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ASSESSMENT OF FARMERS' AWARENESS OF EFFECTS OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTION IN NIGER-DELTA REGION OF NIGERIA.

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Abstract
This study assessed farmers' awareness of effects of climate change on agricultural production in Niger Delta, Nigeria. Specifically, it analyzed socio-economic characteristics of farmers, assesses their awareness of climate change factors affecting agricultural production, and identified factors limiting their awareness. Using a multi-stage random sampling technique, data were collected from 598 respondents in Bayelsa and Delta States, Nigeria. Both descriptive and inferential statistics were employed for data analysis. Findings revealed that majority (77.76%) farmers demonstrated a high level of awareness regarding climate change impacts, with increased temperature, excessive flooding, and water scarcity identified as key concerns. Factors such as age, education level, farm size, farming experience, cooperative membership, and access to extension services significantly influenced awareness levels. However, limited access to reliable information, socio-economic constraints, and inadequate extension services were key barriers to farmers awareness of effects of climate change. Binary logistic regression analysis confirmed the significant effects of socio-economic characteristics such as: farmers' age, educational level, farm size, farming experience, membership of cooperative societies and access to extension services, on agricultural production. The study concluded that targeted interventions like enhanced extension services and improved access to climate information, are crucial for increasing farmers' awareness of effect climate change effect on agricultural production.
***Keywords:** Assessment, climate change, awareness, agricultural production.*

1.0 Introduction

Climate change is one of the most pressing global challenges of the 21st century, posing significant risks to ecosystems, economies, and societies (Malhi et al., 2020). The scholars stated that it is actually an undeniable global phenomenon that has emerged as one of the greatest challenges in present time. Climate change could be perceived as significant and lasting changes in weather patterns over long periods of time, say 30 – 35 years and it is driven by both natural processes and human activities (Turrentine, 2022). Malhi et al. (2020) indicated that the human-induced factors are those particularly linked to the burning of fossil fuels, deforestation, and industrial activities, which have accelerated accumulation of greenhouse gases in the atmosphere, leading to global warming. Effects of climate change are quite devastating, far-reaching and multifaceted, impacting on the ecosystems, economies, and human well-being (Daniel, 2021).

One of the consequences of climate change is perhaps, the rising temperatures, which are already causing polar ice caps and glaciers to melt, contributing to rising sea levels that threaten coastal communities (Bolan et al., 2023). Unpredictable weather patterns are disrupting agricultural systems as evident in resultant food insecurity, economic instability and rising poverty level

amongst the people, especially among rural farmers (Mirzabaev et al., 2023). Godde et al. (2021) opined that extreme weather events, such as hurricanes, floods, heatwaves, and droughts, are becoming more frequent and severe, placing millions of lives and livelihoods at risk and that to a large extent biodiversity is also under threat, as species struggle to adapt to rapidly changing habitats. Adaptation involves making adjustments to social, economic, and environmental systems to reduce vulnerability and enhance resilience to climate change (Eriksen et al., 2021). Eriksen et al. (2021) acknowledged that adaptation addresses the practical realities of living in a changing climate. Adaptation strategies that are advanced to address climate change must be tailored to local contexts, while also addressing global challenges, ensuring that no one is left behind in the pursuit of a sustainable future.

Niger Delta is especially vulnerable due to its fragile ecosystem and the dual pressures of environmental degradation from oil exploration and growing effects of climate change (Odubo and Odubo, 2024). Meanwhile, there seems to be a noticeable gap in understanding how rural farmers perceive and respond to the risks posed by climate change on agriculture (Farooq et al., 2022). The authors noted that farmers' awareness and their adaptive capacity play a pivotal role in mitigating these risks and ensuring the long-term sustainability of agriculture in the region.

Despite the increasing exposure of farmers to climate-related hazards, it remains unclear how well-informed they are about the causes, consequences, and potential adaptation strategies available to them. Without this knowledge, efforts to build resilience of effects of climate change effects may fall short of their intended impact.

This study therefore seeks to bridge this knowledge gap by exploring the awareness levels of farmers in the Niger Delta regarding climate change and its impacts on agricultural activities.

2.0 Objectives of the Study

The broad objective of the study was to assess farmers' awareness of climate change and identify strategies they can employ to adapt to its effects. The specific objectives were to;

(i) analyze the socio-economic characteristics of the farmers in the area of study,
(ii) assess farmers' awareness of effects of climate change on agricultural production,
(iii) assess the proportion of farmers that were aware and those not aware of effects of climate change on agricultural production, and
(iv) identify factors limiting farmers' awareness level of effect climate change on agricultural production.

3.0 Methodology

The study was carried out in both Bayelsa and Delta States in the Niger Delta region of Nigeria. Bayelsa State was created on 1st October, 1996 from Rivers State. It is made up of 8 Local Government Areas (LGAs) with Yenagoa as its capital. Okwuokenye and Iduseri (2019) confirmed its land size to be 21,000Km^2 but has extensive waterways, creeks and swamps, and located within Latitudes $4^0$15' and $5^0$23'N and Longitudes $5^0$15' and $6^0$45'E. Bayelsa State has an estimated population size of about 2.4 million as at 2024 (Bayelsa Population Statistics, 2024). Bayelsa State is endowed with natural resources such as crude oil and natural gas and for this reason it is a major contributor to Nigeria's economy (Chukwuma-ekwueme, 2023). In spite of the State's wealth, it is still underdeveloped in terms of infrastructure (Chukwuma-ekwueme, 2023). Okwuokenye and Iduseri (2019) stated that Bayelsa State is predominantly made up of the Ijaw people and their livelihood is majorly fishing due to the surrounding water bodies and they as well grow crops such as oil palm, coconut, sugar cane, rubber, citrus and others. Okwuokenye and Iduseri (2019) acknowledged that the people have rich cultural traditions such as Isaac Boro Day and various boat regattas.

]Delta State was created on August 27, 1991, from defunct Bendel State. Delta State is made up of 25 LGAs with the capital seat at Asaba and an estimated population size of 6,037,667 as at

2024 (Delta State, Nigeria Population Statistics, 2024). The State's land area is 17,698Km^2, bordered by Edo, Ondo, Anambra, Imo, Rivers, and Bayelsa states, with a coastline along the Atlantic Ocean and lies between Longitude 5^0.00" and 6^0.45" North and Latitudes 18^{0}and 23^0 South (Okwuokenye and Onyemekihian, 2023). The State majorly contributes to the Nigeria's economy due to its rich crude oil and natural gas deposit. In addition, Delta State is rich in agricultural potentials where most of her inhabitants are predominantly farmers growing crops like cassava, Oil palm rubber, yam, maize and other (Okwuokenye and Iduseri, 2019). Delta State is made up of the Urhobo, Itsekiri, Ijaw, Isoko, and Anioma ethnic groups and based on this, it has a rich and diverse culture, cultural festivals, traditional dances and rich history.

Data used for this study were obtained from primary and secondary sources. Primarily, data were collected with the aid of questionnaire and interview schedule, administered to literate and illiterate farmers respectively. Secondary data were sourced from text books, journal articles and from the Internet.

The study employed a multistage sampling technique. In Stage 1, Bayelsa and Delta States were purposively selected based on their geographic proximity, similar climatic conditions, and comparable agricultural practices. Stage 2 involved the random selection of two agricultural zones from each State: Bayelsa Central and Bayelsa West from Bayelsa State, and Delta North and Delta Central from Delta State. In Stage 3, two LGAs were randomly selected from each zone, resulting to total of eight LGAs. Subsequently, Stage 4 involved random selection of two rural communities from each LGA, totaling 16 rural communities for the study.

In Bayelsa State, the selected LGAs and their respective rural communities (in parenthesis) were:
Bayelsa Central: Kolokuma/Opokuma (Akaibiri and Igbanwa), Yenagoa (Atisa and Yenagoa)
Bayelsa West: Sagbama (Ogobiri and Ofoni), Ekeremor (Aleibiri and Ayamassa)
In Delta State, the selected LGAs and rural communities (in parenthesis) included:
Delta North: Ika South (Omumu and Alihami), Aniocha South (Ewulu and Isheagu)
Delta Central: Sapele (Amukpe and Ebada), Ughelli South (Otokutu and Ekakpamre)
From these 16 rural communities, a total of 40 farmers were randomly selected for the study. Out of the instruments returned, 598 (93.44%) were valid and subsequently used for data analysis.

Descriptive and inferential statistics were employed to analyze the data collected. Descriptive statistics were used to analyse the socio-economic characteristics of farmers, as well as the proportion of farmers that were aware and unaware of effects of climate change on agricultural production. Likert type scale was utilized to assess farmers' level of awareness regarding the climate change factors impacting on agricultural production, along with the factors limiting their awareness. Farmers' awareness of climate change impacts on agricultural production was analysed using a 4-point Likert type scale, with response options coded as follows: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). The scale produced a mean threshold of 2.50, calculated as (4 + 3 + 2 + 1) / 4 = 2.50. Mean score of 2.50 or higher indicated that farmers agreed they were aware of effect on agricultural production. Conversely, mean score below 2.50 suggests lack of awareness of effect on agricultural production. Same Likert type scale was used to analyze factors limiting farmers' awareness of effects of climate change. Mean score of 2.50 or higher indicated that farmers agreed the factor in question was indeed limiting their awareness of climate change impacts on agricultural production. Conversely, factors with mean scores below 2.50 were considered not to be significant barriers to their awareness

Inferential statistics were utilized to test the study's hypotheses. Binary logistic regression model was used to analyse the influence of farmers' socio-economic characteristics on their level of awareness of the effect of climate change on agricultural production (hypothesis 1). The regression model was used to analyse the relationship between a dichotomous dependent variable, Y (awareness level) takes only two values, 1 and 0 correspondingly and the independent variable(s) (Mdoda (2020). This is based on the assumption that Y is a binary response (dependent) variable, and X (X_1, X_2.....Xn) is a set of independent variables. The dependent variable was coded as 1 if

the farmer was aware of climate change effects and 0 if otherwise. The regression model was presented both implicitly and explicitly as follows:

Lny = In (p/I-P) = F (BiXi) +ei

In (P/I-P) = F (BiXi) +ei

Where: Y = Level of awareness (Aware = 1; not aware = 0)

P = Probability of farmers that are aware of climate change effect on agricultural production

I-P = Probability of farmers that are not aware of climate change effect on agricultural production

I-n = Natural Logarithm function

Bi = Vector of logistic respect coefficients

Xi = Vector of independent variables (socio-economic characteristics) given as follows:

Y = Level of awareness (Aware = 1; not aware = 0)

X_1 = Gender: male =1; female = 0

X_2 = Age: measured in years

X_3 = Marital Status: married =1; single =2; divorced/separated =3; widow/widower =4

X_4 = Household size: number of people living and feeding together

X_5 = Educational status: no formal educ. = 1; primary educ. = 2; secondary educ. = 3; tertiary educ. = 4

X_6 = Farm size of respondents: measured in hectares.

X_7 = Farming experience: measured in hectares

X_8 = Member of cooperative society: member = 1; non-member = 0

X_9 = Access of extension services: High access = 1; low access = 0

Hypothesis 2 was analysed using Binomial test. It was used to determine if there is a significant difference between the proportion of farmers that were aware and those not aware of the effect of climate change on agricultural production. The formula for Binomial distribution is given as follows:

b(x;n,p) = nCx*px*(1-p) n-x

Where b = binomial probability

x = total number of successes (aware or unaware of the effect of climate change on agricultural production)

p = probability of success on an individual trial

n = number of trials

In decision-making, the possible values of the test statistic are divided into two regions. The critical region of the sampling distribution represents the range of values that would lead to rejecting the null hypothesis, even if it is actually true.

4.0 Results and Discussion

4.1 Socio-economic characteristics

Table 1 shows that majority (61.71%) of the respondents were males, while females accounted for 38.29%, Although the survey suggests that farming in the area is not inherently gender-biased, participation appears to be skewed towards men within the Niger Delta region of Nigeria. This imbalance may be attributed to the traditional role of men as primary breadwinners, viewing farming as a means of providing for their families. Additionally, men often have comparatively easier access to farmland than their female counterparts. This result corroborates findings of Ikoyo-Eweto et al. (2023) that reported a predominance of male farmers in the area. The age distribution of farmers highlights the participation of various age groups, with majority (40.64%) falling within 40–59-years age range, and an overall average age of 41.67 years. This suggests that farming in the region is predominantly undertaken by individuals who are in their prime and physically active years. Similar findings by Opeyemi et al. (2021) that reported a comparable average age among farmers in the region supported the result.

Table 1 also shows that most (41.14%) of famers had secondary education. This suggests that the farmers are well-positioned to readily adopt and utilize agricultural technologies with minimal or no external assistance. This observation is consistent with the findings of Opeyemi et al. (2021) that emphasized farmers education as key, which enhances their ability to access and implement agricultural innovations, ultimately improving their productivity. Majority (71.74%) of farmers in the study area were married, compared to 14.88% who were single, 5.52% widowed, and 7.86% divorced or separated. Marriage in this context may reflect a sense of responsibility, as married individuals are often tasked with providing for the economic needs of their families, an obligation frequently met through proceeds from their farming activities. This finding agrees with Ovharhe et al. (2020), who reported that most farmers in the region are married and actively engaged in farming to meet their families' financial demands.

Table 1 further shows that most (32.27%) had between 20 - 29 years of farming experience, with an overall average of 24.58 years. These findings suggest they are highly experienced in their agricultural activities. Such experience equips them to effectively manage the risks and uncertainties commonly associated with farming. This observation was supported by Ikoyo-Eweto et al. (2023), who noted that substantial farming experience enhances farmers' capacity to address challenges on the farm, ultimately leading to improved productivity. The average farm size among the farmers was 2.34 hectares, with the most (34.44%) of the farmers cultivating between 2.1 and 3.0 hectares. This indicated that the farmers are primarily operating on a small-scale level, as their farm sizes are generally less than 4 hectares. These findings are consistent with those of Garba et al. (2021), who similarly observed that the majority of farmers in Nigeria cultivate less than 4 hectares of land, thereby classifying them as small-scale farmers.

The respondents had an average household size of six persons, with the majority (45.82%) having between 4 - 6 members in their households. This suggests that the farmers generally have relatively large household sizes, implying they have dependants who rely on them for economic support. In return, household members may serve as a source of farm labour, contributing to agricultural activities. These findings are consistent with Okwuokenye and Urhibo (2019), who reported similar household sizes among farmers in Delta State. Result on cooperative group revealed that majority (85.62%) of farmers were members of one cooperative group or another within their communities. Participation in cooperatives offers various benefits, which likely explains high level of membership among farmers. This finding aligns with Akpomedaye (2023) who noted that involvement in cooperative groups provides farmers with advantages such as enhanced farming activities and greater access to extension services. Additionally, Table 1 shows that 52.17% of the farmers had access to extension services, disseminated in various forms and tailored to their specific needs. Access to extension services plays a crucial role in keeping farmers informed about new agricultural technologies that can significantly improve productivity. High level of access observed is consistent with the findings of Ayenew et al. (2020) who reported increasing farmer access to extension services that results in higher adoption rates of improved technologies and subsequent increases in farm output.

Table 1: Distribution of respondents based on socio-economic characteristics (n=598)

Variables	Categories	Freq.	Percentage	Mean
Sex	Male	369	61.71	
	Female	229	38.29	
Age range (years)	≤ 20	75	12.54	
	20 – 39	182	30.43	
	40 – 59	243	40.64	
	≥ 60	98	16.39	41.67
Formal educational Status	Non formal educ.	91	15.22	
	Primary educ.	137	22.91	
	Secondary educ.	246	41.14	

	Post-secondary educ.	124	20.74	
Marital status	Single	89	14.88	
	Married	429	71.74	
	Divorced/Separated	47	7.86	
	Widow(er)	33	5.52	
Farming experience (yrs)	< 10	81	13.55	
	10 – 19	113	18.90	
	20 – 29	193	32.27	
	30 – 39	142	23.75	
	≥ 40	69	11.54	24.58
Farm size (ha.)	≤ 1.0	101	16.89	
	1.1 – 2.0	157	26.25	
	2.1 – 3.0	194	34.44	
	3.1 – 4.0	82	13.71	
	4.1 – 5.0	43	7.19	
	≥ 5.1	21	3.51	2.34
Household size (years)	1 – 3	131	21.91	
	4 – 6	274	45.82	
	7 – 9	122	20.40	
	≥ 10	71	11.87	5.67 = 6
Member of cooperative society	Yes	512	85.62	
	No	86	14.38	
Access to extension services	Yes	312	52.17	
	No	286	47.83	

Source: Field Survey (2025)

4.2 Farmers' awareness of effects of climate change on agricultural production

Farmers' awareness of effects of various climate change factors on agricultural production is presented in Table 2. Among these factors, increased temperature (mean = 3.63), excessive flooding (mean = 3.52), water scarcity (mean = 3.33), and changes in rainfall patterns (mean = 3.19) ranked first through fourth, respectively, as the most recognized factors farmers were aware of impacting agricultural production. Other factors identified by farmers included seasonal variations (mean = 2.93), catastrophic storms (mean = 2.87), severe bushfires (mean = 2.64), and excessive heat (mean = 2.52). These latter factors ranked 5th, 6th, 7th, and 8th, respectively, among the climate change factors farmers were aware of as impacting agricultural production. The findings indicated that farmers were aware of several climate change factors that can significantly affect agricultural productivity. The prevalence of these factors may, to a large extent, contribute to food shortages and food insecurity both in the region and across the country. The result is in consonance with the findings of Olorunfemi et al. (2021) that reported farmers recognized these factors as having the potential to adversely affecting agricultural production and, consequently, lead to food insecurity.

Table 2: Farmers' awareness of effects of climate change agricultural Production (n=598)

Variables	Mean	Standard Dev.	Rank
- Increase in temperature	3.63*	0.58	1st
- Excessive flood	3.52*	0.60	2nd
- Water scarcity	3.33*	0.6	3rd
- Change in rainfall pattern	3.19*	0.62	4th
- Seasonal variation	2.93*	0.69	5th
- Catastrophic storms	2.87*	0.64	6th
- Severe fire from bush burning	2.64*	0.71	7th
- Excessive heat	2.52*	0.73	8th

- Intense drought	1.41	0.69	9th
- Rising sea levels	1.18	0.78	10th
- Declining biodiversity	1.11	0.74	11th

Source: Field survey (2025). * *Agreed = mean ≥ 2.50*

4.3 Proportion of farmers level of awareness of climate change factors

Assessment of the proportion of farmers that were aware and those not aware of climate change effect on agricultural production is shown on Table 3. The results revealed that most (40.97%) had high level of awareness of climate change factors affecting agricultural production. About 15.54% had very high awareness while 25.75%, 14.72% and 6.02% had moderate, low and poor awareness of climate change factors that affect agricultural production. Further consideration of farmers awareness level of the climate change factors affecting agricultural production, using a dichotomous approach, Table 4 revealed that most (77.76%) of the farmers were highly aware while the other fraction (22.24%) had low awareness of climate change factors affecting agricultural production. High level of awareness among farmers regarding climate change factors affecting agricultural production revealed their detailed understanding of climate change and its impact on agriculture. This conclusion is reinforced by findings of Ikpe et al. (2023) that every stage of agricultural production, from land cultivation to the disposal of agricultural products, is influenced by weather and climate

Table 3: Farmers level of awareness of climate change factors (n=598)

Level of awareness	Frequency	Percentage
- Very high awareness	75	12.54
- High awareness	245	40.97
- Moderate awareness	154	25.75
- Low awareness	88	14.72
- Poor awareness	36	6.02
Total	598	100.00

Source: Field survey (2025).

4.4 Factors limiting farmer's awareness level of climate change effect on agricultural production.

Result on factors limiting farmers level of awareness of climate change factors affecting agricultural production is shown in Table 5. It revealed that several factors such as: lack of access to reliable information on climate change (mean = 3.29), socio-economic characteristics of farmers (mean = 3.21), lack of finance (mean = 3.08) and limited access to extension services (mean = 3.02) were some of the factors limiting farmers level of awareness of climate change effect on agricultural production. The influence of access to reliable information is supported by Ado et al. (2018) who found farmers with access to dependable climate change information are more likely to understand its effects on agricultural production. Similarly, the impact of farmers' socio-economic characteristics aligns with Mdoda (2020) who reported that factors such as age, education level, farming experience, and farm size influence their awareness of climate change effects. The findings suggest that older farmers tend to be less aware of climate change impacts, while those who are more educated, have larger farms, and possess greater farming experience are generally more informed. Additionally, the role of farmers' income in shaping awareness of climate change was justified by findings of Magaji and Musa (2024) who noted that higher-income farmers are better positioned to create awareness and allocate resources to mitigate its effects. Furthermore, Mdoda (2020) also highlighted that farmers' contact with extension service providers positively influences their knowledge of climate change's impact on agricultural production.

Other factors revealed to be responsible for farmers level of awareness of climate change on agricultural production include: limited perception level of farmers (mean = 2.81), limited

access to agricultural technology (mean = 2.66), poor digital literacy (mean = 2.54) and location of the farmers (mean = 2.51). The findings on farmers' limited perception levels are similar to findings of Magaji and Musa (2024) that perception plays a crucial role in shaping farmers understanding of climate change's impact on crop yields and food security. In same vein, the connection between access to agricultural technology and awareness of climate change effects is supported by Mdoda (2020) who noted farmers benefit from extension workers' advice, capacity-building programs, training, and field schools, which equip them with knowledge on climate change impacts on agricultural production. Furthermore, the constraint of limited digital literacy in farmers' awareness of climate change effects is corroborated by Zheng et al. (2022) who reported that most smallholder farmers do not utilize digital technologies such as the Internet and social media, as sources of agricultural information. Also, the farmer's location can significantly restrict their awareness of climate change impacts, particularly in remote areas with limited access to information sources.

Table 4: Factors limiting farmers level of awareness to effects of Climate change on agricultural production (n=598)

Factors limiting farmers level of awareness to effect on agricultural production	Mean	Standard Deviation	Remark
- Lack of access to reliable information on climate change	3.29	0.58	Agreed
- Socio-economic characteristics of farmers (e.g. low level of farmers' education, age and farm experience)	3.21	0.61	Agreed
- Lack of finance	3.08	0.65	Agreed
- Limited access to extension services	3.02	0.58	Agreed
- Limited perception level of farmers	2.81	0.69	Agreed
- Limited access to agricultural technology	2.66	0.62	Agreed
- Poor digital literacy	2.54	0.67	Agreed
- Location of the farmers	2.51	0.68	Agreed
- Influence from neighbours	2.33	0.72	Disagreed
- Lack of orientation from the government	2.01	0.74	Disagreed
- Just seeing climate change as one natural thing that has no effect	1.58	0.78	Disagreed

Source, Field survey (2025). *Agreed ≥ 2.50*

4.5 Impact of farmers' socio-economic traits on climate change awareness in agriculture

The key factors influencing farmers' awareness of climate change effects on agricultural production were analyzed using a Binary Logistics model. The results, presented in Table 6, indicated that coefficient of determination (R^2) for socio-economic characteristics was 0.629. Thus, suggested that independent variables included in the model account for 62.9% of the socio-economic factors shaping farmers' awareness levels regarding climate change impacts on agriculture. Among nine socio-economic variables examined, six of them, namely: age, education level, farm size, farming experience, cooperative society membership, and access to extension services were found to be significant determinants of awareness. These findings infer the strength and effectiveness of the model in explaining the influence of socio-economic factors on farmers' awareness of climate change and its effects on agricultural production. Based on regression coefficients, the results showed that the predicted logit of (awareness) = 12.869 – 1.310X2 + 0.902X5 + 1.783X6 + 0.894X7 + 1.729X8 + 0.814X9. The interpretation of the results is based on regression coefficients and odds ratios. A positive coefficient indicates that an increase in the variable enhances the likelihood of awareness, whereas a negative coefficient suggests a decline in awareness probability.

Regression analysis demonstrated that farmers' awareness of climate change effects on agricultural production is negatively correlated with age, a relationship that is statistically significant at 5% level. The beta coefficient is -1.310, with a standard error (SE) of 0.218. Negative correlation implies younger farmers are likely to be more aware of climate change effects than their older counterparts. The odds ratio of 2.084 suggested an increase in farmers age will result to decrease by a factor of two of their awareness level. This trend may be attributed to older farmers' reluctance to seek new information. These findings align with Mdoda (2020), who observed that older farmers tend to be less proactive in acquiring knowledge related to climate change and its impact on agricultural production. Analysis of farmers' educational levels yielded a beta coefficient of 0.902 with SE of 0.014. The relationship was positive and statistically significant at the 1% level, indicating that higher levels of education correlate with increased awareness of climate change effects. The odds ratio of 2.980 suggested that higher educational attainment enhances farmers' awareness of climate change impacts by approximately three times. These findings are in line with findings of Opeyemi et al. (2021) that highlighted education as a crucial factor in equipping farmers with the knowledge necessary to understand and respond to climate change challenges in agricultural production.

Relationship of farm size and farmers' awareness of climate change effects on agricultural production was found to be positive and statistically significant at 5% level. Its beta coefficient was 1.783, with SE of 0.337, indicating that farmers with larger farm sizes are likely to be more aware of climate change impacts. The odds ratio of 3.012 suggested that an increase in farm size triples the likelihood of climate change awareness. These findings are consistent with Magaji and Musa (2024) that expressed effects of climate change are more apparent to farmers managing larger farms. Similarly, farming experience demonstrated a positive and significant relationship with climate change awareness at 5% level, with a beta coefficient of 0.894 and SE of 0.022. This suggests that farmers with more years of experience are better informed about climate change effects. The odds ratio of 2.410 indicated that each additional year of farming experience increases awareness levels by approximately 2.41 times. These findings are supported by Mdoda (2020) who asserted that experienced farmers possess a deeper understanding of climatic conditions and their impact on agricultural productivity.

Relationship between farmers' membership in cooperative societies and their awareness of climate change effects on agricultural production was positive and statistically significant at 5% level. Beta coefficient, standard error and odds ratio were 1.729, 0.041 and 1.331 respectively. The result implies that farmers who are members of cooperative societies are 1.331 times more likely to be aware of climate change effects compared to non-members. Membership in cooperatives facilitates interactions among farmers, enabling the exchange of information regarding climate change and its impact, thereby enhancing awareness. In like manner, access to extension services was positively and significantly associated with farmers' awareness of climate change at the 1% level. Beta coefficient was 0.114, with SE of 0.002 and odds ratio of 2.111. This indicates that farmers with better access to extension services are more likely to be informed about climate change effects on agriculture. These findings agreed with findings of Pandey et al. (2018) that emphasized the critical role of extension services in raising farmers' awareness and equipping them with the knowledge necessary to implement effective climate adaptation strategies.

Table 5: Impact of farmers' socio-economic traits on climate change awareness in Agriculture (n=598)

Socio-economic Variables	B-Coefficient	Standard Error	Exp (B)	Odd ratio
Constant	12.869	0.023	2.741	
Gender	1.362	1.183	0.391	1.011
Sex	- 1.310*	0.218	0.283	2.084
Marital status	.374	0.201	0.172	0.927
Household size	1.256	0.862	1.241	1.001
Educational level	0.902**	0.014	0.791	2.980
Farm size	1.783*	0.337	0.532	3.012
Farm experience	0.894*	0.022	0.708	2.410
Membership of cooperative society	1.729*	0.041	0.505	1.331
Access to extension services	0.114**	0.002	0.634	2.111
R^2	0.629			
Pseudo R2	0.541			
Log-likelihood	17.532			

*NB: ** is significant at 5% and *** is significant at 1%*

5.0 Conclusion and Recommendations

5.1 Conclusion

The study examines the socio-economic characteristics of farmers in the Niger Delta region, revealing a predominantly male farming population with active participation from individuals in their prime working years. Farmers generally have a moderate to high level of education, which facilitates the adoption of agricultural technologies. Additionally, their extensive farming experience enhances risk management and productivity. The findings also indicate that most farmers operate on a small scale, with cooperative memberships playing a key role in improving access to resources and extension services.

In terms of climate change awareness, the study confirms that a majority of farmers recognize its impact on agricultural production, particularly through factors such as rising temperatures, flooding, and water scarcity. However, awareness levels vary, largely influenced by socio-economic factors such as age, education, farm size, experience, and access to extension services. Farmers' awareness of climate change and its effects on agricultural production is influenced by a combination of informational, socio-economic, technological, and institutional factors. Limited access to reliable information remains the most critical constraint, emphasizing the need for effective communication systems. Socio-economic characteristics and financial capacity further highlight inequalities in farmers' ability to acquire knowledge and adopt adaptation strategies. In addition, weak extension services, low digital literacy, poor access to technology, and unfavourable geographical locations intensify these challenges, especially among rural and resource-poor farmers.

Statistical analysis further reinforces the role of socio-economic traits in shaping climate change awareness. Younger, more educated, and experienced farmers, along with those managing larger farms and benefiting from extension services, demonstrate higher awareness levels. The study finds that 88.13% of farmers acknowledge climate change effects, a statistically significant proportion. These findings highlight the need for targeted interventions, including improved information dissemination and enhanced extension services, to strengthen farmers' adaptive capacity in addressing climate change challenges in agriculture.

5.2 Recommendations

Based on the study's findings, it was recommended that;

Farmers should be given adequate and timely attention to access climate information and extension services. This has become necessary since access to reliable climate change information and extension services significantly influences awareness levels that can as well make them know the resilient strides to take to mitigate the effects of climate change. Such information and services can be accessed through climate-related training, workshops, and advisory services to help farmers have better understanding of climate change impacts and adaptation strategies.

The study highlights a gender disparity in farming participation, with men having easier access to farmland. To promote inclusivity, policies should focus on providing women with equal access to land, credit, and agricultural inputs, ensuring that they can actively participate and benefit from farming opportunities.

Since membership in cooperatives enhances farmers' awareness and access to resources, efforts should be made to strengthen farmer groups. Government and NGOs can support cooperative initiatives by providing incentives, capacity-building programs, and financial support to improve knowledge-sharing among farmers.

Limited digital literacy and financial constraints were identified as key barriers to climate awareness. Against this background, integrating digital education into agricultural training programs and facilitating access to affordable credit and insurance schemes can empower farmers to access climate information and adopt innovative farming techniques for climate resilience.

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