Climate Change in Rural Agriculture: An Assessment of the Coping Strategies of Women Farmers in Delta State, Nigeria.

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Abstract
This study assessed the coping strategies adopted by women farmers in response to climate change in rural agricultural communities of Delta State, Nigeria. A multistage sampling technique was employed to select 160 female farmers across the study area. Data were collected through structured questionnaires and analyzed using descriptive statistics, including means, frequencies, percentages, and Likert scale ratings. Findings revealed that a significant proportion of respondents (45%) were between the ages of 31 and 40, with half (50%) being married. About 45% lived in households with 6 to 10 members. Educational attainment was relatively high, with 45% having completed secondary education and 43.75% possessing 7 to 9 years of experience in climate change mitigation practices. The primary sources of climate change information among respondents were informal networks and traditional media: 25% cited friends and family, 21.87% cited television, 20% radio, and only 15.63% cited social media. In terms of adaptation strategies, 30% of respondents reported using irrigation to counter drought effects, 19.37% practiced re-afforestation, 17.5% modified livestock feeding practices, 15.63% diversified their livestock, and 11.25% adopted climate-resilient crop and animal breeds. These results indicate that women farmers in the region demonstrate a reasonable awareness of climate change and actively engage in a range of coping strategies. The study recommends that government and development stakeholders strengthen extension services by hiring and training more agents to deliver targeted climate information, innovative adaptation practices, and technical support to female farmers in Delta State.

Keywords: Adaptation, constraints, mitigation, source of information, resistant, Nigeria

1. Introduction
Due to the thriving local and global market, population growth, and food demand, crop production has been acknowledged as a potential driver of economic advancement in Africa as of October 2023. The economic potential of food production in Africa is at risk due to altered rainfall patterns, rising temperatures, and ensuing changes in climatic conditions. Furthermore, in Africa, the majority of women rely on food production as their primary source of income. According to Azad et al. (2013) and Nandi et al. (2019), female farmers in Bangladesh and Nigeria are particularly susceptible to complete crop loss at times of intense precipitation. The percentage of revenue from crop output thus dropped sharply. Stated differently, women farmers 7 are more susceptible to

revenue loss due to floods than those in other industries (Ezemonye, 2015; Kaman et al., 2023). They are susceptible to increased marginalization because they lack access to markets, credit, high-yielding inputs, training and extension services, private property, and the capacity to decide how best to organize their own livelihoods (Ugwu, 2019). According to Akinola (2018), women in Africa control less than 1% of the continent's land. They have less choices because their husbands disown the majority of the land. This makes it more difficult for them to react appropriately to flooding and other harsh weather conditions. Furthermore, since the majority of the crops will be grown in extremes of high temperatures, the inability to obtain drought-resistant types of women implies that they can yield high-quality harvests. Most African women farmers are vulnerable to climate variability because of their over-reliance on rain-fed agriculture as well as other non-climatic and socioeconomic factors (Molua, 2011; Bakanogullari et al., 2022). According to studies by Akinseye et al. (2013) and Recha et al. (2017), variations in rainfall had an impact on the crop's early growth, which decreased yields. Previous research has demonstrated that female farmers are disproportionately impacted by climate change because they have less access to markets, financing, agricultural extension and training services, and agricultural land (Adeoti et al., 2019). Ugwu, 2019; (2019). According to Abeke et al. (2019), some female farmers have turned to indigenous knowledge to cope with climate variability. However, their ability to do so has been hampered by their inability to switch cropping cycles or acquire high-yielding varieties during periods of high rainfall variability. According to Drucza (2018), even though women make up a significant share of the workforce in agricultural activities like crop production, scientific agricultural literature has neglected women's perspectives and given preference to men's (patriarchal). In light of this, it appears that little is known in the literature on the limitations faced by women in crop farming in the context of a changing and unpredictable climate system. As a result, little is known about the limitations faced by women who are most directly involved in agricultural production under a changing and changeable climate environment. Instead of examining those factors, the study seeks to understand two things: the effects of climate change on rural agriculture and the coping strategies of women farmers in Delta state. Accordingly, the study uses the following specific objectives to investigate the awareness of rural women in Nigeria regarding climate change adaptation: describing the socio-economic characteristics of rural women in the study area; identifying the sources of information on climate change; identifying the roles of rural women farmers in adapting to climate change in the study area; and determining the effects of climate change on the livelihood activities of rural women.

2 Materials and Methods

The study was carried out in Delta State, Nigeria. Delta State has twenty-five (25) local government areas, with a population census of about 5.6 million people (NPC, 2016). It is located between longitude 5°00` and 6°00` East of the Greenwich Meridian and Latitude 5°00` and 6°30` North of the Equator. It is bordered on the North by Edo State, the East by Anambra and Rivers States and the South by Bayelsa State, while to the West is the bright of Benin which covers about

160 kilometres of the state's coastline. Crops grown in the state are oil palm, yam, and cassava, while fishing and heliciculture are also practiced in the state.

2.1 Sampling Technique and Sampling Size

The study employed a multi-stage random sampling technique. In the first stage, four local government areas—Aniocha South, Aniocha North, Ika South, and Ika North—were chosen at random from among the twenty-five local governments in Delta State because of the high number of women farmers in the state. Ten (10) women farmers were chosen from each community using a simple random sampling technique in the third stage, bringing the total number of respondents in the study area to 160. In the second stage, four communities were chosen at random from each local government area using the simple random technique.

2.2 Sources of data

For this study, both primary and secondary data were employed. Personal interviews and the distribution of a well-structured questionnaire to oil palm producers in the study region were used to gather primary data. Information was gathered using the questionnaire by the study's goals.

2.3 Methods of data analysis

Descriptive statistics, such as tables, frequency distributions, percentages, means, and Likert scales, were used to analyze the data collected for the study. The study's goals were analyzed using descriptive statistics, which included describing the socioeconomic characteristics of the respondents to get a broad picture of the women farmers in the study area, identifying the sources of information about climate change that women farmers in the study area use, identifying the roles that women farmers play in adapting to climate change in the study area, and figuring out how climate change affects women's livelihood activities.

3. Results and Discussion

3.1 Socio-economic characteristics of the respondents.

According to Table 1's results, 47.5% of respondents were between the ages of 31 and 40, 18.75% were between the ages of 41 and 50, 13.75% were between the ages of 51 and 60, and another 8.75% were between the ages of 21 and 30. Additionally, 6.25% of respondents were under the age of 20, and only 5% were over 60. These findings suggest that respondents in the 31 to 50 age range were likely to be more active and resilient to fatigue from the tiresome work and effort required to adapt to climate change in the study area. According to Anugwo *et al*, (2024) research work on, “High Feed Costs in Poultry Farming: An Analysis of Effective Coping Strategies in Enugu State, Nigeria”, the majority of the poultry farmers in the study area were middle-aged. Additionally, Table 1 revealed that 50.0% of respondents were married, 17.5% were single, 18.75% were divorced, and 13.75% were separated. This suggests that the majority of respondents were married and would have enough family workers to complete some of the labor-intensive jobs and adaptations to climate change in the research area. According to Table 1's results, 45% of respondents had households with six to ten people, 37.5% had households with one to five people,

11.25% had households with eleven to fifteen people, and only 6.25% had households with more than fifteen people in the same study area. implying that the respondents' farms had a sufficient amount of labor to address the causes of climate change. Table 1 also revealed that 21.88% of respondents had no formal education, 23.75% had completed primary school, 45.0% had completed secondary school, and only 9.37% had completed university education. This suggests that the majority of the respondents had formal education, and a high level of literacy is anticipated to improve comprehension of concepts and technologies utilized to mitigate the consequences of climate change in the research region. The results also revealed that 42.5% of farmers in the study area farmed between one and two hectares of land, 26.25% farmed less than a hectare, 22.5% farmed more than three hectares, and only 8.75% farmed more than four hectares. This indicates that the majority of farmers in the study area were still farming for subsistence. 12.5% of respondents have between one and three years of experience with climate change mitigating strategies, 26.87% have between four and six years, 43.75% have between seven and nine years, and 16.88% have more than ten years of experience with climate change coping strategies in the study area, according to Table 1. This suggests that many of the study area's respondents have implemented coping mechanisms for a considerable amount of time, which will lessen the impact of climate change on their farms.

Table 1: Socio-economic characteristics of rural women farmers

Age	Frequency	Percentage
<20	10	6.25
21-30	14	8.75
31-40	76	47.5
41-50	30	18.75
51-60	22	13.75
>60	08	5.0
Marital Status		
Single	28	17.5
Married	80	50.0
Divorce	30	18.75
Separated	22	13.75
Household Size		
1-5	60	37.5
6-10	72	45.0
11-15	18	11.25
>15	10	6.25
Educational level		
No formal education	35	21.88
Primary School	38	23.75
Secondary School	72	45.0
Tertiary level	15	9.37
Farm Size		
<1 hectare	42	26.25
1-2 hectares	68	42.5

3-4 hectares	36	22.5
>4 hectares	14	8.75
Farming Experience		
1-3 years	20	12.5
4-6 years	43	26.87
7-9 years	70	43.75
>10 years	27	16.88
Total	160	100

Source: Field Survey, 2024.

According to the findings in Table 2, 21.87% of the respondents reportedly obtained their information about climate change from television, 20% from radio, and 25.0% from friends and family. Furthermore, the results showed that 15.63% of respondents sourced their information about climate change from social media, compared to 8.75% who sourced it from extension agents, 6.25% who sourced it from cooperative societies, and only 2.50% who sourced it from local newspapers and magazines. Given that few farmers in the study area have constant access to electricity to power their radios, televisions, and phones and that the current increase in fuel prices isn't helping, it is evident that the farmers' primary source of information about climate change came from friends and family. This outcome is consistent with research by Akinnagbe *et al.* (2012), which found that farmers viewed the interpersonal and group methods as the most common ways to obtain climate change information.

Table 2: Distribution of respondents according to the sources of information on climate change

Information Source	Frequency	Percentage
Television	35	21.87
Radio	32	20.0
Newspaper/Magazine	04	2.50
Social media	25	15.63
Cooperative societies	10	6.25
Family/friends	40	25.0
Extension visits	14	8.75
Total	160	100

Source: Field Survey, 2024.

3.3 Roles of women as coping strategies to climate change

According to the results in Table 3, the majority of farmers (30%) used irrigation as a primary coping strategy to combat drought brought on by climate change in the study area. This was followed by 19.37% of respondents who re-planted and 17.5% of respondents who altered their feeding habits. Additionally, 15.63% of respondents used livestock diversification as a coping strategy to combat climate change, 11.25% purchased highly resistant plant and animal breeds to combat diseases caused by excessive heat and flooding, and only 6.25% used very high-quality feed for their livestock in the study area. With irrigation operations being the most popular coping method among respondents, this result demonstrates that farmers in the study region have extensive experience with coping strategies used to mitigate the consequences of climate change in the study area. The findings of Anugwo et al. (2024), who examined the Impact of Malaria on

the Income of Rural Cassava Farmers in Enugu State, Nigeria: A Case Study of Awgu Local Government Area, are consistent with this outcome.

Table 3: Distribution of respondents on their roles of coping strategies to climate change

Coping Strategies Used by Women	Frequency	Percentage
Livestock diversification	25	15.63
Highly resistant breeds	18	11.25
Re-afforestation	31	19.37
Irrigation activities	48	30.0
Changes in Feeding Patterns	28	17.5
High feed quality	10	6.25
Total	160	100

Source: Field Survey, 2024.

3.4 Effects of climate change on women's livelihood activities in the study area

The perceived impacts of climate change on the livelihood of women farmers in the research area are displayed in Table 4 below. The perceived impacts of climate change on the livelihood of women farmers in the study area were examined using a three-point Likert scale. The threshold of 2.0 and higher suggests that any perception questions with a mean of 2.0 and higher have a significant impact on the livelihood of women farmers in the research region, whereas perception questions with a mean of less than 2.0 have a minimal impact. With a mean score of 2.44 and a top ranking, the perception question about the loss of medicinal plants and herbs due to floods and high temperatures was the most felt effect of climate change on the livelihood of women farmers. This suggests that the majority of these women no longer use herbs to treat their illnesses because they are destroyed by heat and floods, forcing them to use orthodox medicines, which leaves them with less money and debt. The respondents selected reduced revenue from low yield (mean of 2.34) as the second most serious effect of climate change, suggesting that this effect negatively impacted their livelihood by reducing their income. The third most significant impact of climate change on respondents' livelihoods was the loss of crops, lands, and homes, with a mean score of 2.17. This suggests that when these women farmers lose their homes and their sources of income, productivity declines. Since revenue that would typically come from the sale of livestock is lost to the whims of climate change, the increase in animal death from heat and dehydration, with a mean of 2.15, was listed as the fourth most felt effect of climate change on respondents' livelihoods. Food scarcity brought on by a delayed cropping season was ranked fifth with a mean score of 2.13 because the delay or cessation of rainfall patterns resulted in late crop planting, late harvesting, and occasionally complete loss of these food crops, which in turn affected productivity and, ultimately, the livelihood of these women farmers in the study area. With a mean of 2.12, the increase in labor costs was the least significant and least felt effect of climate change in the study area. This suggests that all of the perceived effects of climate change have also had an impact on laborers, who now charge exorbitant prices, forcing these women farmers to pay high labor costs that they shouldn't have had to pay. Eventually, this affects their profits, which in turn affects their productivity in the study area.

Table 4: Distribution of Respondents on the Effects of Climate Change on Agricultural Practices

S/N	Perceived Climate Effects	Serious	Less serious	Not serious	Mean	Ranking
1.	Increase in mortality of livestock due to heat and dehydration	55(165)	75(150)	30(30)	2.15	4th

2.	Loss of crops, lands and homes due to floods	60(180)	68(136)	32(32)	2.17	3rd
3.	Scarcity of food due to delay in cropping season	62(186)	57(114)	41(41)	2.13	5th
4.	Reduced income due to low yield	77(231)	61(122)	22(22)	2.34	2nd
5.	Increase in labour cost	54(162)	72(144)	34(34)	2.12	6th
6.	Loss of medicinal plants/herds as a result of high temperature or floods	84(252)	63(126)	13(13)	2.44	1st

Source: Field Survey, 2024

4. Conclusion and Recommendations

According to the study's findings, the majority of farmers (47.5%) were between the ages of 31 and 40, 50% of the respondents were married, and 45% of these farmers had households with one to six people. The majority of these farmers had completed secondary school, and the majority of them (42.5%) cultivated one to two hectares of land, and (43.75%) had experience with coping mechanisms related to climate change for seven to nine years. Additionally, the study found that 25% of respondents cited friends and family as their primary information source. The loss of medicinal plants and herbs was the most felt impact of climate change on respondents' livelihoods, while 30% of women farmers in the study area used irrigation activities as their primary coping strategy to lessen the effects of climate change on their livelihoods

It is, therefore, advised that the government hire and educate additional extension agents to provide farmers in the study area with more information about climate change and to teach them new ideas and inventive ways to deal with its whims. To make it easier for these farmers to acquire climate change-resistant animal and plant breeds, the government could market it to them through the Ministry of Agriculture and state ADPs. To avoid late crop cultivation in the planting season, farmers should also establish cooperatives to facilitate simple access to loans and easily available raw materials. Additionally, as farmers are the ones who know what components to add to help combat the effects of climate change in the study area, they should compound their feed to make it of higher quality than feed purchased from feed mills in feeding their livestock when necessary.

Ethical Statement: There is no need for an ethical statement as it`s not work that requires ethical committee approval.

Conflict of Interest: We, the authors, declare there is no conflict of interest between us as article authors.

Article contribution statement: The corresponding author engaged in the conceptualization, design, data collection and processing, writing and reviewing and editing while the second author engaged in statistical analysis and literature search for this research article. The third author contributed to data collection and report writing/review.

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