Scientific Research Publishing

American Journal of Climate Change, 2023, 12, 116-139
https://www.scirp.org/journal/ajcc
ISSN Online: 2167-9509
ISSN Print: 2167-9495

Gender Perspectives of Vulnerability to Climate Change: A Descriptive Evidence from Farming Households at Ikpayongo Community in Gwer Lga, Benue State, Nigeria

Monday Akpegi Onah[1], Elizabeth Jeiyol[1], Odeh Adimanyi[1], Chiviter Ukange[2]

[1]Department of Geography, Benue State University, Makurdi, Nigeria
[2]Gender and Environmental Risk Reduction Initiative (GERI), Makurdi, Nigeria
Email: aonah@bsum.edu.ng, ejeiyol@bsum.edu.ng, odehadimanyi@yahoo.com, chivirtervitalis@gmail.co

How to cite this paper: Onah, M. A., Jeiyol, E., Adimanyi, O., & Ukange, C. (2023). Gender Perspectives of Vulnerability to Climate Change: A Descriptive Evidence from Farming Households at Ikpayongo Community in Gwer Lga, Benue State, Nigeria. *American Journal of Climate Change, 12,* 116-139.
https://doi.org/10.4236/ajcc.2023.121007

Received: September 27, 2022
Accepted: March 7, 2023
Published: March 10, 2023

Abstract

Climate change impact and risks on agricultural livelihood affect women and men disproportionately and often to the disadvantage of women and girls. Consequently, this study assessed gender perspectives of vulnerability to climate change of farming households at Ikpayongo community in Gwer local government area, Benue State, Nigeria using descriptive approach. The study identified a total of 120 male-headed and female-headed farming households across four neighbourhoods and administered structured questionnaire on them using simple random sampling method, while data analysis was done using descriptive statistics. The results indicate lower education and income status among female-headed households, though male-headed households have high household size. Both sexes have relatively equal access to land for farming, however men have large farm size compared to women. The major crops cultivated by men were rice and yam, while women cultivated largely groundnut and cassava. Women are more exposed and sensitive to climate-related hazards such as floods and heat stress due to the location of their farms. The result further shows that males possess better adaptive capacity given their higher incomes, social networks and more access to training/capacity building programmes and credit facilities. The study concludes that female-headed farming households are more vulnerable to climate change and variability than male-headed farming households due to higher exposure and a lower adaptive capacity. Programme and policies to improve women access to credit facilities and relevant training to boost their adaptive capacity and build resilience are highly recommended. This would also limit exposure with attendant reduction in vulnerability.

Keywords

Climate Change, Gender, Farming Households, Vulnerability, Adaptive Capacity

1. Introduction

Vulnerability according to Turner et al. (2003) "is the extent of injury likely to be caused to a system as a result of its exposure to a hazard". The Third and Fourth Assessment Reports of the IPCC (2014) view vulnerability as "the level to which a system is susceptible to, or incapable of coping with the adverse effects of climate change, climate variability and extremes". Vulnerability deals with the character, magnitude and degree of exposure of a system to climate change and variability, its sensitivity and adaptive capacity. In other words, vulnerability is a function of exposure and sensitivity of a system and its ability to adapt. According to IPCC (2007), adaptive capacity of a system is its ability to reduce the possible consequences of climate variability through prevailing opportunities or using measures to deal with these consequences. Sensitivity on the other hand is the extent to which a system is affected by climate-related stimuli either positively or negatively; covertly or overtly. While exposure is the extent to which a system is unshielded from major climate-related events. In this study, vulnerability is the extent to which farming households are exposed and susceptible to, and their capacity to adapt to, the negative climate change risks, impacts and stresses.

Agriculture, one of the most vulnerable sectors of the economy to climate change, impacts and risks especially in the developing countries, given that they largely rely on rain-fed agriculture. The devastating impacts of climate change are predicted to disproportionately affect the world's poor with a majority of them situated in rural areas and rely heavily on the primary sectors including agriculture for their livelihoods (World Water Development Report, 2020). Similar view of high vulnerability of agricultural livelihoods to climate change impacts and risks was also documented by Hoque, Cui, Xu, Islam, Tang and Ding (2019). They asserted that "the adverse impacts of climate change exert mounting pressure on agriculture-dependent livelihoods of many developing and (even) developed nations". Evidently, their empirical study of coastal Bangladesh identified Bhola, Patuakhali, and Lakshmipur districts, around the mouth of the deltaic Meghna estuaries as the hot spot of vulnerability distribution resulting from spatial variation of erosion, cyclones, drought, rain-fed agriculture, land degradation, soil phosphorus, crop productivity, sanitation and housing condition. In the same vein, Venus, Bilgram, Sauer and Arun (2022) reported varying (low to high) levels of livelihood vulnerability to climate change by smallholders farmers in the Indo-Gangetic plains. Nong, Gan and Hu (2022) reported moderate vulnerability of farm households in Northeast Vietnam to natural hazards

and climate variability. The comparative high vulnerability of agricultural sector to was also documented by Parker, Bourgoin Martinez-Valle and Läderach (2019); Field, Barros, Dokken, Mach, Mastrandrea and Bilir, et al., (2014). In Africa (including Nigeria) and south Asia, Knox, Hess, Daccache and Wheeler (2012) projected that major grains such as maize and sorghum are to suffer mean yield losses of 8% by 2050, while wheat is expected to decline by 17%, within the same time frame. It is evident from these empirical studies that climate-dependent agricultural livelihoods particularly in developing countries are vulnerable to climate change and variability. Besides, the fact agricultural sector is comparatively more vulnerable than other sectors of the economy is no longer in doubt. However, this general knowledge is insufficient to support the decision-making needed to build climate-change resilient agricultural livelihoods in rural communities in Africa without factoring in gender dimension which underscores the need for this study.

Studies have attempted to provide understanding of the gender concerns and dimensions in agricultural vulnerability to climate change. For instance, World Water Development Report (2020) suggested that, within the family unit, the magnitude of impact of climate change on women and girls will be significantly higher and much worse in view of the prevailing gender inequalities in the world today. In agriculture particularly in most developing countries including Nigeria, women are highly involved with women small holder farmers constituting 70 - 80 percent of the agricultural labour force (CIRDDOC Nigeria, 2022), however, men are the ones that reap the proceeds. This economic disadvantage and wage discrimination make women more vulnerable to the impacts of climate change as they lack adequate resources that would help reduce their vulnerability. These factors work together to determine the expected differences in the impacts and vulnerabilities of women and men (Carr & Thompson, 2014; McKune et al., 2015; Eastin, 2018; Adzawla, Azumah, Anani, & Donkoh, 2019). Also, Adzawla et al. (2019) reported severer climate impacts on the livelihoods of females than males in Ghana. This is because the adaptive capacities of males were found to be higher than that of females leaving women more vulnerable with limited capacity to cope. These studies suggested that major gender vulnerability factor is hinged on the fact women and girls are not allowed to enjoy the fruit of their agricultural production, probably because decision on access, ownership and allocation of resources largely rest on men and boys, and women and girls being restricted to certain roles such as sowing, weeding, harvesting and processing in agricultural production processes (Sahel Capital, 2014). Chandra, McNamara, Dargusch, Caspe, and Dalabajan (2017) reports that climate change and conflict significantly increased smallholder farmers vulnerability, resulting in loss of livelihoods, financial assets, agricultural yield and the worsening of debt problems. However, women are more disadvantaged and as such tend to farm in smaller plots, work shorter hours or limit farming to cash crops. Chandra, et al. (2017) does not account for why women are more disadvantaged than men and the ex-

tent of vulnerability, but focused of their adaptation mechanism resulting from the disproportionate vulnerability levels thereby create a research gap. According to Brody, Demetriades and Esplen, (2008), "women provide up to 90 percent of labour for rice cultivation and in Sub-Saharan Africa and they are responsible for 80 percent of food production. Men, by contrast, are generally responsible for cash cropping and larger livestock". Therefore responsibility for adaptation is likely to fall on their shoulders, including finding alternative ways to feed their family. The report however, maintained that "statutory and/or customary laws often restrict women's property and land rights and make it difficult for them to access credit and agricultural extension services, while also reducing their incentive to engage in environmentally sustainable farming practices and make long-term investments in land rehabilitation and soil quality." This report suggests that limited access to credit increases vulnerability by limiting their capacity to engage in sustainable farming practices. In a related study, Alhassan, Kuwornu and Osei-Asare (2019) found a significant difference in the vulnerability levels of female-headed and male-headed farming households. Female-headed households were more vulnerable to livelihood strategies, socio-demographic profile, social networks, water and food major components of the LVI, whereas male-headed households were more vulnerable to health.

Furthermore, Anugwa, Obossou, Onyeneke, et al. (2022) maintained that "gender inequality is one of the main drivers of food insecurity in sub-Saharan Africa, as it is the main threat to the agricultural production activities of women due to climate change". They also pointed out that the interplay between gender and vulnerability to the impacts of climate change especially on agriculture and food security in Nigeria is poorly documented". This assertion aligns with the cardinal rationale of this study, which holds that the knowledge of the fact agriculture is more vulnerable to climate change impacts and risks than other sectors, and the disproportionate vulnerable in favour of men than women is not sufficient for decision-making and policy. It is equally important to understand the extent to which women are disproportionately vulnerable and what are the vulnerability factors/components that drive the process.

At present there is limited information from empirical studies in the study that provides evidences on the extent of gender vulnerability of farming households to climate change impact and risks, hence, the need for this study. Moreover, vulnerability factors and drivers are largely location-dependent due to differences in socioeconomic, cultural and environmental factors, which underscore the need to investigate vulnerability at community level for effective intervention. Livelihood Vulnerability Index approach therefore provides a useful tool for achieving this due to its flexibility in the selection of vulnerability indicators that are relevant in different contexts (Adzawla, Azumah, Anani, & Donkoh, 2019).

Ikpayongo community, Gwer Local Government of Benue state is a rich agrarian community of over 30,000 inhabitants with oranges, mangoes, sweet pota-

toes, cassava, soya bean, guinea corn, yams, sesame, rice, groundnuts, and palm tree as the major crops grown. Agriculture forms the backbone of the Benue State economy, engaging more than 70 per cent of the working population. This has made Benue the major source of food production in the Nation. However, irrigation farming is still extremely limited and even completely absent in most parts of Benue state, hence, agriculture here is largely climate dependent. Men and women engage in agriculture and are exposed to the same impacts of climate change, however, male-headed and female-headed farming households have disproportionate access to adaptive capacities.

This follows that farming household in Benue State in general and Ikpayongo community in particular are typically considered to be vulnerable to climate change impact, risks and hazards. However, relatively little is known about how that vulnerability differs between men and women farming households, the drivers of the vulnerability along gender lines. Therefore, knowledge and understanding on the extent of vulnerability the farming households and adaptation in the study area is scanty or non-existent in the literature which makes the study imperative.

In achieving this, the study focused on assessing socioeconomic characteristics of farming households; nature of household farming activities; identified four (4) contributors to climate change vulnerability based on Livelihood Vulnerability Index (LVI) approach (Deressa et al., 2009; Alhassan, Kuwornu, & Osei-Asare, 2019) which are exposure and sensitivity; social and human capital; financial and communication; and natural capital components/contributions. The last three components are generally referred to as adaptive capacity based on IPCC definition of vulnerability.

The study however adopted descriptive approach instead of the conventional indices generated from complex computations. The study by this approach demonstrated that similar results and even optimal and clearer explanation of gender perspective to vulnerability of farming households can be arrived at with simple descriptive approach capable of informing policy direction and/or shift.

Livelihood Vulnerability Index (LVI) Framework

The Livelihood Vulnerability Index (LVI) is an indicator approach for assessing vulnerability of different livelihood options especially agriculture to climate change/variability risks and impact. It was developed by Hahn, Riederer and Foster (2009) to estimate climate change vulnerability in the Mabote and Moma Districts of Mozambique. Broadly, it recognized the three main vulnerability factors/components of exposure, sensitivity and adaptive capacity to climate change and variability, which is consistent with the definition of vulnerability by IPCC (2007) that largely viewed vulnerability as a function of exposure, sensitivity and adaptive capacity to cope.

Hahn, Riederer and Foster (2009) identified livelihood vulnerability determinants as socio-demographics, livelihoods, social networks, health, food and water security, natural disasters and climate variability. These determinants fall into

any of three vulnerability factors of exposure, sensitivity and adaptive capacity. Each of these factors or determinants is measured using sub-components or variables called indicators (**Table 1**).

According to Madhuri, Tewari and Bhowmick, P.K., (2014), the central focus of the Hahn et al. (2009) LVI "is to look into various aspects of vulnerability and differences in households' efforts and adaptive capacity to maintain livelihood". Differences in household access to finance, human, social, natural and physical capitals are recognized (**Figure 1**).

Table 1. Livelihood vulnerability index framework.

Major components	Sub-components
Socio-demographic Profile	Dependency ratio
	Average age of household heads
	% of households without latrines
	% of households with household head never attending school
	% of households with orphans
	Average number of persons per room
Livelihood Strategies	% of households with family member working in another community
	% of households dependent only on agriculture as a source of income
	% of households who do not own their farm lands
	Average agricultural livelihood diversification index
Social Network	Average receive:give ratio (0-2)
	Average borrow:lend money (0-2)
	% of households that have not gone to their local government for assistance in the past 12 months
Health	Average time to health facility (minutes)
	% of households with family member with chronic illness
	% of households where a family member had to miss works or school in the past two weeks because of illness
	Average malaria exposure prevention index (range: 0 - 12)
Food	% of households dependent on family farm for food
	% of households dependent on family farm for food
	Average number of months households struggle to find food (range: 0 - 12)
	Average crop diversity index (range: 0 - 1)
	% of households not saving crops
	% of households not saving seeds
Water	% of households reporting water conflicts
	% of households utilizing a natural water source
	Average time to water source (minutes)
	% of households without a consistent water supply
	Inverse of the average number of liters of water stored per household
Natural Disasters and Climate Variability	Average number of flood, bush fires and drought events in the past 10 years
	% of households who lost crops as a result of the floods, drought and bushfires
	% of households that did not receive a warning about the pending natural disasters
	% of households reporting an injury or death due to natural disaster in the past 10 years
	Mean standard deviation of the daily average maximum temperature by month
	Mean standard deviation of the daily average minimum temperature by month
	Mean standard deviation of the daily average maximum temperature by month

Source: Adopted from Alhassan, Kuwornu and Osei-Asare (2019).

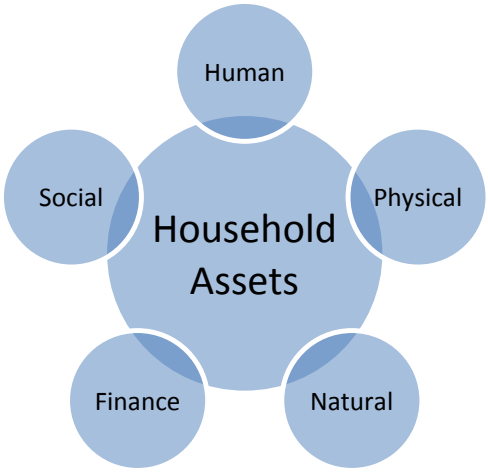

Figure 1. Conceptual framework of livelihood vulnerability index.

Hahn et al. (2009) maintained that the framework represents a pragmatic approach which may be used to monitor vulnerability, program resources for assistance, and/or evaluate potential program/policy effectiveness in data-scarce regions by introducing scenarios into the LVI model for baseline comparison. However, Ali et al., (2014) and Alhassan, Kuwornu and Osei-Asare (2019) observed that the selected indicators have to be contextual and relevant to the local communities in which the investigation is being conducted. This flexibility in the selection the major vulnerability components and sub-components (indicators) makes LVI approach attractive in assessing livelihood vulnerability to climate change and variability in areas. For example, Alhassan, Kuwornu and Osei-Asare (2019) successfully applied it in assessing gender dimension of vulnerability to climate change and variability of smallholder farming households in Ghana; Madhuri, Tewari, and Bhowmick, (2014) in livelihood vulnerability index analysis in Bihar; and Chinwendu, Sadiku, Okhimamhe and Eichie (2017) in studying households vulnerability and adaptation to climate variability induced water stress on downstream Kaduna River Basin. This informed the choice of adopting this framework in this study with modifications in accordance with local factors.

2. Materials and Methods

2.1. Study Area

Ikpayongo is an agrarian community in Gwer-East local government area of Benue state, and is located about 10 km from Makurdi, the State capital. The area is found between latitude 7˚43'50"N and longitude 8˚32'10"E (**Figure 2**) with an estimated population of 50,000 persons. The area has a mean elevation of 110 metres above sea level (Ali, Onah, Mage, Yiyeh, Tarzoho, & Iorhuna, 2022). Ikpayongo is bounded by Makurdi local government to the North, and largely under the influence of Makurdi growing into a semi-urban area. It is an important agricultural community, though largely subsistence and rain-fed agriculture.

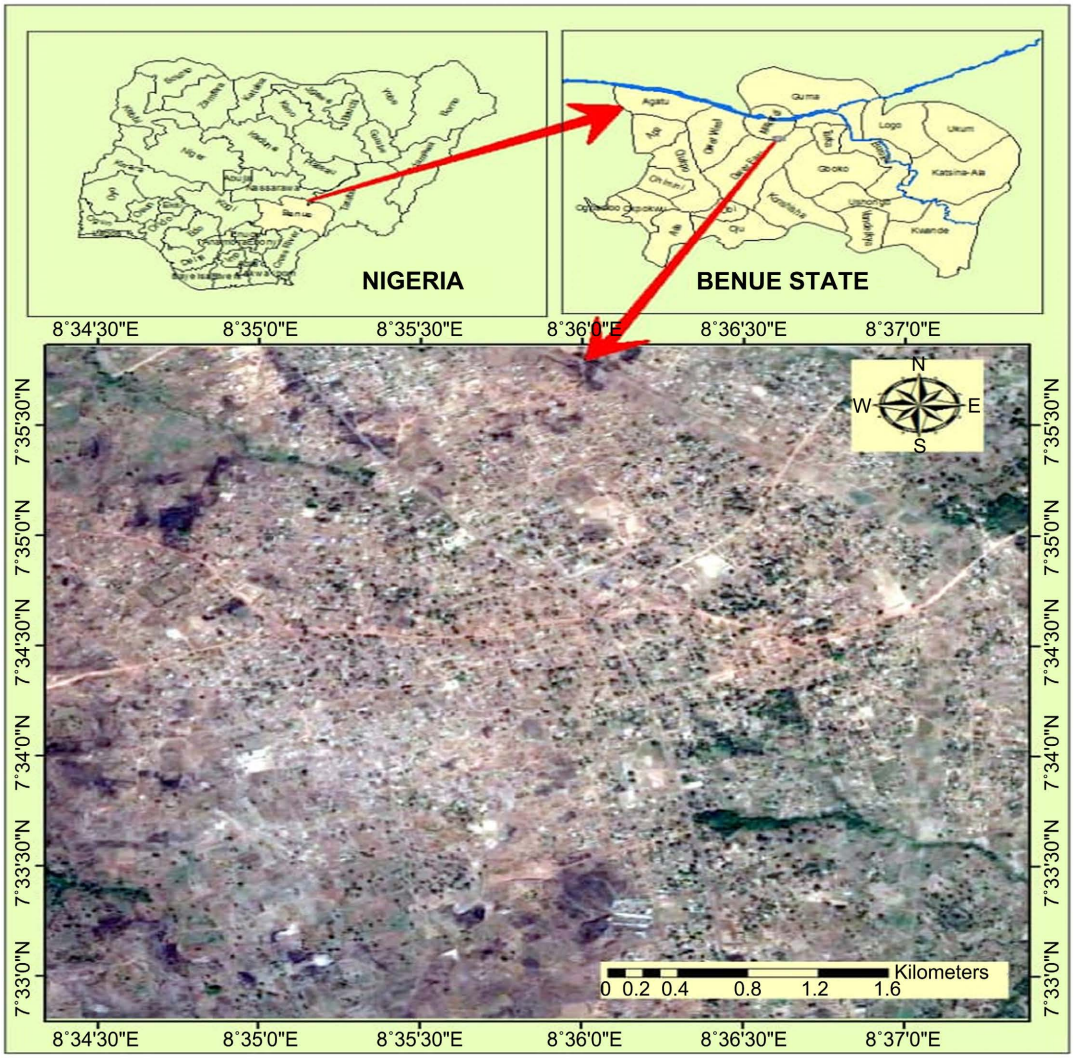

Figure 2. Ikpayongo community of Gwer Local Government Area of Benue State, Nigeria.

The area lies in the wet and dry savannah climate (Aw) and experiences a mean temperature of 28˚C while mean monthly temperature values indicate that the coolest and hottest months are December (26˚C) and March (31˚C) respectively (Tyubee, 2008). Its relative humidity fluctuates with seasons, reaching its means monthly peak of about 92% in the rainy season, which begins in April, reaches its peak in August and decreases to end in October. The dry season on the other hand last for five (5) months (November-March). The area has a mean annual rainfall total of 1190 mm and annual rainfall total ranging between 775 mm and 1792 mm. The area is drained by the following seasonal streams/river, Kinde, Ansaagh (river), Yakpande, Jagura and Tindi-kyula streams.

2.2. Methods

Structured questionnaire were used data collect on different components/factors of vulnerability levels for households. There were however instances where the researchers obtained additional information from respondents through fol-

low-up interview at the cause of administering questionnaire and observation. Consequently, 120 questionnaire were administered to farming household heads using simple random technique across Ikpayongo community and were all retrieved for analysis as they were administered on one-on-one basis in form of face-to-face interview and the data analyzed using descriptive statistics. Before using simple random sampling method in questionnaire administration, the study purposively identified four (4) neighbourhoods. Thirty (30) copies of questionnaire were administered in each of the neighbourhood giving a total of 120 questionnaire.

The selection of vulnerability factors (components) the corresponding sun-components (indicators) which informed the data collection was based on the and LVI as defined by Hahn et al. (2009) and though they are modified to reflect the local factors of vulnerability of farming households to climate change and variability as shown in Table 2.

Table 2. Modified livelihood vulnerability index framework.

Major components	Sub-components	Relationship with vulnerability
Socio-demographic Profile	❖Sex (gender) ❖Educational attainment ❖Household size ❖Annual income	The higher the educational attainment, the higher the adaptive capacity and the lower the vulnerability; the smaller the household size, the lower the dependency ratio and the higher the adaptive capacity. Also higher income from farming increases resilience and decreases vulnerability (Ali et al. 2022)
Nature of Farming Activities	❖Years of farming experience ❖Farm size ❖Major crops cultivated ❖Livestock farming	The longer the years of farming experience, the high the adaptive capacity and the lower the vulnerability to climate change impacts; larger farm size are likely to increase earning and reduce vulnerability; traditionally high income generation crops such and yams and rice are likely to increase earning and reduce vulnerability (Author's years of working with farming communities in the study area)
Exposure and sensitivity Factors	❖Flood experience ❖Flood frequency ❖Drought experience (dry spells) ❖Drought frequency ❖Nature of rainfall ❖Excessive heat/heat Stress ❖Frequency of heat stress ❖Physical protection from disaster	Those farmer with longer flood exposure are likely to adapt better and build back stronger and quicker, hence have lower vulnerability; the higher the climatic extremes, the high the vulnerability; while farms with physical protection such as dykes wile experience lower exposure and reduced vulnerability (Akukwe & Ogbodi, 2015; Ali et al., 2022)
Social and Human Capital	❖Membership of farmers groups organization ❖Free labour ❖Training/Capacity Building ❖Frequency of visit by extension works/officers ❖Early disaster warning information ❖Support from relatives ❖Households' members health (illness) status in the last 12 months	Social organizations provide support for its member hence reduces exposure and sensitivity to climate shock which lowers vulnerability: free labour and adequate training reduces vulnerability by increase resilience capacity; early warning system activation helps in adaption, hence reduces vulnerability; good health status of family members increases adaptive capacity and reduces vulnerability (Alhassan, Kuwornu, & Osei-Asare, 2019; Ali et al., 2022)

Continued

Natural Capital	❖Access to farm Land ❖Size of the land you have access to ❖Nature of access to land	The higher the access to fertile arable land the lower the vulnerability restriction of access to land on gender or other ground can increase vulnerability by limiting the adaptive capacity of the disadvantaged gender group (Alhassan, Kuwornu, & Osei-Asare, 2019)
Adaptive Capacity to climate change - Financial and communication Capitals	❖Access to Credit ❖Household Average Annual income ❖Remittances from family or friends ❖Access to irrigation facilities ❖Ownership of communication gadgets ❖Other economic activities	Access to credit for the purpose of accessing extension services and improved inputs reduces vulnerability; remittance and access to irrigation facilities reduces exposure and increases adaptive capacities; ownership of communication gadgets helps in access to information that increase adaptive capacity; and diversification of economic base helps in building resilience to climate shocks thereby reduces vulnerability. (Alhassan, Kuwornu, & Osei-Asare, 2019; Authors views from practical experience).

Source: Developed by the author, 2022.

3. Result and Discussions

3.1. Socioeconomic Characteristics of Farming Household

The study assessed the following socioeconomic characteristics assessed, sex, age, education attainment, household size and households' average annual income. The result is presented in **Table 3**. The result indicates that male accounted for the majority with 60.8% of the farming households as against female with 39.2%. This is common in Nigeria generally and Benue State in particular given that farming is largely considered as men's occupation. This result also suggests that men are dominantly the bread winners in most households which is equally consistent with the culture and traditions in the study area.

The result also shows that 41.1% of male fall within 31 - 40 years age bracket, while 63.8% of the females fall within 20 - 30 years age bracket; suggesting that more younger women are engaged in farming than their male counterpart. However, in terms of education, 67.1% of men attained tertiary education level, while only 12.8% of women attained the same level of education which clearly suggests that male has more access to higher education. The same result shows 12.8% of women had no formal education as against only 6.8% for men. More women (74.5%) stopped at secondary school level which suggests that women are usually pressured to get married after their secondary school education which explains why men have higher education than women in the study area. This finding is consistent with those of Fatimayin (2020) who reported that there is indeed, gender inequality in the Nigerian educational system usually in favour of men and boys. The author attributed the gender inequality in education to socio-cultural and religious, coupled with gender-based economic factors. Similarly, Ofoegbu (2009) reported that the literacy rate for males is higher than for females in the north due to early marriages, unbelief in western education and other religious constraints. Conversely, in the Igbo speaking states, according to Nnachi, (2010) females dominate in education and other vital sectors of

Table 3. Distribution of respondents by socioeconomic characteristics.

Variable	Male	Female
Sex	73 (60.8)	47 (39.2)
Age		
20 - 30 Years	23 (31.5)	30 (63.8)
31 - 40 Years	30 (41.1)	13 (27.7)
41 - 50 Years	13 (17.8)	4 (8.5)
Above 50 Years	7 (9.6)	-
Educational attainment		
Non-Formal	5 (6.8)	6 (12.8)
Primary	6 (8.2)	-
Secondary	8 (11.0)	35 (74.5)
Vocational	5 (6.8)	-
Tertiary	49 (67.1)	6 (12.8)
Household Size		
1 - 5 persons	31 (42.5)	33 (70.2)
6 - 10 persons	26 (35.6)	14 (29.8)
11 - 15 persons	11 (15.1)	-
16 - 20 persons	5 (6.8)	-
Annual income range		
Less than N100,000	18 (24.7)	17 (36.2)
N100,000 - N200,000	26 (35.6)	25 (53.2)
N200,001 - 300,000	16 (21.9)	3 (6.4)
Above N3000,000	13 (17.8)	2 (4.3)
Total	**73 (100)**	**47 (100)**

Source: Field Survey, 2022.

life. This is largely due to socio-economic considerations where Igbos encourages their daughters to go to school and persuaded their sons to go for trade. It should be noted that education has positive functional relationship with adaptive capacity and inversely related with vulnerability. This follows that the gender group with higher educational attainment is likely to be more resilience to climate change impact due higher access to information and better applications of such information, besides having greater access to alternative livelihood mean.

The result on households' size shows that female-headed households are less in size than male-headed households. For instance, 70.2% of female-headed households have household size ranging from 1 - 5 persons. This result could be attributed to the fact that men have greater capacity to cater for larger household size than women. Also most female household heads are either widow, divorced

or separated hence, they are constrained to maintaining smaller household size, while men have higher propensity to remarry at the event of any form of marital breakup with proportionate tendency of increasing their household sizes. Larger farming households could translate to high dependency ratio, hence could increase vulnerability by reducing the available resources for climate change adaptation. From the result therefore, male-headed households have greater burden of dependency, hence more exposed climate shocks.

The result of household income shows that 36.2% of female earn less than N100,000 annually, while only 24.7% male fall within the same income category. Similarly, 17.8% of male earn above N300,000 as against only 4.3% female in this category of income. This result then suggests that men generally earn higher than women in the study area. It should be noted that socio-economic attributes of farming households have significant implications for the extent of vulnerability to climate change impacts and risks. For instance higher income earner with small household size is likely to be less vulnerable. Based on the result presented above, male-headed households are more likely to have high adaptive capacity, hence less vulnerable than female-headed farming households. The findings are similar to those Alhassan, Kuwornu and Osei-Asare (2019). The authors reported that female-headed households were more vulnerable in terms of livelihood strategies which are a direct function of household income and diversity in livelihood options.

3.2. Nature of Household Farming Activities

The result of the nature of households' farming activities is presented in **Table 4**. The result covers years of farming experience, farm size, major crops cultivated and ownership of livestock or poultry. The result shows that male household heads generally have more years of farming experience than their female counter parts. For instance, 74.5% of female fall within 10 - 20 years of farming experience while only 53.4% of male are found this farming group. Generally the higher the farming experience, the lower the exposure and sensitivity farmers are to climate change, hence, the lower the vulnerability level. Again, men are likely less exposed and sensitive to climate change experience. This result is consistent with Ali et al. (2022) where the authors submitted the households with more year of experience are likely to be less vulnerable to flood impact. The key issue here is that length of experience of any climate-related disasters is fundamental to building resilience and to build back better and quicker.

The result also indicates that male-headed households have larger farm size than female headed households. This evident as the result shows that 20.5% of male falls within the group of farmers with above 2 hectares farm size as against 6.4% for female. At the other extreme, 42.6% female cultivate less than 1 hectare of farm land, while only 5.5% of male-headed households fall within this category. In general, male-headed households cultivated larger portion of land annually which gives them greater capacity to cater for larger household size by

Table 4. Households' farming activities.

Variable	Male	Female	Total
Years of farming experience			
10 - 20 Years	39 (53.4)	35 (74.5)	74 (61.7)
21 - 30 Years	24 (32.9)	10 (21.3)	34 (28.3)
31 - 40 Years	5 (6.8)	2 (4.3)	7 (5.8)
Above 40 Years	5 (6.8)	-	5 (4.2)
Farm Size			
Less than 1 hectare	4 (5.5)	20 (42.6)	24 (20.0)
1 - 2 hectares	54 (74.0)	24 (51.1)	78 (65.0)
Above 2 hectares	15 (20.5)	3 (6.4)	18 (15.0)
Major Crops cultivated			
Yam	13 (17.8)	2 (4.3)	15 (12.5)
Cassava	13 (17..8)	15 (31.9)	28 (23.3)
Rice	17 (23.3)	5 (10.6)	22 (18.3)
Beans	6 (8.2)	4 (8.5)	10 (8.3)
Groundnut	24 (32.9)	21 (44.7)	45 (37.5)
Do you have livestock or poultry			
Yes	41 (56.2)	22 (46.8)	63 (52.5)
No	32 (43.8)	25 (53.2)	57 (47.5)
Total	**73 (100)**	**47 (100)**	**120 (100)**

Source: Field Survey, 2022.

earning higher incomes. Conversely they are equally exposed to greater climate change and variability impact at the event of occurrence of adverse events such as flooding or prolonged dry spells (drought). Therefore the extent of vulnerability is the function of the productivity in terms of farm yield in the face of adverse climatic conditions.

The major crop cultivated by men is rice (23.3%), while 10.6% of females cultivated rice. Similarly, 17.8% if male cultivated yam, with only 4.3% of female cultivating yam. More women cultivate groundnut (44.7%) than their male counterparts (32.9%). The major crops cultivated either by male or female is a reflection of cultural norms in the study area. For instance, it is believed that yam and rice are men's crops, while cassava and groundnut should be cultivated by women. In the study area, the crops that are largely cultivated by males (yam and rice) tend to have higher economic value due to demand for those crops and cultural value attached to them. Therefore, the amount of income generated can influence the ability to adapt to climate change by farmer. In the same vein, the result indicates that 56.2% of male-headed households own livestock as against 46.8% of the female-headed households. This suggests that male-headed households diversified their income base, hence possess greater capacity to earn addi-

tional income from raising livestock. Again this result agrees with the results reported by Alhassan, Kuwornu and Osei-Asare (2019) to the effect that male-headed households are more diversified in terms of livelihood option even within agricultural sector.

3.3. Gender Dimension of Farming Households' Vulnerability to Climate Change

The study identified four (4) contributors to climate change vulnerability based on Livelihood Vulnerability Index (LVI) approach viz: exposure and sensitivity; social and human capital; financial and communication; and natural capital components/contributions. The last three components are generally referred to as adaptive capacity based on IPCC definition of vulnerability. The results of these components are presented in **Tables 5-8**.

The result shows that 80.8% of the total respondents (both male and female household heads) have had flood experience in their farm plots which suggests that flooding is common climate-change-related hazard and risk in the study area, with an average frequency of 1 - 2 times (75.3%) in a year. The flood of experience of both sexes is relatively the same with 75.3% for male and 89.4% for female headed households. The reason for this uniformity is that they both operate in the same environment, however the male experience is slightly lower probably because men have higher access to well-drained farm lands, while women are usually left with the remaining available lands. This is also reflected in their opinion on flood frequency with flood occurring twice in year over 46.8% on farm lands belonging to female-headed households compared to 28.8% in male-headed households farm lands. This can also lead to disproportionate level of vulnerability with female-headed households tending to be more vulnerable in terms of flood occurrence and its frequency. Climate-related hazards like floods constitute exposure factor to farms located in flood-prone area by limiting farm yield and in some case lead to complete destruction of such farms that are largely owner by the female-headed households as revealed by follow-up interview at the cause of conducting field survey of this study. This findings suggests that it is not enough to have equally access to land for agricultural purpose, but it is also important for women and girls to have access to fertile and well-drained in locations that are less prone to climate-induced hazards. This is similar to the finding of Madhuri, Tewari, and Bhowmick (2014) where he revealed that Gopalpur area of Bihar, India with relatively more fertile land showed comparatively lower vulnerability to climate-induced hazard.

Besides flood, persistent dry spells during farming season is one of the major extreme event affecting agriculture irrespective of gender. The result shows that 81.7% of the respondents experience persistent dry spells in recent times with adverse impact on their crops. The result is similar in terms of gender with 93.6% of female agreeing that there is persistent dry spells with attendant negative impact on crops though the result is slightly low for male-headed households with 78.1%, however the impact is the same. The result further shows that

Table 5. Farming households exposure and sensitivity to climate change.

Variable	Male	Female	Total
Flood experience			
Yes	55 (75.3)	42 (89.4)	97 (80.8)
No	18 (24.7)	5 (10.6)	23 (19.2)
Flood frequency			
No Response	2 (2.7)	2 (4.3)	4 (3.3)
At least two times in a year	21 (28.8)	22 (46.8)	43 (35.3)
Once in a year	28 (38.4)	14 (29.8)	42 (35.0)
Once in two years	3 (4.1)	-	3 (2.5)
Rarely	-	4 (8.5)	4 (3.3)
Never	19 (26.0)	5 (10.6)	24 (20.0)
Drought experience (dry spells)			
Yes	57 (78.1)	44 (93.6)	101 (81.7)
No	16 (21.9)	3 (6.4)	19 (15.8)
Drought frequency			
1 - 3 times during rainy season	44 (60.3)	26 (55.3)	70 (58.3)
4 - 6 times during rainy season	13 (17.8)	5 (10.6)	18 (15.0)
7 - 9 times during rainy season	-	4 (8.5)	4 (3.3)
Rarely	-	9 (19.1)	9 (7.5)
Never	16 (21.9)	3 (6.4)	19 (15.8)
Nature of rainfall			
Very light rains	-	2 (4.3)	2 (1.7)
Light rains	10 (13.7)	7 (14.9)	17 (14.2)
Moderate rains	50 (68.5)	33 (70.2)	83 (69.2)
Heavy/stormy rains	13 (17.8)	5 (10.6)	18 (15.0)
Excessive heat/heat Stress			
Yes	60 (82.2)	36 (76.6)	96 (80.0)
No	13 (17.8)	11 (23.4)	24 (20.0)
Frequency of heat stress			
No Response	4 (5.5)	2 (4.3)	6 (5.0)
Very often	10 (13.7)	16 (34.0)	26 (21.7)
Often	38 (52.1)	29 (61.7)	67 (55.8)
Rarely or Never	21 (28.8)	-	21 (17.5)
Physical protection from disaster			
Yes	22 (30.1)	13 (27.7)	33 (27.5)
No	51 (69.9)	34 (72.3)	85 (70.8)
Total	**73 (100)**	**47 (100)**	**120 (100)**

Source: Field Survey, 2022.

Table 6. Farming households adaptive capacity to climate change—social and human capital.

Variable	Male	Female	Total
Membership of farmers groups organization			
Yes	32 (43.8)	18 (38.3)	50 (41.7)
No	41 (56.2)	29 (61.7)	70 (58.3)
Free labour			
Yes	58 (79.5)	30 (63.8)	88 (76.3)
No	15 (20.5)	17 (36.2)	32 (23.6)
Training/Capacity Building			
Yes	27 (37.0)	6 (12.8)	33 (27.5)
No	46 (63.0)	41 (87.2)	87 (72.5)
Frequency of visit by extension works/officers			
No response	18 (24.7)	12 (25.5)	30 (25.0)
Not very often	35 (47.9)	32 (68.1)	67 (55.8)
often	8 (11.0)	3 (6.4)	11 (9.2)
Very often	12 (16.4)	-	12 (10.0)
Early disaster warning information			
Yes	40 (54.8)	29 (61.7)	69 (57.5)
No	33 (45.2)	18 (38.3)	51 (42.5)
Support from relatives			
Yes	66 (90.4)	32 (68.1)	98 (81.7)
No	7 (9.6)	15 (31.9)	22 (18.3)
Households' members health (illness) status in the last 12 months			
No Response	3 (4.1)	-	3 (2.5)
Yes	48 (65.8)	30 (63.8)	78 (65.0)
No	22 (30.1)	17 (36.2)	39 (32.5)
Total	**73 (100)**	**47 (100)**	**120 (100)**

Source: Field Survey, 2022.

Table 7. Farming households adaptive capacity to climate change—natural capital.

Variable	Male	Female	Total
Access to farm Land			
Yes	71 (97.3)	40 (85.1)	111 (92.5)
No	2 (2.7)	7 (14.9)	9 (7.5)
Size of the land you have access to			
Less than 1 hectare	11 (15.1)	11 (23.4)	22 (18.3)
1 - 2 hectare	39 (53.4)	36 (76.6)	75 (62.3)
Above 2 hectare	23 (31.5)	-	23 (19.2)

Continued

Nature of access to land			
Purchased	3 (4.1)	-	3 (2.5)
Family land	38 (52.1)	36 (76.6)	74 (61.7)
Community land	2 (2.7)	5 (10.6)	7 (5.8)
Rented	15 (20.5)	2 (4.3)	17 (14.2)
Others	15 (20.5)	4 (8.5)	19 (15.8)
Total	**73 (100)**	**47 (100)**	**120 (100)**

Source: Field Survey, 2022.

Table 8. Farming households adaptive capacity to climate change—financial and communication capitals.

Variable	Male	Female	Total
Access to Credit			
Yes	23 (31.5)	8 (17.0)	31 (25.8)
No	50 (68.5)	39 (83.0)	89 (74.2)
Household Average Annual income			
Less than N100,000	18 (24.7)	17 (36.2)	35 (29.2)
N100,000 - N200,000	26 (35.6)	25 (53.2)	51 (42.5)
N200,001 - 300,000	16 (21.9)	3 (6.4)	19 (15.8)
Above N300,000	13 (17.8)	2 (4.3)	15 (12.5)
Remittances from family or friends			
Yes	20 (27.4)	10 (21.3)	30 (23.0)
No	53 (72.6)	37 (78.7)	90 (75.0)
Access to irrigation facilities			
Yes	8 (11.0)	5 (10.6)	13 (10.8)
No	60 (82.2)	40 (85.1)	100 (83.3)
No response	5 (6.8)	2 (4.3)	7 (5.9)
Ownership of communication gadgets			
Television	3 (4.1)	-	3 (2.5)
Radio	4 (5.5)	2 (4.3)	6 (5.0)
Mobile Phone	29 (39.7)	22 (46.8)	51 (42.5)
More than one Gadget	37 (50.7)	23 (48.9)	60 (50.0)
Other economic activities			
Small scale business	14 (19.2)	5 (10.6)	19 (15.8)
Medium to large scale business	2 (2.7)	-	2 (1.7)
Civil service	16 (21.9)	3 (6.4)	19 (15.8)
Artisanship	6 (8.2)	5 (10.6)	11 (9.2)
More than one activities	35 (48.0)	34 (72.3)	69 (56.7)
Total	**73 (100)**	**47 (100)**	**120 (100)**

Source: Field Survey, 2022.

60.3% of male-headed households are of the view drought frequency is 1 - 3 during rainy season, while 55.3% hold the same view which is similar to the overall result with 58.3%. These dry spells are common in the months of June, July and August and can significantly affects crops with high water requirements, and also crops that need water on a regular basis such as maize and groundnut. Similarly, frequent heat stress is a common extreme climatic event resulting from climate change in this area. For instance, 82.2% and 78.6 of male and female headed households report heat stress on crops and it perceive to occur "often" (52.1% for male and 61.71% for female) especially in the months of April and May. From this result, those crops that are produced predominantly by female-headed household because culturally they are considered as female crops are more susceptible to the impact of climate-induced stressors. The import of this finding is that female-headed households' adaptive capacities are likely to be weakened due to higher exposure of their crops to these hazards such as prolonged dry spells during cropping season.

The nature of the rains are predominantly moderate rains as evident in the result which is reflected in the perception of the respondents - 68.5% for male, 70.2% for female and 69.2% for total respondents falling within moderate category. However, this dominantly moderate rain often results in substantial flooding due to the low lying nature of the relief. In spite of the prevalence of these climate-related hazards and risks, only 30.1% male and 27.7% of female have developed physical protection against disasters such as floods and heat stresses.

3.4. Social and Human Capital

Social and human capital help in adaptation to climate change impact by the farming households. They include membership of social organization, access to free labour, training/capacity building, access to extension workers, access to early warning information, support from the relatives and the health status of the household members. The result is presented in **Table 4** indicates that 56.2% of male household heads do not belong to any farmers or social organizations, while 61.7% of female household heads are not members of social organizations. It should be noted that social organizations provide support for their members in times of disaster which in turn build resilience and reduce vulnerability. In this study, male-headed households are slightly likely to build more resilience due to their social network than their female counterpart. In the study area, male-headed household enjoy more free labour (79.5%) than female (63.8%). This can be attributed to the cultural belief system where male command or exert greater influence on their children than women. Access to free labour tends to impact positively on the scale of production in terms of farm size, and could be the reason for male-headed households having large farm size given that both gender have relatively equally access to farm land, though men and boys have to choose first which parcel of land to farm. To this extent, men and boys are placed at the vantage position to in terms of adaptive capacity and reduced vul-

nerability.

In terms of capacity development of farming households, the result shows that there is generally low capacity build and training programmes as 63.0% and 87.2% of male and female have not been able to access training programmes on improved farming methods and system. However, the percentage of male household heads that have access to training is relatively higher with 37.0% as against 12.8% for female. The result is similar in case of access to extension workers with only 16.4% of male-headed households accessing extension services, while females are completely derived access thereby depriving them the needed knowledge on modern farming techniques and practices to mitigate climate change.

Early warning is critical to deducing damages and disaster impacts and risks. From the result, female household heads have higher access to early warning information from relevant government agency, media, friends and relatives. Overall, 57.5% of the total respondents have access to early warning information on climate related hazard such as flood and dry spells (drought).

Furthermore, the result shows that male (90.4%) have greater support base from relatives than female (68.1%). In general, 81.7% of the total respondents can access support from relatives during disaster which directly enhances their capacity to cope with climate shocks on their agricultural livelihoods.

The quality of health of house-hold member can improve the adaptive capacity of during households. Here, the result shows that 65.8% of the male-headed households reported illness of their household members in the last 12 month compared to 63.8% of female which suggests that female household boost of slightly better health status of the household members which can reduce pressure on their income.

3.5. Natural Capital

The result of the natural capital of the farming households is presented in **Table 5**. The result shows that there is generally high access to land by both sexes. However, male have relatively higher access to land (97.3%) compared to female with 85.1%. Overall access to land stood at 92.5%. Again the result shows that men can access larger expense of land compared to women. For instance, women can not access above two (2) hectares of land for farming, while 31.5% of male can access above two hectares of land. Majority of land access are family lands with 52.1% for male, 76.6% for female and 61.7% as total. Men also have greater capacity to rent land for farming thereby giving them advantage on level of access to land over female. Madhuri, Tewari, and Bhowmick, (2014) found that better access to resources does not necessarily mean that households are adopting resilience measures because of apathetic or indifferent attitudes. In the context of the study area where men take major decisions relating to resources control including access to proceeds from farms, the level of access by gender group especially women and girls can impact on the capacity to adapt.

3.6. Financial and Communication Capital

Financial and communication portfolio of the farmers is very critical for adaptation to climate shocks on agriculture. The result on this indicator is presented in Table 6. The result generally indicates poor access to credit as only 25.8% of the total farming households has access credits and most of the credit came from informal financial organisations and occasional government intervention programmes. Again, female household heads have relatively lower access to credit with only 17.0% as compared to 31.5% of male access of credit facilities for farming. According to Hahn et al. (2009) borrowing and lending money indicate the financial assistance households receive in cash and kind from their social network. Households that borrow money more than they lend are more vulnerable (Hahn et al., 2009). However, Brody, Demetriades and Esplen (2008) views suggest that access to credit for the purpose of accessing improved farm inputs and extension services can boost adaptive and resilience. In this study, access to credit is viewed from Brody, Demetriades and Esplen (2008) perspective, hence, the higher the access to credit facilities the higher the adaptive and resilience of the farming household, and in this case women and again disadvantaged which make them more vulnerable.

The result of the average annual income is similar as only 4.3% of female headed household earning above N300,000 per annum as compared to 17.8% of male. The income of the farming households in the study area is generally low with 43.5% of the total respondents earning from N100,000 and N200,000 yearly. This will no doubt limit their adaptive capacity especially the female-headed households.

Remittances from family members and friends is generally very low as only 27.4% of male and 21.3% of female receive any form of remittances to support the living condition and boost their agricultural livelihoods. Only 23.0% of the total farming household receives remittance. This trend, coupled with low income can limit the adaptive capacity of these farms to climate change irrespective of gender, though women are more negatively affected than men.

The result further shows that overwhelming majority (82.2% for man and 85.1% for female) have no access to irrigation facilities. Only a few (10.8%) both male and female) practice primitive form of irrigation just to grow vegetables during the dry early part of dry season.

The lack of irrigation here can be attributed to lack of government intervention on irrigation agriculture and the low income status of the farmers.

The result on ownership of communication gadgets shows that 50.7% of male household heads have more than one communication gadgets such as television, radio and mobile phones, while 46.8% equally have more than one communication gadgets. In the same vein, 39.7% and 46.8% of male and female have mobile phone as their major communication gadget. It is very important to note that access to communication is very important to accessing information on early warning on climate change related disasters and information on improved

farming methods and practices that would aide better adaptation and improve farm outputs. To this the level of ownership of the means of communication is a booster of adaptive, it inversely related to vulnerability.

Other economic activities engaged by farmers include small to medium scale businesses and, artisanship (crafts) among others. The result indicates that 48.0% of male household heads engage in multiple economic activities besides farming while 72.3% equally engage in multiple economic activities in addition to farming. The result suggests the women have greater capacity to engage in diverse economic activities which can boost their adaptive capacity.

The results of this study are consistent with a number of earlier studies such as Alhassan, Kuwornu and Osei-Asare, (2019); Hahn et al. (2009); Chandra, McNamara, Dargusch, Caspe, and Dalabajan (2017) and Madhuri, Tewari, and Bhowmick (2014) among others in terms of adaptive capacity and exposure levels to climate stressors, yet shade more light on some of the major drivers of vulnerability from the prism of gender using descriptive approach instead of the convention index generated from complex computations.

4. Conclusion

From the forgoing, female-headed households are more exposed to climate change hazards and risks with limited adaptive capacity given their relatively lower income and access to credit facilities as well as training/capacity building. The study therefore recommends that relevant stakeholders led by State authority should develop programme and policies to improve women access to credit facilities and relevant training to boost their adaptive capacity and build resilience. This would no doubt, limit exposure of women and girls to climate change impacts and risks with attendant reduction in vulnerability.

Acknowledgements

We thankfully acknowledge Gender and Environmental Risk Reduction Initiative (GERI) and Owo EcoGreen Life Foundation (OEGLF) for sponsoring this study as part of their contribution to building climate resilient communities. We are also grateful to the community leaders and farmers' association in Ikpayongo for their informed inputs during the field survey.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Adzawla, W., Azumah, S. B., Anani, P. Y., & Donkoh, S. A. (2019). Gender Perspectives of Climate Change Adaptation in Two Selected Districts of Ghana. *Heliyon, 5,* e02854. https://doi.org/10.1016/j.heliyon.2019.e02854

Akukwe, T. I., & Ogbodo, C. (2015). Spatial Analysis of Vulnerability to Flooding in Port

Harcourt Metropolis, Nigeria. *Sage Open, 5,* 1-19.

Alhassan, S. I., Kuwornu, J. K. M., & Osei-Asare, Y. B. (2019). Gender Dimension of Vulnerability to Climate Change and Variability Empirical Evidence of Smallholder Farming Households in Ghana. *International Journal of Climate Change Strategies and Management, 11,* 195-214. https://doi.org/10.1108/IJCCSM-10-2016-0156

Ali, P., Onah, A. M., Mage, O. J., Yiyeh, H. G., Tarzoho, P., & Iorhuna, D. (2022). Principal Component Analysis of Household Vulnerability to Flood Disaster in Makurdi Metropolis, Benue State, Nigeria. *Nigerian Annals of Pure and Applied Sciences, 5,* 39-46.

Ali, P., Onah, A., Mage, O., Yiyeh, H., Tarzoho, P., & Iorhuna, D. (2022). Principal Component Analysis of Household Vulnerability to Flood Disaster in Makurdi Metropolis, Benue State, Nigeria. *Nigerian Annals of Pure and Applied Sciences, 5,* 39-46. https://doi.org/10.5281/zenodo.7132821

Anugwa, I. Q., Obossou, E. A. R., Onyeneke, R. U., & Cha, J. M. (2023) Gender Perspectives in Vulnerability of Nigeria's Agriculture to Climate Change Impacts: A Systematic Review. *Geo Journal, 88,* 1139-1155. Https://doi.org/10.1007/s10708-022-10638-z

Brody, A., Demetriades, J., & Esplen, E, (2008). *Gender and Climate Change: Mapping the Linkage—A Scoping Study on Knowledge and Gaps.* UK Department for International Development, Institute of Development Studies (IDS).

Carr, E. R., & Thompson, M. C. (2014). Gender and Climate Change Adaptation in Agrarian Settings: Current Thinking, New Directions, and Research Frontiers. *Geography Compass, 8,* 182-197. https://doi.org/10.1111/gec3.12121

Chandra, A., McNamara, K. E., Dargusch, P., Caspe, A. M., & Dalabajan, D. (2017). Gendered Vulnerabilities of Smallholder Farmers to Climate Change in Conflict-Prone Areas: A Case Study from Mindanao, Philippines. *Journal of Rural Studies, 50,* 45-59. https://doi.org/10.1016/j.jrurstud.2016.12.011

Chinwendu, O. G., Sadiku, S. O. E., Okhimamhe, A. O., & Eichie, J. (2017) Households Vulnerability and Adaptation to Climate Variability Induced Water Stress on Downstream Kaduna River Basin. *American Journal of Climate Change, 6,* 247-267. https://doi.org/10.4236/ajcc.2017.62013

CIRDDOC Nigeria (2022). *Strenghtening Existing and Emerging Women Mobilisation Platforms and Small Holder Women Farmers' Association in Nigeria (Women Lead Agric In Nigeria).* CIRDDOC Nigeria. https://cirddoc.org/women-lead-agriculture-in-nigeria

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of Farmers' Choice of Adaptation Methods to Climate Change in the Nile Basin of Ethiopia. *Global Environmental Change, 19,* 248-255. https://doi.org/10.1016/j.gloenvcha.2009.01.002

Eastin, J. (2018). Climate Change and Gender Equality in Developing states. *World Development, 107,* 289-305. https://doi.org/10.1016/j.worlddev.2018.02.021

Fatimayin, F. (2020). *Gender Inequality in Education: Implications for National Development.* National Open University of Nigeria.

Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T. E. et al. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Summary for Policymakers. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).* Cambridge University Press.

Hahn, M. B., Riederer, A. M., & Foster, S. O. (2009). The Livelihood Vulnerability Index: A Pragmatic Approach to Assessing Risks from Climate Variability and Change—A Case Study in Mozambique. *Global Environmental Change, 19,* 74-88.

https://doi.org/10.1016/j.gloenvcha.2008.11.002

Hoque, M. Z., Cui, S., Xu, L., Islam, I., Tang, J., & Ding, S. (2019). Assessing Agricultural Livelihood Vulnerability to Climate Change in Coastal Bangladesh. *International Journal of Environmental Research and Public Health, 16,* Article No. 4552. https://doi.org/10.3390/ijerph16224552

Intergovernmental Panel on Climate Change (IPCC) (2014). Climate Change 2014 - Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (1132 p.). In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandreas, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.), Cambridge University Press.

IPCC (Intergovernmental Panel on Climate Change) (2007). *Climate Change: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press.

Knox, J., Hess, T., Daccache, A., & Wheeler, T. (2012). Climate Change Impacts on Crop Productivity in Africa and South Asia. *Environmental Research Letters, 7,* Article ID: 034032. https://doi.org/10.1088/1748-9326/7/3/034032

Madhuri, M., Tewari, H. R., & Bhowmick, P. K. (2014). Livelihood Vulnerability Index Analysis: An Approach to Study Vulnerability in the Context of Bihar. *Jàmbá: Journal of Disaster Risk Studies, 6,* a127. https://doi.org/10.4102/jamba.v6i1.127

McKune, S. L., Borresen, E. C., Young, A. G., Auria Ryley, T. D., Russo, S. L., Camara, A. D. et al. (2015). Climate Change through a Gendered Lens: Examining Livestock Holder Food Security. *Global Food Security, 6,* 1-8. https://doi.org/10.1016/j.gfs.2015.05.001

Nnachi, R. O. (2010) Gender Equity in Education: A Challenge to School System in the Igbo Speaking States of Nigeria. *Journal of the Nigerian Academy of Education, 6,* 105-115.

Nong, H. T. T., Gan, C., & Hu, B. (2022). Livelihood Vulnerability to Climate Change: A Case of Farm Households in Northeast Vietnam. *Environment, Development and Sustainability, 24,* 12059-12078. https://doi.org/10.1007/s10668-022-02201-0

Ofoegbu, I. F. (2009). Female Access to Basic Education: A case for Open Distance learning in Edo. *Journal of Counseling, 2,* 46-57. https://doi.org/10.4314/ejc.v2i1.52653

Parker, L., Bourgoin, C., Martinez-Valle, A., & Läderach, P. (2019) Vulnerability of the Agricultural Sector to Climate Change: The Development of a Pan-Tropical Climate Risk Vulnerability Assessment to Inform Sub-National Decision Making. *PLOS ONE, 14,* e0213641. https://doi.org/10.1371/journal.pone.0213641

Sahel Capital (2014). The Role of Women in Nigerian Agriculture. In *Sahel's Newsletter* (Vol. 7, 3 p.). Sahel Capital.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., Eckley, N., Kasperson, J. X., Luers, A., Martello, M. L., Polsky, C., Pulsipher, A., & Schiller, A. (2003). A Framework for Vulnerability Analysis in Sustainability Science. *Proceedings of the National Academy of Sciences of the United States of America, 100,* 8074-8079. https://doi.org/10.1073/pnas.1231335100

Tyubee, B. T. (2008). Urban Growth and Air Pollution in Makurdi, Nigeria. In *Association of Nigerian Geographers' Proceedings of the National Conference on Urbanization, Resources Exploitation and Environmental Sustainability in Nigeria* (pp. 411-426). Association of Nigerian Geographers (ANG).

UN World Water Development Report (2020). *UN World Water Development Report 2020.* UN-Water.

Venus, T. E., Bilgram, S., Sauer, J., & Khatri-Chettri, A. (2022). Livelihood Vulnerability and Climate Change: A Comparative Analysis of Smallholders in the Indo-Gangetic Plains. *Environment, Development and Sustainability, 24,* 1981-2009. https://doi.org/10.1007/s10668-021-01516-8