constraints	Institutional constraints
High insurance premium	**0.587**	0.185	-0.065	-0.463
High interest rate on credit	-0.112	0.133	-0.236	**0.604**
Poor access to climate information	**0.557**	0.075	-0.202	-0.230
Nonchalant attitude of investors towards climate change mitigation	**0.694**	0.047	-0.107	-0.272
Poor government policy	0.008	-0.090	0.102	**0.604**
Lack of quality education	**0.674**	0.066	0.035	0.281
Lack of technical know-how	0.396	0.319	0.221	**0.555**
Poor access to extension agents	0.431	-0.021	0.597	0.016
Poor road network	-0.391	-0.084	**0.708**	0.245
Poor storage facilities	-0.038	0.018	**0.834**	-0.026
Low quality processing equipment	**0.689**	0.278	0.047	0.164
Low quality input	**0.684**	0.203	0.014	0.067
Poor knowledge of diversification	0.321	**0.702**	-0.269	0.038
Lack of information on alternative markets	0.120	**0.825**	0.034	-0.008
Poor knowledge on growing resistant varieties	0.180	**0.833**	0.047	0.019
Inefficient marketing information	-0.118	0.373	**0.602**	-0.093
Limited farm land	0.092	**0.798**	0.224	0.037

Source: Field Survey, 2024

Test of Hypothesis

Ho_1: Socio-economic characteristics of agribusiness investors have no significant effect on choice of climate change adaptation strategies.

This hypothesis was tested using the p-value obtained from the estimation of the model. The P-value, which apart from the R^2 also gave the overall significance of the model. The value obtained through estimation was 0.0000. In view of the fact that this value is less than the probability level of 0.05, the null hypothesis was rejected and the alternative hypothesis accepted that socio-economic characteristics of agribusiness investors have

significant effect on the choice of climate change adaptation strategies.

CONCLUSION

Conclusively, the study confirmed that Agribusiness investors in the area rightly perceived the direction of changes in climatic variables, implying that they have been responding to climate change. It was equally established that despite the optimal performance of agribusiness investments in southeast Nigeria, the sector was still bedeviled by some constraining factors which retard the growth and development of the sector These identified constraints to climate change adaptation were classified under the four principal component factors which include: economic/managerial constraints, socioeconomic constraints, infrastructural constraints and institutional constraints. Based on the findings, it is concluded that socio-economic characteristics of the agribusiness investors have significant effect on the choice of climate change adaptation strategies.

RECOMMENDATIONS

Based on the findings of this research, the study recommended enlightenment program on climate change to sensitize investors on the effects and sustainable adaptation strategies to be adopted in combating climate change effects in southeast Nigeria.

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