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Gender Based Assessment of Climate Change Adaptation Strategies in Delta State, Nigeria

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Abstract
The study assesses the perceived constraints in the adoption of climate change impact adaptation strategies in the context of gender amongst farmers and fishers in Delta State. This was achieved using 4,000 copies of questionnaire administered in 10 Local Government Areas of the State, selected randomly. Data generated were analyzed using descriptive statistics. The results generally showed that more men than women farmers were likely to adopt and effectively use most climate change impact adaptation strategies. On the part of fishers, while more men than women fishers were likely to adopt climate change impact adaptation strategies, significantly more women than men fishers made effectively use of same strategies. The study also revealed that women farmers/fishers were constrained by limited access to education, limited income, limited control of the use of farmlands, non-involvement in decision making and limited access to weather/climate information. It was recommended that gendered initiatives such as access to farm inputs, climate information, training, providing of alternative source of energy, climate smart agriculture tools and credit facilities for women, be engrafted into adaptation planning process of government and private development agencies.

Keywords: Climate Change; Gender; Constraints; Adaptation; Initiatives; Effectiveness

Introduction

The impacts of climate change are felt by everyone regardless of social status, gender, age, occupation, etc. However, some social groups may be more vulnerable than others because different groups have different capacities to adapt to the impact of climate change (Djoudi *et al.,* 2016). According to Jordan (2018), differences in vulnerability to climate change stresses arise from political structures and socio-cultural norms, which create social inequalities with regards to access and distribution of resources. This implies that climate change will be felt by different groups of people in different ways. In the context of gender, due to differences in socially constructed gender roles and differences in social status ascribed to different genders, women and men experience the impacts of climate change in different ways (World Bank Group, Food and Agriculture Organization of the United Nations – (FAO-UN) and International Fund for Agricultural Development – (IFAD), 2015; Ngigi *et al.,* 2017; Yadav and Lal, 2017).

It has been reported that due to gender stereotyped roles for women and their involvement in subsistence driven agriculture of developing countries, they are more impacted by climate stress, while being engaged in agricultural production and domestic chores (Adzawla, *et al.*, 2019).According to the FAO (2011), women generally account for 43% of agricultural labour in developing countries. Same statistics revealed that the proportion of women involved in agricultural labour ranges from 20% in Latin America to about 50% in eastern, south eastern Asia and Sub-Saharan Africa. During times of drought and irregular rainfall, women face harder working conditions to be able to secure food and water for their families (Denton, 2010).It is therefore important to consider differences in gendered constraints in adapting to climate change impacts, in order to deliver climate-smart agriculture interventions that are beneficial, sustainable and equitable to all concerned (Price, 2018).It is also suggested that attention should be given to evaluating gendered constraints faced by both men and women, in order to make them adapt better to the impacts of climate change (Doss *et al.,* (2018).

Despite the fact that women are considered more vulnerable to climate change impacts, it has been reported that women are capable of using skills and opportunities provided, for the design of effective community-based adaptive solutions (UNDP, 2012; Djoudi *et al*., 2016). This can be inferred from studies which reported that women are mostly the custodians of the local resources derivable from their immediate environment and efficient mobilizers of local knowledge in adapting effectively to climate change impacts (Nelson *et al.,* 2002; Meinzen-Dick *et al.*, 2014; Khalil *et al.,* 2019). Despite these facts, Adzawla *et al.,* (2019) reported that the adaptive capacity of women is less compared to men, due to low levels in the intensities of adoption techniques employed in farming.

A study by Denton (2002) also indicated that women are more challenged in adapting to climate change, due to marginalization and deprivation. Assan *et al.,* (2018) pointed out that while women rely on loans from loan groups and village savings, men rely on the proceeds from the sale of livestock in Ghana. Studies by Jost *et al.,* 2015 and McKinley *et al.,* 2018 note that women farmers are less likely to adopt adaptation strategies due to financial and resource limitations and less control over land and the exclusion of female farmers by agricultural organizations, from many of the benefits of extension, including access to information, tools, seed, fertilizers, and improved livestock. Davidson (2016) noted that women are often excluded from participation in adaptation decision-making, so that their unique knowledge andneeds associated with their specific roles in farming tend not to be reflected in those decisions.

The World Bank, FAO and IFAD, 2015; FAO (2011) acknowledged that despite rural women being the principal basic food producers and key to food security in Africa, they face gender-based barriers in access to land, credit, extension services and technology. Such situations require clear guidelines on how to manage the needs of both men and women in different social and natural environments, in order to adapt effectively to climate change (Kristjanson *et al.,* (2017). Following from the gaps identified from previous studies, this study assesses the level of applicability and effectiveness of community-based climate change adaptation strategies used by farmers and fishers on a gender basis in Delta State of the Niger Delta Region of Nigeria. The study also evaluates possible constraints limiting the use and effectiveness of climate change impact adaptation strategies and suggestions for achieving effectiveness in same.

Materials and Methods

Delta State is located in the South-South geopolitical zone of Nigeria, and makes up part of the Niger Delta Region. It lies between Longitude 5° 00’ and 6° 45’ East of the Greenwich Meridian and Latitude: 5° 00’ and 6° 30’ North of the Equator. It is bordered by Edo State to the north, Anambra and Rivers States to the east, Bayelsa State and the Atlantic Ocean to the south, and Ondo State to the west (Centre for Population and Environmental Development – (CPED), 2019). The study covers the three major ecological zones in the State, which arethe Mangrove Swamp Forest, Freshwater Swamp Forest and the Lowland Rain Forest (Figure 1).The climate of Delta State, as well as most parts of the Niger Delta region, is classified as the wet equatorial climate type (Koppen’s Af. climate) and characterized by two seasons. The dry season spans from November to March, while the rainy season spans from April to October. The State experiences abundant rainfall withmean annual rainfall that varies from about 3,500 mm in the coastal area, to about 1,500 mm in the northern part of the State. The climate, ranges from humid in the south to sub-humid in the northeast. Decrease in humidity towards the north is accompanied by a more intense and marked dry season (Shima *et al.*, 2015). Temperature increases from the south to the north at a mean annual range of 25°C and 28°C respectively. Lower mean temperatures are recorded in the rainy season, while the higher mean temperatures

are recorded before the onset of the rains in February and March.

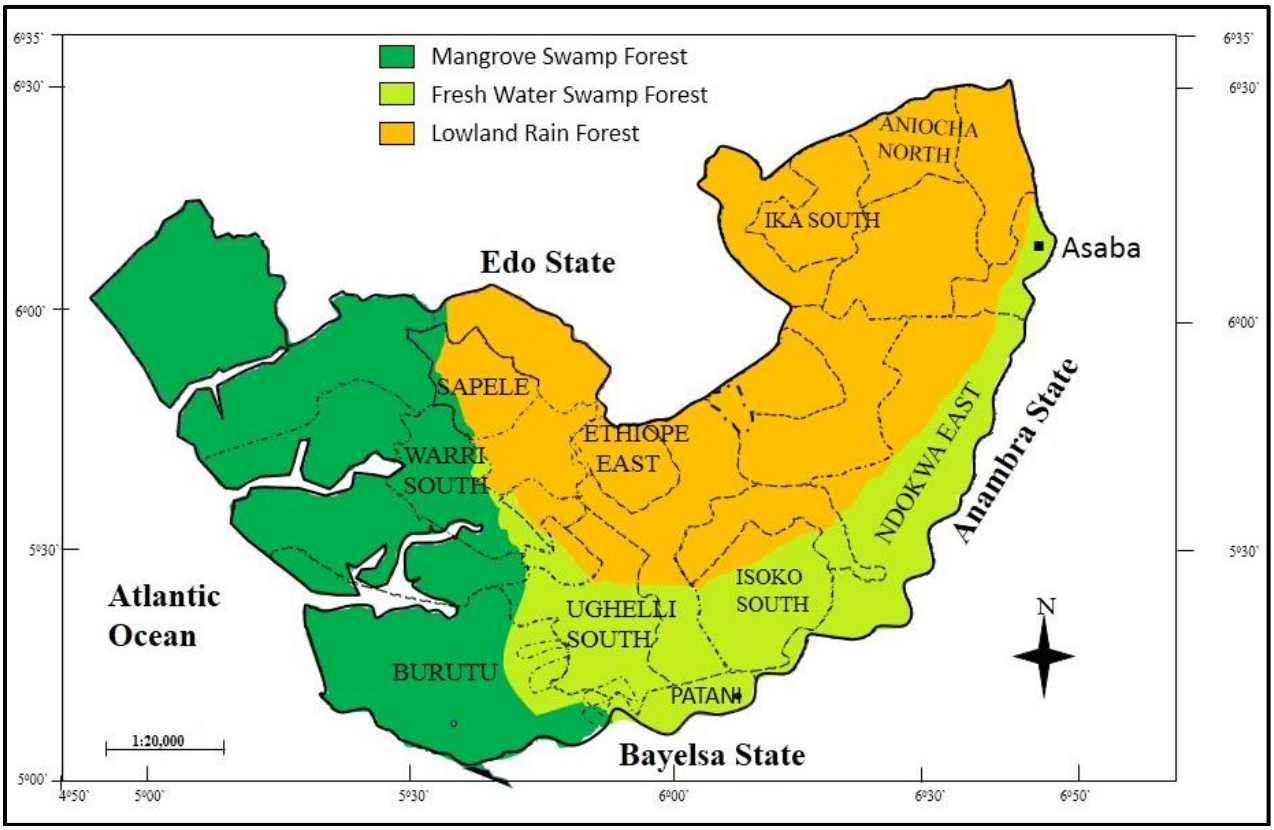

Figure 1. Delta State Showing Ecological Zones and Local Government Areas Sampled
Source: Centre for Population and Environmental Development, CPED (2019)

Farming and fishing are the major economic activities among rural citizens of Delta State. The farming systems in Delta State involve principally the traditional peasant subsistence/crop farming method, with land and labour being the principal inputs of production. Fishing activities are carried by peasants using fishing boats, nets, hooks, spears and traps, within onshore marine water bodies such as estuaries, brackish mangrove creeks, large white water rivers, floodplain swamps, lakes and artificially built fishing ponds (CPED, 2019). Other economic activities include wine and gin making from raffia palm, basket weaving, bead making, trading etc. The study made use of quantitative data collection techniques, which covered 10 LGAs in Delta State namely Aniocha North, Ika South, Ethiope East, Ndokwa East, Isoko South, Sapele, Warri South, Burutu, Patani and Ughelli South (Figure 1), selected randomly from each ecological zone. To ensure that people in all parts of the ward within each LGA have an equal chance of being included in the sample, each ward was further demarcated into blocks of 10 housing units. Both male and female farmers and fishers were interviewed to assess the perceived effectiveness of adaptation strategies adopted. Constraints to the effectiveness of adaptation strategies adopted were also analysed in the context of gender. In each LGA, between 400 to 450 copies of household questionnaire were administered based on their population, out of which 400 copies retrieved were analysed. For all 10 LGAs, a total of 4000 household copies of questionnaire were used for the data analysis in this study. The male and female respondents were 1,822 and 2,178 respectively. Data derived from the questionnaire were analysed using SPSS, version 25.0. Statistical tools such as

mean, frequency, percentage and chi-square analysis were used to compare utilization, effectiveness and constraints of the various adaptation strategies adopted by both male and female farmers, livestock owners and fishers.

Results

Climate Change Evidences in Delta State

The results in Table 1 indicate respondents' awareness and observance of climate change evidences in Delta State. The results show that more people (90.5%) agree that climate change is evident in Delta State, and is evidenced by early onset of rainfall (86.1%), increase in rainfall amount (93.9%), increase in temperature (90.7%), increase in daily sunshine hours (74.0%), increase in sunshine intensity (85.2%) and changes in wind speed (75.1%). Evidence of increase in temperature is supported by Odjugo (2010), whose study showed that between 1901 and 2005, average temperatures recorded in Nigeria had increased by 1.1^{o}C, which was clearly greater than the global mean temperature increase of 0.74°C recorded since 1860. Evidences of increase in rainfall amount is supported by Odjugo (2007), whose study showed that even though there is a general decline in rainfall in Nigeria, the coastal areas of Nigeria (within which Delta State is located) still experience slightly increased rainfall in recent times (Odjugo, 2007). The IPCC (1996) further confirms that one of the remarkable evidences of climate change is"increasing rainfall in most coastal areas and decreasing rains in the continental interiors".

Table 1. Awareness and Observance of the Evidences of Climate Change

Awareness and Evidences of Climate Change	Percentage of Respondents who agree	Percentage of Respondents who disagree	Total
Climate Change is observable in Delta State	90.5	9.5	**100**
Climate change is evident by early onset of rain	86.1	13.9	**100**
Climate change is evident by early cessation of rain	49.9	50.1	**100**
Climate change is evident by increase in rainfall amount	93.9	6.1	**100**
Climate change is evident by decrease in rainfall amount	31.8	68.2	**100**
Climate change is evident by increase in temperature	90.7	9.3	**100**
Climate change is evident by increase in daily sunshine hours	74.9	25.1	**100**
Climate change is evident by increase in sunshine intensity	85.2	14.8	**100**
Climate change is evident by changes in wind speed	75.1	24.9	**100**

Perception on Choice and Effectiveness of Climate Change Adaptation Strategy by Farming and Fishing Folks

The results in Table 2 show climate change adaptation strategies applied by both male and female farming folks in Delta State. The results generally reveal similarities between men and women farmers in the choice of strategy applied in adapting to climate change impacts. The most applicable strategy used by both male and female farmers was 'early planting' (79.6% and 81.1%) respectively. This was followed consecutively by 'early and frequent weeding' (77.6% and 78.2%), 'planting different varieties of crops (72.7% and 74%), 'planting of early maturing crops' (68.5% and 69.0%), crop rotation (68.0% and 65.0%), 'seasonal rotation (65.5% and 63.5%), 'adopting different planting times' (64% and 66.2%), 'increasing the size of cultivated land' (59.0% and 55.5%), 'fallowing' (55.2% and 54.0%), 'planting on mounds and ridges' (52.9% and 55.0%) and 'use of fertilizers' (51.2% and 46.3%).

Table 2. Choice and Effectiveness of Climate Change Adaptation Strategies

S/N	Adaptation Strategies	Male Respondents			Female Respondents		
		Respondents Applying Strategy (%)	Respondents not Applying Strategy (%)	Total Male	Respondents Applying Strategy (%)	Respondents not Applying Strategy (%)	Total Male
1	Mulching	39.4	60.6	100	37.1	62.9	100
2	Terracing	20.4	79.6	100	20.0	80.0	100
3	Contour farming	18.9	81.1	100	17.9	82.1	100
4	Plastic culture	33.4	66.6	100	32.2	67.8	100
5	Early planting	79.6	20.4	100	81.1	18.9	100
6	Seasonal rotation	65.5	34.5	100	63.5	36.5	100
7	Water drainage	27.0	73.0	100	25.4	74.6	100
8	Irrigation	25.2	74.8	100	24.7	75.3	100
9	Use of fertilizers	51.2	48.8	100	46.3	53.7	100
10	Early and frequent weeding	77.6	22.4	100	78.2	21.8	100
11	Fallowing	55.2	44.8	100	54.0	46.0	100
12	Crop rotation	68	32.0	100	65.0	35.0	100
13	Planting different varieties of crops	72.7	27.3	100	74.0	26.0	100
14	Rearing different breeds of livestock	24	76.0	100	17.6	82.4	100
15	Adopting	64	36.	10	66.	33.	10

	different planting times		0	0	2	8	0
16	Diversifying from farm to non-farm activities	45.4	54.6	100	44.6	55.4	100
17	Changing from crop to livestock farming	16.4	83.6	100	10.3	89.7	100
18	Changing from livestock to crop farming	16.8	83.2	100	12.6	87.4	100
19	Change of soil conservation techniques	40.5	59.5	100	34.3	65.7	100
20	Planting on mounds/ ridges	52.9	47.1	100	55.0	45.0	100
21	Increasing size of cultivated land	59.0	41.0	100	55.5	44.5	100
22	Planting of early maturing crops	68.5	31.5	100	69.0	31.0	100
23	Rearing of early maturing livestock	24.0	76.0	100	16.5	83.5	100
24	Planting of flood tolerant crop	24.0	76.0	100	21.8	78.2	100
25	Planting of drought tolerant crops	21.0	79.0	100	16.9	83.1	100
26	Planting of salt tolerant crops	9.9	90.1	100	7.5	92.5	100
27	Planting of disease/pest resistant varieties	23.2	76.8	100	19.7	80.3	100

Although most of the practices listed in Table 2 are age long agricultural practices in the study area, the higher percentage of respondents adopting climate related adaptation measures typify the existence of changing climate in the area. It was also noticed that a greater percentage of women farmers compared to men farmers opted for strategies that required less financial cost such as 'early planting', 'early and frequent weeding', 'planting different varieties of crops', 'planting of early maturing crops', 'adopting different planting times' and planting on mounds and ridges. On the other hand, a greater percentage of men farmers compared to women farmers opted for strategies which required comparatively greater financial costs, such as increasing size of cultivated land, use of fertilizers, ownership and control of a many farming lands to support farming practices such as crop rotation, seasonal rotation and fallowing. The results in Table 3 show the responses by only male and female crop/livestock farmers, who utilized the various strategies as outlined in Table 2. The responses are categorised on the basis of perceived effectiveness of the different climate change strategies, which have been adopted, to adapt to climate change impacts in the area. The most effective strategy adopted by male and female farmers was 'crop rotation' (94.9% and 94.6%). This was followed consecutively by 'early planting' (94.0% and 94.4%), 'early and frequent weeding' (93.9% and 94.2%), 'planting of early maturing crops' (94% and 93.5%),

'planting different varieties of crops' (93.8% and 92.1%), 'increasing size of cultivated land' (92.8% and 94.0%), 'seasonal rotation' (90.7% and 90.4%), 'fallowing' (90.1% and 90.3%) and others.

More women than men farmers reported effectiveness in climate change adaptation strategies which include mulching, plastic culture, early planting, use of fertilizers, early and frequent weeding, fallowing, increasing size of cultivated land and planting of pest/disease resistant varieties. While more men than women farmers reported effectiveness in terracing, contour farming, seasonal rotation, water drainage, irrigation, crop rotation, planting different varieties of crops, rearing different breeds of livestock, adopting different planting times, diversifying from farm to non-farm activities, changing from crop to livestock farming, changing from livestock to crop farming, changing soil conservation techniques, planting on mounds/ridges, planting of early maturing crops, rearing of early maturing livestock, planting of flood tolerant crops, planting of drought tolerant crops and planting of salt tolerant crops.

A Chi-square test for independence indicated significant associations between gender and effectiveness in use of fertilizer, {$\varkappa^2$(2, n = 4000) = 9.91, p = 0.007, phi = 0.05}, rearing of different breeds of livestock, {$\varkappa^2$(2, n = 4000) = 25.33, p = 0.00, phi = 0.08}, changing from crop farming to livestock farming {$\varkappa^2$(2, n = 4000) = 33.18, p = 0.00, phi = 0.09}, changing from livestock to crop farming {$\varkappa^2$(2, n = 4000) = 15.58, p = 0.00, phi = 0.06}, changing of soil conservation technique {$\varkappa^2$(2, n = 4000) = 16.65, p = 0.00, phi = 0.07}, increasing size of cultivated land {$\varkappa^2$(2, n = 4000) = 6.45, p = 0.04, phi = 0.04}, rearing of early maturing livestock {$\varkappa^2$(2, n = 4000) = 35.48, p = 0.00, phi = 0.09}, use of drought tolerant crops {$\varkappa^2$(2, n = 4000) = 14.27, p = 0.001, phi = 0.06}, use of salt tolerant crops {$\varkappa^2$(2, n = 4000) = 13.47, p = 0.001, phi = 0.06}and use of disease/pest resistant varieties {$\varkappa^2$(2, n = 4000) = 7.28, p = 0.03, phi = 0.04}.

The results of the Chi-square analysis indicated that women farmers were significantly more effective only in the use of fertilizers, increase in cultivated land and planting of pest/disease resistant varieties, while men farmers were significantly more effective in the rearing of different breeds of livestock, changing from crop farming to livestock farming, changing from livestock to crop farming, changing of soil conservation technique, rearing of early maturing livestock, use of drought tolerant crops and use of salt tolerant crops. This implies that men farmers seem to have more access to resources required to effectively adapt to climate change impacts.

Table 3. Effectiveness of Climate Change Adaptation Strategies between Male and Female Farmers

S/N	Adaptation Strategies	Male Respondents Applying Strategy			Female Respondents Applying Strategy		
		Respondents reporting effectiveness (%)	Respondents reporting non-effectiveness (%)	Total Male	Respondents reporting effectiveness (%)	Respondents reporting non-effectiveness (%)	Total Female
1	Mulching	82.7	17.3	100	83.9	16.1	100
2	Terracing	76.8	23.2	100	73.2	26.8	100
3	Contour farming	75.4	24.6	100	74.8	25.2	100
4	Plastic culture	85.2	14.8	100	86.2	13.8	100
5	Early planting	94.0	6.0	100	94.4	5.6	100
6	Seasonal rotation	90.7	9.3	100	90.4	9.6	100
7	Water drainage	75.2	24.8	100	73.5	26.5	100

8	Irrigation	69.6	30.4	100	67.5	32.5	100
9	Use of fertilizers	84.2	15.8	100	85.3	14.7	100
10	Early and frequent weeding	93.9	6.1	100	94.2	5.8	100
11	Fallowing	90.1	9.9	100	90.3	9.7	100
12	Crop rotation	94.9	5.1	100	94.6	5.4	100
13	Planting different varieties of crops	93.8	6.2	100	92.1	7.9	100
14	Rearing different breeds of livestock	83.3	16.7	100	83.0	17.0	100
15	Adopting different planting times	89.9	10.1	100	88.9	11.1	100
16	Diversifying from farm to non-farm activities	88.5	11.5	100	87.4	12.6	100
17	Changing from crop to livestock farming	79.6	20.4	100	77.2	22.8	100
18	Changing from livestock to crop farming	84.4	15.6	100	80.7	19.3	100
19	Change of soil conservation techniques	83.7	16.3	100	80.0	20.0	100
20	Planting on mounds/ ridges	88.8	11.2	100	87.3	12.7	100
21	Increasing size of cultivated land	92.8	7.2	100	94.0	6.0	100
22	Planting of early maturing crops	94.0	6.0	100	93.5	6.5	100
23	Rearing of early maturing livestock	87.6	12.4	100	84.7	15.3	100
24	Planting of flood tolerant crop	80.5	19.5	100	77.2	22.8	100
25	Planting of drought tolerant crops	74.3	25.7	100	68.4	31.6	100
26	Planting of salt tolerant crops	72.8	27.2	100	60.1	39.9	100
27	Planting of disease/pest resistant varieties	79.8	20.2	100	80.8	19.2	100

The results in Table 4 show the responses of respondents regarding the applicability of climate change adaptation strategies for fishing purpose in Delta State. Generally low levels of utilization of climate change adaptation strategies by male and female farmers and fishers could be attributed to fact that at least 74.4% of respondents were not involved in fishing. The majority of respondents were involved in other occupations including crop farming and trading. The results reveal that more men fishers than women fishers applied the various climate change adaptation techniques for fishing. The most applicable strategy used by both male and female fishers

was 'hunting for different species of fish' (25.6% and 17.8%) respectively. This was followed consecutively with 'combining fishing and crop farming' (24.5% and 17.1%), relocating to a different fishing ground (22.2% and 16.9%), 'changing type of fishing gear' (21.3% and 14.8%), and 'fishing further ashore' (18.7% and 14.5%).

Table 4. Applicable and Non-Applicable Climate Change Adaptation Strategies for Male and Female Fishers

S/N		Male Respondents			Female Respondents		
		Number of Respondents	Number of Respondents not	Total Male	Number of Respondents	Number of Respondents not	Total Male
1	Changing from fishing to crop farming	16.3	83.7	100	13.4	86.6	100
2	Changing from fishing to non-farm activities	16.2	83.8	100	12.9	87.1	100
3	Changing from fishing to livestock farming	12.0	88.0	100	6.7	93.3	100
4	Use of motorized vessels	16.5	83.5	100	13.5	86.5	100
5	Hunting for different species of fish	25.6	74.4	100	17.8	82.2	100
6	Changing from hunting of one species of fish to another	20.1	79.9	100	16.9	83.1	100
7	Fishing further ashore	18.7	81.3	100	14.5	85.5	100
8	Relocating to a different fishing ground	22.2	77.8	100	16.9	83.1	100
9	Changing type of fishing gear	21.3	78.7	100	14.8	85.2	100
10	Combining Fishing with crop farming	24.5	75.5	100	17.1	82.9	100
11	Combining fishing with livestock farming	12.7	87.3	100	7.6	92.4	100
12	Combining fishing with crop and livestock farming	11.8	88.2	100	7.2	92.8	100

The results in Table 5 is derived from the responses of only male and female respondents involved in fishing and shows the opinion of male and female fishers regarding the effectiveness of the various applicable climate change adaptation strategies adopted for fishing. The results show that the most effective adaptation strategy adopted by both men and women fishers was 'hunting for different species of fish' (90.8% and 92.8%). This was followed by 'hunting for different species of fish' (90.8% and 92.8%), 'combining fishing with crop farming' (89.9% and 91.2%), 'use of motorised vessels' (89.0% and 88.8%), 'changing type of fishing gear' (86.9% and 87.0%), 'changing from hunting one species of fish to another' (86.2% and 89.8%), and others. The results also show that more female fishers than male fishers reported effectiveness in all climate change adaptation strategies listed except the 'use of motorised vessels' and 'fishing further ashore'. A Chi-square test for independence indicated significant associations between gender and effectiveness in changing from fishing to crop farming, {$\varkappa^2$(2, n = 4000) = 15.88, *p* = 0.00, *phi* = 0.06}, changing from fishing to non-farm activities, {$\varkappa^2$(2, n = 4000) = 12.27, *p* = 0.002, *phi* = 0.06}, changing from fishing to livestock farming {$\varkappa^2$(2, n = 4000) = 33.67, *p* = 0.00, *phi* = 0.09}, use of motorized vehicles {$\varkappa^2$(2, n = 4000) = 7.16, *p* = 0.03, *phi* = 0.04}, hunting different types of fish {$\varkappa^2$(2, n = 4000) = 37.17, *p* = 0.00, *phi* = 0.10}, hunting another fish type {$\varkappa^2$(2, n = 4000) = 25.38, *p* = 0.00, *phi* = 0.08}, going further ashore for fishing {$\varkappa^2$(2, n = 4000) = 13.12, *p* = 0.001, *phi* = 0.06}, relocating to a different fishing ground {$\varkappa^2$(2, n = 4000) = 19.25, *p* = 0.00, *phi* = 0.07}, changing fishing gear {$\varkappa^2$(2, n = 4000) = 28.38, *p* = 0.00, *phi* = 0.08}, combining fishing with crop farming {$\varkappa^2$(2, n = 4000) = 33.30, *p* = 0.00, *phi* = 0.09}, combining fishing with livestock farming{$\varkappa^2$(2, n = 4000) = 28.26, *p* = 0.00, *phi* = 0.08} and combining fishing, crop farming and livestock farming{$\varkappa^2$(2, n = 4000) = 30.54, *p* = 0.00, *phi* = 0.09}.

The results of the Chi-square analysis indicated that women farmers were significantly more effective in changing from fishing to crop farming, changing from fishing to non-farm activities, changing from fishing to livestock farming, hunting different types of fish, hunting another fish type, relocating to a different fishing ground, changing fishing gear, combining fishing with crop farming, combining fishing with livestock farming and combining fishing, crop farming and livestock farming. On the other hand, men fishers were significantly more effective only in the use of motorized vehicles and going further ashore for fishing.The results imply that women fishers are capable of making effective use of opportunities afforded to improve their adaptive capacity to climate change. Significantly less women fishers making effective use of motorized vessels and fishing further ashore may be due to financial, technical and security constraints.

Table 5. Effectiveness of Climate Change Adaptation Strategies between Male and Female Fishers

S/N		Male Respondents Applying Strategy			Female Respondents Applying Strategy		
		Respondents Reporting	Respondents Reporting Non-	Total Respondents (%)	Respondents Reporting	Respondents Reporting Non-	Total Respondents (%)
1	Changing from fishing to crop farming	81.8	18.2	100	90.4	9.6	100
2	Changing from fishing to non-	80.7	19.3	100	86.5	13.5	100

	farm activities						
3	Changing from fishing to livestock farming	77.1	22.9	100	80.1	19.9	100
4	Use of motorized vessels	89.0	11.0	100	88.8	11.2	100
5	Hunting for different species of fish	90.8	9.2	100	92.8	7.2	100
6	Changing from hunting of one species of fish to another	86.2	13.8	100	89.8	10.2	100
7	Fishing further ashore	85.3	14.7	100	84.4	15.6	100
8	Relocating to a different fishing ground	88.4	11.6	100	91.1	8.9	100
9	Changing type of fishing gear	86.9	13.1	100	87.0	13.0	100
10	Combining Fishing with crop farming	89.9	10.1	100	91.2	8.8	100
11	Combining fishing with livestock farming	73.7	26.3	100	76.8	23.2	100
12	Combining fishing with crop and livestock farming	68.4	31.6	100	79.6	20.4	100

Constraints to the Effectiveness of Women-Led Climate Change Adaptation Strategies

Determining the constraints women face in adopting strategies required for adapting to climate change impacts could be determined from the responses of respondents concerning their level of education, their average monthly income, the number of farmlands owned, participation in decision making and accessibility to weather/climate information. The results in Table 6 show the responses of male and female respondents on their highest level of education attained. The results show that there were more females (15.5%) with no formal education compared to men (8.1%). More men (42.6% and 31.9%) than women (38.3% and 18.9%) had attained secondary and tertiary levels of education respectively. Although more women (27.3%) than men (17.5%) had the primary or basic education as their highest al level of education attained, the results generally show that women were less disposed to attaining higher level educational qualifications compared to men. This implication of low tertiary education for women implies that women are less equipped with expert knowledge to cope with impacts of climate change. They resort more to the use of local knowledge of their environment in

charting ways of adapting effectively. A combination of expert and local knowledge would empower and prove useful to women towards effectively managing the effects of climate change.

Table 6. Distribution of Male and Female Respondents According to Highest Level of Education Attained

Highest Level of Education	Percentage of Male Respondents	Percentage of Female Respondents
No formal Education	8.1	15.5
Primary Education	17.5	27.3
Secondary Education	42.6	38.3
Tertiary Education	31.9	18.9
Total	**100**	**100**

The results in Table 7 show the average monthly income of male and female respondents. The results generally reveal that men have financial advantage over women as more men reported higher monthly incomes, compared to women. The results show that more women (69.2%), compared to less men (48.9%), earn less than N20,000 monthly, while more men (51.1%) compared to women (30.9) earn above N20,000 monthly. This implies that men have greater financial capacity to buy better farm inputs and adopt appropriate technologies to adapt better to climate change. Women are less financially capable to secure better farm inputs and technologies to adapt better to climate change.

Table 7. Distribution of Male and Female Respondents According to Average Monthly Income

Average Monthly Income (~~₦~~)	Percentage of Male Respondents	Percentage of Female Respondents
Less than 10,000	13.0	26.5
10,000 – 20,000	35.9	42.7
Above 20,000	51.1	30.9
Total	**100**	**100**

The results in Table 8 show the distribution of male and female respondents according to the number of farmlands owned. The results generally reveal that women are not denied ownership to farmland, as land ownership status between men and women are similar. The results indicate that almost equal percentage of men and women own between 1 – 5 farmlands. While more women (26%) own 6 – 10 farmlands, more men (10.4%) own above 10 farmlands. This fairly equal ownership implies that women do not have restricted access to farmlands. Although according to traditional practice, most farmlands used by women are owned by their husbands. Even though they are given permission to farm on such lands, they are usually not entitled to make critical decisions for optimum use of such landed property.

Table 8. Distribution of Male and Female Respondents According to Number of Farmlands Owned

Number of (at least 100x100 ft)Farmlands Owned	Percentage of Male Respondents	Percentage of Female Respondents
1 – 5 farmlands	65.5	65.8
6 – 10 farmlands	24.1	26.0
Above 10 farmlands	10.4	8.2
Total	**100**	**100**

The responses of male and female respondents on their involvement in decision making at either individual, household or community level is shown in Table 9. The results reveal that more men (96.4%) than women (89.6) participate in decision making either as individual, household or community. The inability for women to make decisions for themselves, makes it difficult to for them to decide on necessary steps (such as changing the variety or species of crops to plant) to take in adapting effectively to climate change impacts. These results imply that there is need for power and gender relations to be addressed both at the family and community levels. Access to climate information can determine how easily a farmer or fisher can adapt easily to climate change impacts.

Table 9. Distribution of Male and Female Respondents According to Participation in Decision-Making

Affirmation of Participation in Decision Making	Percentage of Male Respondents	Percentage of Female Respondents
I participate in decision-making at one or more levels	96.4	89.6
I do not participate in decision-making	3.6	10.4
Total	**100**	**100**

The responses of respondents in Table 10 reveal accessibility to weather/climate information between men and women. The results indicate that more men (88.7%) than women (83.0) are privy to weather/climate related information. Keeping women abreast on weather/climate information would save losses incurred as a result of unforeseen extreme weather conditions. It is therefore important that both male and female farmers/fishers have access to regular weather/climate updates for planning ahead and avoiding losses.

Table 10. Distribution of Male and Female Respondents According to Accessibility to Weather/Climate Information

Access to Climate Information	Percentage of Male Respondents	Percentage of Female Respondents
I have received climate information previously	88.7	83.0
I have never received climate information previously	11.3	17.0
Total	**100**	**100**

Equipping Women to Adapt Effectively to Climate Change

It is important that women are equipped or empowered to adapt effectively because they are regarded as the more vulnerable gender (FAO, 2011; Yadav and Lal, 2017). The results on Table 11 show responses from both male and female respondents on possible ways of empowering women to play key roles required for adapting effectively to climate change impacts. Most respondents (54.8%) suggested that women should have 'more access to farm inputs, climate information and training'. This is

followed by respondents (23.3%) who suggested that women should have access to 'access to alternative sources of renewable energy, climate-smart agriculture tools, land and credit'. These conditions would make women better positioned to adapt better to climate change impacts.

Table 11. Perception on Women-Led Community-Based Initiatives in Adapting Effectively to Climate Change Impacts

Women-Led and Community-Based Initiatives in Adapting Effectively to Climate Change Impacts	Percentage of Respondents
Access to farm inputs	1.2
Access to climate information	4.4
Access to training	4.1
Access to irrigation	0.2
Access to drainage	0.5
Access to extension services	0.9
Access to alternative sources of renewable energy	0.2
Provision of climate-smart agriculture tools	0.9
Access to land	0.3
Access to credit	5.8
Freedom from traditional and cultural beliefs	1.0
Access to farm inputs, climate information and training	54.8
Access to irrigation, drainage and extension services	2.2
Access to alternative sources of renewable energy, climate-smart agriculture tools, land and credit	23.3
No Response	0.8
Total	**100**

Discussion

In the study area, it was observed that women are not availed equal opportunity as men in coping effectively with climate change impacts. This is revealed from the results in which more women reported less income and less access to farming lands and climate information, compared to their men counterparts. For this reason, more women tend to adopt measures that are less capital intensive such as 'early planting', 'early and frequent weeding', 'planting different varieties of crops', 'planting of early maturing crops', 'adopting different planting times' and 'planting on mounds and ridges'. On the other hand, more men adopted strategies which could incur comparatively greater financial costs, such as increasing size of cultivated land, use of fertilizers, ownership and control of a many farming lands to support farming practices such as crop rotation, seasonal rotation and fallowing. These results were similar to findings by Ngigi *et al.,* (2017) who indicated that women tended to adopt "crop-related strategies", which may be less labour/cost intensive while men adopted the use of "livestock and agroforestry-related strategies", which may be more labour/cost intensive.The results are also confirmed from studies by Jost *et al*., 2015 and McKinley *et al*., 2018, who reported that women farmers may likely not adopt certain adaptation strategies due to financial and resource limitations, less control over land and their exclusion from benefits of extension services, such as access to information, tools, seed, fertilizers, and improved livestock. The results are also supported by findings by Kristjason *et al*., (2017) who reason that women's lower adoption levels to climate change adaptation strategies may be related to the fact that most of such investments are labour and cost intensive, the returns of which are long term in nature. Being that women have less access to resource, which includes labour and capital, there is less assurance of getting good returns from such investments.

The results of the study indicating that men farmers were significantly more effective than women farmers in most of the climate change adaptation strategies, aligns with findings by Adzawla *et al.,* (2019), whose study indicate that the adaptive capacity of women is less compared to men, due to low levels in the intensities of adoption techniques employed in farming in a region in Ghana. In the case of fishers, the results revealed a situation where

more men than women were involved in the utilization of most of the strategies for coping with climate change impacts. This could be the result of lack of capital and training for women and security issues involved with militancy around the Niger-Delta creeks. The study also recognizes the fact that more women fishers reported effectiveness in strategies, including those which were adopted by more men fishers. This is aligns with findings by Meinzen-Dick *et al.*, (2014); Khalil *et al.,* (2019) who reported that women are better in managing and making optimal use of environmental resources, and findings by Nelson *et al*., (2002) who observed that women are better positioned towards playing the key role in food security and conserving biodiversity.

In adopting strategies required for adapting effectively to climate change, the study reveals that more women than men are faced with a number of constraints, which include education/training, less income, non-involvement in decision making and access to climate information. Similar numbers of men and women in the selected areas reportedly have access to about same number of farmlands. But it is necessary to point out that women sometimes lay claims over lands belonging to their husbands, but are incapable of making critical decisions concerning strategies to be adopted during farming, to cope with the impacts of climate change. These results align with the findings by the FAO, 2011; Davidson (2016); World Bank Group, FAO and IFAD, (2015); Jordan, (2018); Assan, *et al.,* (2018), who revealed that women specifically face constraints, which include limited access to finance, less control over land resources, limited access to education/training, information and farming/fishing tools and less involvement in decision making. The results of the study reveal that despite the fact that women farmers are constrained by finance and training, they are resilient and capable of making better use of limited opportunities afforded them. For this reason, the UNDP (2012); Price (2018) are of the opinion that women should not be regarded as "victims" of climate change impacts because of their capacity to use skills and opportunities provided for effectively coping with climate change impacts. Huyer and Partey (2020) opine that women could fare better if they are availed the opportunity of using climate-smart agricultural (CSA) tools. They further recommend that power and gender relations, beginning from the family level need to be addressed, as pointed out from the study.

Conclusion and Recommendation

Investing in women as an aspect of climate responses can lead to greater benefits in Delta State. This is because women have shown greater capacity to effectively utilize opportunities and skills given them. In coping with climate change impacts, men and women are faced with different constraints, needs and priorities, and therefore research, adaptation planning and financing need recognize these differences to guide the necessary interventions needed. Adaptation initiatives should empower women at the global, national, and community levels. Based on the suggestions provided by the study subjects, the skills of women farmers and fishers can be built by encouraging education of the girl child, even up to tertiary level, providing credit or soft loans, with low interest rates, involving women in training sessions, involving women in decision making and providing women access to weather/climate information and climate-smart agriculture tools. Being that most communities in sub-Saharan Africa observe a patriarchy system characterized by male domination, such initiatives would require continued discussions, advocacy and capacity-building on the gender dimensions of climate change beginning from the household level. Both men and women have to be willing to support these initiatives, develop new ones and build upon existing guidelines and tools on how to mainstream gender in adaptation planning. It would not be out of place to create adaptation learning networks to facilitate sharing of knowledge

within and across communities in Delta State and beyond.

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