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Gender Differentials in the Utilization of Climate Change Adaptation Strategies among Rural Cassava Farmers in South-East, Nigeria

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Abstract
This study analyzed the gender differentials in the utilization of climate change adaptation strategies among rural cassava farmers in South-east, Nigeria. It specifically described the socio-economic characteristics of male and female cassava farmers; identified information sources on climate change adaptation strategies employed by male and female cassava farmers and their perceived effects of climate change on cassava production. Data were collected from 280 farmers selected through multistage sampling procedure with the aid of structured questionnaire. Descriptive statistics, such as frequency distribution; percentage counts; mean score and ANOVA were used for data analysis. Results showed that the mean age of the cassava farmers was 47 years (males) and 45 years (females), majority of male (88%) and female (66.19%) were married. 44.2% of the male farmers and 42.86% of the female farmers acquired tertiary education. About 43.07% of the female farmers and 53.35% practiced mixed cropping as their major production system. Fellow farmers were the major information sources on indigenous and modern climate change adaptation strategies for male (97.70%) and female farmers (97.17%). The male farmers identified prolonged drought ($\bar{x} = 3.4$), and incidence of pest and disease ($\bar{x} = 3.4$) as major effects of climate change on cassava production), while the female farmers indicated increased flooding ($\bar{x} = 3.4$) and prolonged drought ($\bar{x} = 3.4$). The study concluded that there was no significant difference between male and female cassava farmers in climate change adaptation strategies across States. Hence, it recommended that male and female cassava farmers should form vibrant Farmers' Association that can come together to share knowledge on the use of sustainable adaptation strategies and to curb the effect of climate change on cassava crops.
Keywords: *Cassava production, Climate change, Adaptation strategies, Gender, Rural farmers*

Introduction

Cassava, *Manihot esculenta* has evolved from a famine-reserve crop into a high-value livelihood resource for millions of rural households in Nigeria, where smallholder men and women farmers contribute significantly to national production (Danso-Abbeam et al., 2021). As a staple crop that provides significant caloric intake and income, cassava plays a central role in household food security and national agricultural resilience. However, in recent years the production of this staple crop is increasingly threatened by climate induced changes, such as rising temperatures, erratic rainfall, and unpredictable extreme events (Diallo et

al., 2020). In addition, undermining the yield of cassava, the development is intensified rural poverty, particularly among smallholder farmers and persons who derive their livelihood from cassava value chain (Okon & Edeme, 2021).

Climate change adaptation is therefore not only an agronomic necessity but a livelihood coping strategy. Evidence across Nigeria and other African countries demonstrates that farmers are adopting a mix of indigenous and modern strategies, including crop diversification, adjusting planting calendars, mulching, irrigation, and climate-smart agronomy, to buffer against climate risks (Eze et al., 2019; Elijah et al., 2020; Musafiri et al., 2022). Yet, as several studies affirm, adoption of climate change adaptation strategies between men and women farmers is deeply shaped by unequal access to information, technology, land, extension support, and decision-making power (Olorunfemi et al., 2021; Oyetunde-Usman et al., 2021; Ifeanyi-Obi & Henri-Ukoha, 2022). This makes climate adaptation a profoundly gender sensitive.

Women constitute a major share of Nigeria's agricultural labour force, especially in cassava production, processing, and marketing (Ekanam *et al*., 2020). Despite their central roles, women often remain socially excluded from critical climate-change information, extension services, and productive resources due to entrenched cultural and institutional norms (Ifeanyi-Obi & Ugorji, 2020). Gender schema theory explains that such structural inequalities persist because societies embed rigid expectations about what men and women can or should do, ultimately shaping their access to opportunities and their adaptive capacities (Kendra, 2020). As a result, women farmers, who already shoulder disproportionate care-giving and subsistence burdens, become more vulnerable to climatic shocks and less able to respond effectively (Obinna & Onu, 2021).

Moreover, the complementary but distinct knowledge systems held by men and women in farming households are often overlooked in adaptation planning, even though research consistently shows that gender-inclusive strategies yield more sustainable outcomes (Mukoya & Mulinya, 2018; Ibrahim et al., 2020). Strengthening farmers' climate resilience therefore requires intentional efforts to dismantle gender-based barriers, expand equitable access to resources, and amplify women's agency in agricultural decision-making (Ifeanyi-Obi & Henri-Ukoha, 2022).

While numerous studies document climate impacts and general adaptation practices among farmers in Nigeria, such as reported by Tiamiyu et al., 2018; Tarfa et al., 2019; Patle et al. (2020), not much is known on how gender influenced the choice of adaptation strategies, or how effectively they are used across gender lines and why, especially, in the study area. Orji *et al* (2024) warned that insufficient knowledge of gender gaps and institutional barriers that affect men and women differently adaptation programme planning and implementation often undermines efforts aimed at leveraging social and cultural mechanism to foster technology adoption. Ifeanyi-Obi & Henri-Ukoha (2022) added that such knowledge gap deprives climate change adaptation efforts gendered indigenous knowledge. Also, the dearth of empirical update on how gender influences the types of adaptation strategies, and/or constraints faced by rural cassava farmers in adopting adaptation strategies creates a critical gap that undermines cassava based rural livelihoods. Hence, the study specifically, it seeks to:

i. describe the socio-economic characteristics of male and female cassava farmers;
ii. identify male and female cassava farmers' sources of information on adaptation strategies to climate change;
iii. ascertain the effects of climate change on cassava production among male and female farmers; and
iv. analyze gender differential in the use of climate change adaptation strategies among male and female cassava farmers in South-east Nigeria**.**

Methodology

The study was conducted in Southeast, geopolitical zone of Nigeria. The region is located between latitudes 5º20' and 6º25' North and longitudes 6º25' and 8º51' East. The area comprises Abia, Imo, Anambra, Enugu and Ebonyi States, with a combined land mass of approximately 10.95 million hectares and a population of about 16.38 million people (Statista 2022). The climate of the region is characterized by two major seasons,

the rainy season, spanning April to October, and the dry season, lasting from November to March, although recent fluctuations in climatic conditions have altered their consistency. Average annual temperature stands at about 27°C, rainfall is estimated at 1,800 mm, with relative humidity around 72 percent and 4.4 hours of daily sunshine (NPC, 2006). The South-East is predominantly occupied by the Igbo ethnic group, known for its cultural diversity and strong agricultural orientation. Cassava farming is particularly common among households, cutting across both male and female farmers (Henri-Ukoha, 2020, and thus provided a suitable context for the study.

Sampling Procedure and Sampling Size

The population for the study consisted of male and female cassava farmers across the South-east. From this population, a multi-stage sampling procedure was applied to select respondents. In the first stage, all the states in the region were chosen due to their intensity in cassava production. From these, three states, Abia, Imo, and Ebonyi were randomly selected from each of the selected states, two agricultural zones were chosen through simple random sampling, namely, Aba and Umuahia in Abia State, Owerri and Orlu in Imo State, and Ikwo and Abakaliki in Ebonyi State. These zones were further divided into 12 blocks from which eight circles were randomly selected, giving a total of 48 circles. Considering the uneven distribution of the sub-circles varied across locations, proportionate sampling was employed at 11.5 percent to ensure fairness, resulting in the selection of 34 sub-circles. From these sub-circles, 10 male and 10 female cassava farmers were purposively drawn from each state, yielding a final sample size of 280 respondents, comprising 158 male and 122 female farmers.

Primary data were collected using structured questionnaires and interview schedules; analyzed using both descriptive and inferential statistics. Descriptive statistics, such as frequencies, percentages, and mean scores, were used to realize information on socio-economic variables, sources of climate information, and perceived climate change effects among male and female farmers. The hypothesis was tested using Analysis of Variance (ANOVA).

Results and Discussion

Socio-Economic Characteristics of Cassava Farmers

Result in Table 1 as indicated in the pooled percentage mean that majority (44.2%) of the male participants had tertiary education against 42.86% women participants, showing that the study participants were mostly literate farmers who are more likely to show interest in exploring new adaptation strategies. The average farm size of the males was 1.7 ha while that of the females was 1.1 ha portraying them as small-scale farmers who may not invest show willingness to invest in adaptation strategies. The mean age for males was 47 years against 45 for females, suggesting that they are individuals within productive ages and willing to try-out something new to adapt cassava production amidst climate change. In terms of experience, males had 21 years while females had 18 years, indicating their inclination to make informed comparative decision between available adaptation strategies. The income disparities showed that males had average annual income of ₦416,395 against the females' ₦393,716, reinforcing the age-long patriarchal perception of males possessing more resources than females. More males (53.62%) recorded co-operative membership than females reported 45.95%., highlighting male's greater access to social capital.

These results confirm the earlier findings of Nwakwasi and Okoroma (2021.) that in typical African context, female farmers' demographic attributes relative to their male counterpart is often in disparity, favouring the male gender. Studies by Jacob & Samuel, 2020; Emerhirhi *et al.,* 2024; Orji *et al.* (2024) also alluded lesser females' access to social capital relative to the males, thereby limiting female farmers' collective bargaining power, access to extension, credit, land ownership, inheritance, and decision-making structures. Implicitly, to achieve inclusive adoption of adaptation strategies female farmers need additional support to give them equitable access to climate adaptation strategies.

Table 1: Distribution of male and female cassava farmers according to their socio-economic Characteristics

Socioeconomic characteristics	Abia		Ebonyi		Imo		(Pooled mean) Southeast Zone	
	Male	Female	Male	Female	Male	Female	Male	Female
Age/(years)								
20-29	6.25	0.0	0.0	0	16.85	0.0	7.70	0.00
30-39	28.13	21.43	8.11	17.39	12.36	12.68	16.19	17.16
40-49	25.00	50.00	35.14	78.26	12.36	40.85	24.20	56.37
50-59	40.62	28.57	56.75	4.35	58.43	46.48	51.93	26.47
Means ($\bar{x}$)	**45**	**45**	**49**	**43**	**46**	**48**	**47**	**45**
Marital status								
Single	9.38	0.0	0.0	0.0	14.61	0.0	7.90	0.00
Married	84.37	82.14	100.0	100.0	82.02	18.31	88.00	66.91
Divorced	6.25	3.57	0.0	0.0	0.0	1.41	2.00	1.76
Widowed	6.25	14.29	0.0	0.0	3.37	80.28	3.00	31.52
Educational Level								
No formal	6.25	3.57	0.0	0.0	2.25	4.23	2.83	2.60
Primary	37.50	25.00	5.41	4.35	17.98	28.17	20.29	19.17
Secondary	34.38	39.29	24.32	21.75	39.33	45.07	32.67	35.37
Tertiary	21.88	32.24	96.77	73.90	40.45	11.53	44.21	42.86
Farming Experience (years)								
1-15	40.63	46.43	13.51	73.91	32.58	28.17	28.91	49.50
16-30	31.24	42.86	83.79	26.09	43.82	45.07	52.95	38.00
31-45	28.13	10.71	2.70	0	23.60	26.76	18.14	12.50
Mean ($\bar{x}$)	21	21	22	22	18	22	**21years**	**18years**
Household size								
4-6	59.37	50.00	56.76	82.61	39.33	61.97	51.82	64.86
7-9	28.13	28.58	35.13	4.35	38.20	19.72	33.82	17.55
10-12	3.12	10.71	0.0	0.0	1.12	0.0	14.36	17.59
Mean ($\bar{x}$)	**6**	**5**	**5**	**6**	**6**	**5**	**5**	**5**
Farm Size (hectares)								
0.25-1.00	18.75	50.00	8.11	56.52	56.18	74.65	27.68	60.39
1.25-2.00	31.25	32.14	59.46	43.48	28.09	21.12	39.60	32.24
2.25-3.00	50.00	10.72	32.43	0.0	14.61	4.23	32.34	4.98
3.25-4.00	0.0	7.14	0.0	0.0	1.12	0.0	0.38	2.39
Mean ($\bar{x}$)	**1.9**	**1.9**	**1.2**	**1.5**	**1.3**	**1.1**	**1.7**	**1.1**
Cropping system								
Sole cropping	0.0	3.57	0.0	0	2.25	2.82	0.75	2.13
Mixed cropping	100.0	96.43	0.0	8.70	29.21	54.93	43.07	53.35
All of the above	0.0	0.0	100.0	91.30	68.54	42.25	56.18	44.52
Farm organization membership								
Member	56.25	71.43	54.05	8.69	50.56	57.75	53.62	45.95
Non member	43.75	28.57	45.95	91.31	49.44	42.25	46.38	54.05
Extension contacts								
Monthly	59.38	85.71	59.46	56.52	44.94	54.93	54.59	65.72
Fortnightly	37.50	10.72	40.54	43.48	38.20	36.62	38.74	30.27
No contact	3.12	3.57	0.0	0.0	16.86	8.45	6.67	4.01
Annual farm income (₦)								
60,000-150,000	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
151,000-241,000	3.13	7.14	0.0	0.0	8.99	2.82	4.04	3.32
242,000-332,000	25.00	42.86	0.0	0.0	6.74	43.65	10.58	28.84
333,000-423,000	50.00	14.29	0.0	0.0	23.60	30.99	24.53	15.09

424,000-514,000	21.87	35.71	100.0	100.0	60.67	22.54	60.85	52.75
Mean ($\bar{x}$)	**369,468**	**358,500**	**469,000**	**469,000**	**410,719**	**353,648**	**416,395**	**393,716**

Sources of Information on Climate Change Adaptation Strategies

From result in Table 2, the pooled percentage mean reveals that fellow farmers served as the major source of information on climate change adaptation for both males (97.70%) and females (97.70%) cassava farmers. This was followed by extension agents, in which females' access (96.70%) dominated the males' (89.00%). Females also recorded greater use of radio (88.20%) as a source of information than the males (86.33%). While more friends/relations (84.37%) we used by the females than their male counterpart (82.33%).

These results agree with Musafiri *et al.* (2022) who reported increasing use of extension services, radio farmer programmes by women contact farmers, as well as the farmer-to-farmer agricultural channels on climate related information. Though Okoroma *et al,* (2023) raised concerns about the propensity of farmer-to-farmer information sources to disseminate distorted, outdated, incomplete and unreliable information on climate change adaptation practices, Chukwuji *et al .,* 2019; Sangotegbe *et al* (2019), considered farmer-to-farmer extension as an informal advisory service delivery that has greatly supplemented the limited coverage deficiency of the Training and Visit (T&V) extension system commonly utilized in Nigeria. By implication, disseminating climate change adaptation strategies through extension agents, radio and farmer groups will boost adoption by women.

Table 2: Percentage Distribution of male and female cassava farmers by sources of information on climate change adaptation

Sources of Information	Abia		Ebonyi		Imo		(Pooled mean) South-East	
	Male	Female	Male	Female	Male	Female	Male	Female
Extension agents	96.9	100	89.2	100	80.9	90.1	89.00	96.70
Research institution	18.8	7.1	5.4	0	22.5	14.1	15.57	7.07
Fellow farmers	96.9	92.9	97.3	100	98.9	98.6	97.70	97.17
Friends/relations	90.6	89.3	67.6	65.2	88.8	98.6	82.33	84.37
Farmers' cooperative	59.4	75	5.4	4.3	37.1	61.9	33.97	47.07
Extension bulletins	68.8	75	62.2	52.2	31.5	21.1	54.17	49.43
Radio	93.8	92.9	100	95.6	65.2	76.1	86.33	88.20
Television Programme	93.8	96.4	10.8	4.3	50.6	22.5	51.73	41.07
Internet	90.6	96.4	2.7	0	20.2	9.9	37.83	35.43
Weather station	81.3	96.4	2.7	0	16.9	8.5	33.63	34.97

Source: Field Survey, 2023

Perceived Effects of Climate Change on Cassava Production

From the pooled mean, Table 3 result showed that increased flooding was most perceived by the females as the major effect of climate change on cassava production in the area ($\bar{x}$) = 3.4). Prolonged drought recorded equal mean perception by males ($\bar{x}$) = 3.4). and females ($\bar{x}$) = 3.4). In terms of incidence of pest/disease infestation effect, the males considered it as much of a problem ($\bar{x}$) = 3.4) than the females. While delay in planting period ($\bar{x}$) = 3.3). and changes in timing and length of growing crops ($\bar{x}$) = 3.3) were perceived by males as ways in which climate change effects were felt in the area. The average grand pooled mean ($\bar{x}$) = 3.0), indicates that the males considered the indicators understudied rather more problematic than the female folks.

The results reinforced the findings of Aduagbo *et al.,* (2019) that though men and engage in agriculture together their priorities sometimes differ. They explained that what men may consider important for agricultural production may enjoy lesser attention by women, this is because what women consider more severe include limited land size, lower income levels, and unequal access to adaptation resources. The findings reaffirm global evidence that climate variability disproportionately affects men and women farmers in developing countries (Henri-Ukoha et al., 2018; Yakubu, Appiah & Siaw, 2019; Adebisi, Oyebode & Owosibo, 2020; Ifeanyi-Obi & Ugorji, 2020; Ajayi et al., 2021; World Bank, 2021)). Implicitly, effective needs assessment for gender-based adaptation strategies must involve both men and women to participate in identifying and defining adaptation strategies to achieve inclusiveness.

Table 3: Mean distribution of male and female cassava farmers according to perceived effects of climate change on cassava production

	Abia		Ebonyi		Imo		(Pooled mean) South-East	
Perceived Effects	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Increased flooding	3.5	3.9	4.0	4.0	2.5	2.2	3.3*	3.4*
Decreased flooding	1.9	1.4	3.2	3.2	2.0	2.0	2.4	2.2
Increased soil erosion	3.2	3.3	3.1	4.0	2.5	2.0	2.9*	3.1*
decreased soil erosion	1.9	1.7	3.2	3.3	2.0	2.0	2.4	2.3
Decreased fertility depletion	3.8	3.2	3.1	3.0	2.0	2.0	2.9*	2.7*
Prolonged drought	3.3	3.4	4.0	4.0	2.8	2.8	3.4*	3.4*
Incidence of pest / disease infestation	3.4	3.4	3.9	4.0	2.8	2.4	3.4*	3.3*
Poor yield	3.5	3.3	3.0	3.2	2.8	2.3	3.1*	2.9*
Delay in planting period	3.4	3.1	3.2	3.3	3.2	3.2	3.3*	3.2*
Changes in timing and length of growing crops	3.4	3.1	3.1	3.1	3.5	3.4	3.3*	3.2*
Stunted growth rate of crops	3.3	3.3	3.1	3.0	2.7	2.5	3.0*	2.9*
Rotting of tubers & roots	3.3	3.6	2.9	3.0	2.5	2.5	2.9*	3.0*
Reduced farm land due to flood.	3.3	3.5	4.0	4.0	2.5	2.4	3.3*	3.3*
Grand mean	**3.3**	**3.1**	**3.4**	**3.5**	**2.5**	**2.4**	**3.0***	**2.9**

Source: Field Survey, 2023

Gender Differentials in Climate Change Adaptation Strategies

To test the presumption that male and female cassava farmers in the study area do not significantly differ in the use of climate change adaptation strategies, ANOVA test was carried out at 5% significant level. The result as shown in Table 4 indicated that between groups and within groups, the total Sum of Squares and Mean square gave 570.83 and 269.81, respectively, with an F-value of 51.29 and probability value of 0.000. Given that the P-value = 0.000 was less than the threshold of 0.05 the result indicated the existence of significant difference in the use of climate change adaptation strategies among the cassava farmers. The result aligns with findings of Orji *et al,* (2024) which reported disparities in the manner and level men and women adopted agricultural technologies. The disparity according to Hartl *et al.* (2022) is because women are often circumstantially less aware about available technologies, making them to adopt at a different and sometimes slower rate relative to the men. This implies that gender is not just another variable in the use of climate change adaptation strategies, but an axis of power that shapes adaptation choices, vulnerabilities, and opportunities between men and women cassava farmers.

Table 4: Test of Significant Differences in the use of indigenous climate change adaptation strategies between male and female cassava farmers in South-East Nigeria

Source		SS	MS	F	Sig	Decision
Between group	5	434.64	217.32	61.29***	0. 000	Significant
Within group	3	136.19	52.49			
Total		**570.83**	**269.81**			

Source: SPSS Result of Field Survey Data, 2023

Conclusion and Recommendations

The study has bridged the knowledge gap and also has provided a novel perspective and approach to indigenous and modern climate change adaptation strategies in South-East, Nigeria. The study has provided information on male and female cassava farmers sources of information on climate adaptation strategies. The effects of climate change on cassava production, the indigenous and modern climate change adaptation strategies used by male and female cassava farmers and the constraints against the use of indigenous and modern climate change adaptation strategies has provided information on male and female cassava farmers' socio-economic characteristics which significantly affected climate change adaptation strategies and also revealed that male and female use of indigenous and modern climate change adaptation strategies in the three states in South-East Nigeria did not differ. The content of this study has the capacity to bring about change in attitude and action by a user with a clear indication that climate change is real. This study has provided new knowledge that could enhance and convince male and female to do something differently and better in terms of promoting proactive and strategic climate change adaptation strategies in order to enhance sustainable cassava production and food security in Nigeria. Hence, the following recommendations were considered pertinent**:**

1. Male and female cassava farmers should form vibrant farmers' association that can come together to share knowledge among themselves on the effects of climate change, sustainable adaptation strategies and constraints to effective climate adaptation and proffer possible solutions to climate change. This is because climate change requires collective efforts by all stakeholders.
2. State Ministries of Agriculture and Local Governments in the South-east should conduct gender-disaggregated profiling and support women-focused farmer groups with land access, literacy training, and tailored climate adaptation packages for cassava farmers. This will provide additional support that will enable the women overcome the sociocultural barriers restraining them from accessing and utilizing the adaptation strategies
3. ADPs in the South-east, radio stations, and telecom providers can promote the dissemination and adoption of climate change adaptation strategies among cassava farmers by delivering climate information through commodity groups, using local-language radio programmes, SMS alerts, demonstration plots, and female extension agents to improve information access for male and female farmers.
4. To promote effective utilization of climate change adaptation strategies, such as the use of drought-tolerant cassava varieties, soil conservation practices, community water harvesting, and affordable crop insurance to reduce climate change impacts on cassava production, statutory agencies of the government, cooperatives, and state governments should prioritize the development and distribution of location-specific technologies. This ensures that technologies adopted are tailored to meet the social and environmental peculiarities of the location they are intended to be used.
5. State Governments, NGOs, and community leaders should push for the establishment of gender desk tasked with addressing disparities in the use of climate related technologies among men and women farmers in the area. This will mainstream gender inclusion by ensuring women's access to inputs, credit, training, and decision-making platforms in cassava climate adaptation programmes.

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