

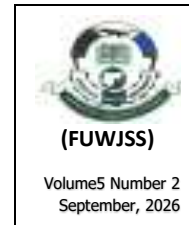
ADAPTIVE STRATEGIES OF WOMEN TO CLIMATE CHANGE IN RURAL GOMBE, NIGERIA

Danalami Arabs Rukujei

Department Of Social Standard Development
Sustainable Procurement, Environmental and Social
Standards Centre of Excellence

Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, Nigeria

Email: danlamiarabsrukujie@gmail.com



Abstract

Climate change severely disrupts rural livelihoods in northern Nigeria, compelling women farmers to diversify in response to erratic rainfall, droughts, and resource scarcity. This study investigates whether these responses represent proactive adaptive strategies or reactive distress diversification among women farmers in Billiri Local Government Area, Gombe State. A concurrent mixed-methods design was employed, integrating quantitative surveys ($n = 323$ women farmers) with qualitative focus group discussions and key informant interviews. Data were analyzed using descriptive statistics, multiple regression, and thematic analysis within the sustainable livelihood's framework. Results reveal heavy reliance on seasonally variable natural assets (91.6% well access, primarily wet-season), small and fragmented land holdings (77.4% in one location), and limited ownership rights (74.9%), despite reported equity in access (87.0%). Common responses include crop farming (89.8%) and animal rearing (49.8%), but transformative practices like agroforestry remain low (11.1%). Regression analysis confirms that natural assets significantly predict livelihood sustainability ($\beta = 0.640$, $p < 0.001$), yet cultural, financial, and environmental barriers drive distress-oriented coping rather than long-term adaptation. The study concludes that current responses are largely survival-driven, perpetuating vulnerability. Gender-transformative interventions, including secure land tenure, improved water access, and targeted climate-smart training, are recommended to foster genuine adaptive capacity and enhance resilience in rural Gombe.

Keywords: Women farmers, climate change, livelihood, land tenure, adaptive strategies

Introduction

Climate change represents one of the most pressing global challenges of the 21st century, profoundly disrupting agricultural livelihoods in sub-Saharan Africa through erratic rainfall patterns, prolonged droughts, rising temperatures, and increased frequency of extreme weather events

(Intergovernmental Panel on Climate Change [IPCC], 2022). In northern Nigeria, particularly the semi-arid northeast region, these changes exacerbate existing vulnerabilities, leading to reduced crop yields, livestock losses, water scarcity, and heightened food insecurity among rural households. Smallholder farmers face declining productivity and limited coping capacity, often compelling them to diversify livelihoods as a response mechanism (Wossen et al., 2017).

Women farmers are disproportionately affected by these pressures due to pre-existing gender inequalities that restrict their access to and control over critical natural livelihood assets such as land, water, forests, and financial resources (Food and Agriculture Organization of the United Nations [FAO], 2011). In rural Nigeria, women contribute significantly to agricultural labour, often up to 70% in some areas, yet they own or control fewer productive resources, face cultural norms limiting mobility and decision-making, and bear primary responsibility for household food security and caregiving (Agarwal, 1994). These gendered constraints amplify vulnerability and shape the nature of livelihood responses to climate stressors.

While some responses may represent proactive adaptive strategies, such as adopting climate-smart agriculture, investing in irrigation, or diversifying into sustainable non-farm activities, others manifest as distress diversification, characterized by short-term, necessity-driven shifts that offer limited long-term resilience (Bene et al., 2016). The distinction between adaptive strategies and distress diversification is critical in sociological and development studies. Adaptive strategies involve deliberate, opportunity-oriented actions that enhance capacity to anticipate, absorb, and recover from shocks while maintaining or improving livelihood sustainability (Chambers & Conway, 1992). In contrast, distress diversification reflects survival tactics under acute pressure, often eroding asset bases and perpetuating cycles of poverty rather than building resilience (Asfaw et al., 2017).

In Gombe State, northeastern Nigeria, these dynamics are particularly acute. The region experiences Sudan Savannah agro-ecology with a single rainy season (May–October) and annual rainfall of 800–1,000 mm, making agriculture highly rain-fed and vulnerable to climatic variability. Billiri Local Government Area (LGA), located between latitudes 9°41'30"N to 9°57'50"N and longitudes 11°01'00"E to 11°15'40"E, exemplifies these challenges. Women constitute a substantial portion of the farming labour force, yet their adaptive options are constrained by fragmented land holdings, poor irrigation infrastructure, and cultural restrictions on resource ownership (Udoh, Akpan & Uko, 2017).

This study addresses the gap by examining women farmers' livelihood responses to climate change pressures in Billiri LGA. Drawing on the sustainable livelihoods framework (Chambers & Conway, 1992), it assesses access to natural assets, the nature of diversification strategies, and the extent to which these responses enhance sustainability or reflect distress. The specific objectives are to: (1) identify key livelihood responses among women farmers; (2) determine whether these constitute adaptive strategies or distress diversification; (3) examine the role of natural livelihood assets in shaping responses; (4) analyze barriers and enablers; and (5) provide recommendations for gender-responsive climate adaptation policies. The study is scoped to women farmers in three wards (Tanglang, Tal, and Todi), using primary data collected in early 2025.

Climate Change, Gender and Sustainable Livelihood Systems in Rural Nigeria

Climate change is reshaping agrarian economies across sub-Saharan Africa with profound gendered consequences. Empirical evidence consistently demonstrates that women smallholder farmers bear a disproportionate burden of climate-induced livelihood shocks due to structural inequalities embedded in land tenure, extension service access, financial inclusion, and decision-making authority (FAO, 2011; Nkengla-Asi et al., 2017). The Intergovernmental Panel on Climate Change (2022) notes that the intersection of climate exposure and social vulnerability, particularly gender inequality, amplifies the risks facing rural women in semi-arid zones of the Global South.

In West and Central Africa, studies have documented how erratic rainfall, prolonged dry seasons, and land degradation force women into reactive livelihood adjustments rather than strategic adaptive investments (Bene et al., 2016). These adjustments, including petty trading, firewood collection, and casual farm labour, often reflect asset erosion rather than capability building (Ellis, 2000). Ayanlade et al. (2023), studying women farmers in Kwara and Nassarawa States, Nigeria, found that female-headed households exhibit significantly higher vulnerability indices and lower rates of climate-smart agriculture adoption compared to male-headed households, attributing this gap to tenure insecurity and limited access to climate information services. The literature further distinguishes between *ex ante* adaptive strategies, actions taken before shocks materialize, such as crop diversification, soil conservation, and early-warning system use, and *ex post* coping responses, including distress asset sales, reduced food intake, and temporary migration (Chambers & Conway, 1992; Scoones, 1998). For rural women in northern Nigeria's semi-arid zones, environmental pressures, droughts, erosion, water scarcity, intersect with customary tenure

restrictions to keep responses predominantly in the ex post, distress-driven category (Maziya, Nkonki-Mandleni, Mbizana & Tirivanhu, 2024). Addressing these dynamics requires frameworks that examine not only livelihood assets but also the structural and gendered constraints on their deployment.

The sustainable livelihoods framework (SLF), introduced by Chambers and Conway (1992), provides the foundational lens for understanding how rural households respond to shocks such as climate change. The SLF conceptualizes livelihoods as comprising five capital assets, natural (land, water), human (skills, health), social (networks, norms), financial (income, savings), and physical (infrastructure), that households draw upon to pursue strategies for survival and well-being. A livelihood is sustainable when it can cope with stresses, maintain capabilities, and avoid undermining natural resources for future generations (Chambers & Conway, 1992; Scoones, 1998). Climate change disrupts these assets, forcing diversification that can be either adaptive (proactive, transformative) or distress-driven (reactive, erosive; Bene et al., 2016). Gender plays a pivotal role in shaping these responses. Women in rural sub-Saharan Africa, including northern Nigeria, face structural inequalities that limit access to and control over natural assets, making them more vulnerable to climate impacts (Agarwal, 1994; FAO, 2011). Women often own smaller land parcels, have restricted decision-making power, and bear disproportionate care burdens, which constrain their ability to adopt long-term adaptive strategies such as climate-smart agriculture, irrigation, or diversified income streams (Ayanlade et al., 2023; Nkengla-Asi et al., 2017). Instead, many women resort to distress diversification, short-term coping mechanisms like reducing food intake, borrowing, or engaging in low-return off-farm activities, to meet immediate household needs (Asfaw et al., 2017; Ellis, 2000).

In Nigeria, empirical studies highlight these gendered patterns. In Gombe State specifically, women crop farmers engage in livelihood diversification based on income sources, often influenced by climate variability, but responses are frequently reactive rather than strategic (Tata, Abu, Garba, & Abdullahi, 2024). Factors such as limited land rights, cultural norms, and inadequate extension services push women toward distress coping rather than transformative adaptation like agroforestry or cooperative membership (Oluwatimilehin & Ayanlade, 2023; Wossen et al., 2017). The distinction between adaptive strategies and distress diversification is well-documented in African drylands (Bene et al., 2016; Ellis, 2000). In northern Nigeria's semi-arid zones like Gombe, climate pressures, droughts, erosion, seasonal water scarcity, exacerbate this, with women often prioritising immediate household food security over long-term sustainability (Maziya et al., 2024). This study bridges these gaps by examining women farmers in

Billiri LGA, Gombe State, to determine the character of their livelihood responses and the role of natural assets in shaping them.

Theoretical Framework

This study is anchored in two complementary theoretical frameworks: The Sustainable Livelihoods Framework (SLF) and Feminist Political Ecology (FPE). Together, these frameworks provide both a structural and a gendered lens through which the livelihood responses of women farmers to climate change are examined and interpreted.

The Sustainable Livelihoods Framework (SLF)

The Sustainable Livelihoods Framework, originally formulated by Chambers and Conway (1992) and later operationalized by Scoones (1998) and the United Kingdom Department for International Development (DFID, 1999), constitutes the primary analytical scaffold of this study. The SLF posits that rural households possess a portfolio of five capital assets, natural, human, social, financial, and physical, upon which they draw to construct livelihood strategies in the context of prevailing vulnerability conditions (shocks, trends, seasonality) and mediating institutional structures (policies, organisations, processes). A livelihood is deemed sustainable when it enables households to cope with and recover from stresses and shocks, maintain or enhance capabilities and assets, and provide net benefits to future generations without undermining the natural resource base (Chambers & Conway, 1992, p. 6).

In this study, the SLF is employed to assess women farmers' access to natural livelihood assets (land, water, forests) in Billiri LGA and to determine whether their livelihood responses, crop farming, animal rearing, water management, agroforestry, and off-farm diversification, represent asset-building adaptive strategies or asset-eroding distress responses (Scoones, 1998). The SLF's explicit attention to structural vulnerability and institutional mediating factors allows the study to locate women's responses within the broader political and environmental context of semi-arid northern Nigeria, moving beyond individual-level explanations to systemic analysis (DFID, 1999). The five-capital pentagon analysis employed in the results section directly operationalizes this framework.

Feminist Political Ecology, developed by Rocheleau, Thomas-Slayter, and Wangari (1996) and subsequently advanced by scholars including Agarwal (1994) and Elmhirst (2011), provides the gendered analytical lens that complements the SLF. FPE asserts that access to, control over, and knowledge of natural resources are fundamentally shaped by gender relations, arguing that political-ecological analyses must be attentive to how

gender intersects with class, ethnicity, and place in structuring environmental experiences and outcomes.

For this study, FPE is applied to explain why women farmers in Billiri LGA, despite reporting relatively equitable access to resources (87.0% in Table 3), face persistent barriers to ownership and control (74.9% report limited land ownership rights; 79.6% report cultural restrictions). FPE's distinction between access rights (the ability to use a resource) and control rights (the authority to make decisions about its use and disposition) is central to interpreting the paradox of apparent access alongside substantive exclusion documented in the findings (Agarwal, 1994; Meinzen-Dick & Mwangi, 2009). Furthermore, FPE directs attention to the gendered knowledge systems and social networks that shape which livelihood strategies are available to and adopted by women, explaining the persistently low uptake of transformative practices such as agroforestry (11.1%). The integration of SLF and FPE in a single analytical framework is methodologically coherent: SLF provides the structural mapping of livelihood assets and outcomes, while FPE unpacks the gendered power relations that mediate women's capacity to translate asset access into genuine adaptive strategies. This dual framework guided the formulation of research objectives, the design of data collection instruments, and the interpretation of both quantitative and qualitative findings throughout the study.

Research Methodology

This study adopted a concurrent mixed-methods design to capture both quantitative patterns and qualitative nuances of women farmers' livelihood responses to climate change. The approach allowed triangulation of data for robust insights (Creswell & Plano Clark, 2018). The research was conducted in Billiri Local Government Area (LGA), Gombe State, northeastern Nigeria (latitudes 9°41'30"N–9°57'50"N, longitudes 11°01'00"E–11°15'40"E). Billiri lies in the Sudan Savannah agro-ecological zone, characterized by a single rainy season (May–October), annual rainfall of 800–1,000 mm, and increasing climatic variability. Agriculture is the primary livelihood for approximately 85% of the population, with women comprising a significant portion of the labour force.

The target population comprised women engaged in farming in rural households of Billiri LGA. A multi-stage sampling technique was used: (1) purposive selection of three wards (Tanglang, Tal, Todi) to represent agro-ecological and accessibility variations; (2) systematic random sampling of 380 households from extension office lists, yielding 323 valid responses (92.1% response rate). Sample size was determined using Cochran's (1977) formula for finite populations, assuming a 95% confidence level ($Z = 1.96$),

$\pm 5\%$ margin of error, and $p = 0.5$. Qualitative components included six gender-segregated focus group discussions (FGDs; 8–12 participants each) and 12 key informant interviews (KIIs) with extension officers, community leaders, and Gombe State Ministry of Agriculture officials.

Primary data were collected February–March 2025 using structured questionnaires (administered face-to-face in Tangale/Hausa), FGD guides, and semi-structured KII protocols. The questionnaire covered socio-demographics, access to five livelihood assets, perceived climate impacts, adaptation practices, and food security (modified Household Food Insecurity Access Scale). All interactions were audio-recorded with consent and transcribed and translated into English. Quantitative data were analyzed using SPSS version 26: descriptive statistics (frequencies, percentages, means) and inferential statistics (multiple regression) to examine relationships between asset access, responses, and sustainability. A Sustainable Livelihood Index (pentagon analysis) assessed capital balances. Qualitative data underwent thematic analysis in NVivo 12 (inductive/deductive coding; intercoder agreement $\kappa = 0.82$). Quantitative and qualitative findings were integrated using a triangulation protocol. Informed consent was secured from all participants; anonymity and confidentiality were maintained throughout the research process.

Results and Discussions

The analysis uncovered notable trends regarding women farmers' access to natural resources, their engagement in various livelihood activities, and the obstacles they face. Results indicate a tendency towards distress diversification as a coping strategy, highlighting the complexities of their situation where the interplay of available resources and external barriers shapes agricultural practices and overall economic resilience.

Table 1: Socio-Demographic Characteristics of Respondents (N = 323)

Characteristic	Category	Frequency	Percentage (%)
Age	25–34 years	116	35.9
Marital Status	Married	146	45.2
	Single	150	46.4
Education Level	Secondary	105	32.5
Primary Occupation	Farming	134	41.5
Years of Residence	11–20 years	168	52.0

Source: Field survey, 2025

Table 1 presents a demographic overview of the sample, revealing a relatively young population with a moderate level of education. Farming is the primary occupation among respondents, reflecting a deep-rooted connection to the land. Many have resided in the area for over a decade, contributing to their understanding of local environmental conditions.

Table 2: Access to Natural Water Sources (Seasonal Variability)

Water Source	Access (%)	Primarily Wet Season	Year-Round Access
Wells	91.6	High	Low
Lakes/Dams	~75–80	High	Limited
Rivers/Streams	~70	Seasonal	Variable

Source: Field survey, 2025

Table 2 shows that wells serve as the primary water source (91.6% access), yet this reliance is marked by pronounced seasonality. The limited year-round access raises concern about community vulnerability during dry seasons, underscoring the need for sustainable water management practices.

Table 3: Gendered Access, Ownership, and Barriers to Natural Assets

Indicator	Percentage Agreeing (%)
Equal access to resources with men	87.0
Land in one location only	77.4
Limited land ownership rights	74.9
Cultural restrictions	79.6
Financial constraints	77.4
Reduced land access due to droughts/erosion	77.1

Source: Field survey, 2025

Table 3 reveals a striking contradiction: while 87.0% of respondents report equitable asset access, this is juxtaposed with considerable barriers including restricted ownership rights and pervasive cultural norms. Perceived access does not translate into actual ownership or control, indicating deeper systemic issues that remain unresolved (Meinzen-Dick & Mwangi, 2009).

Table 4: Common Livelihood Responses / Diversification Activities

Activity	Participation (%)	Frequency (Very Often/Often)
Crop farming	89.8	High
Water management	43.0	,
Animal rearing	49.8	Moderate
Agroforestry	11.1	Low

Source: Field survey, 2025

Table 4 illustrates the dominance of traditional activities (crop farming: 89.8%; animal rearing: 49.8%) with a notable gap in sustainable long-term practices. Agroforestry remains markedly underutilized (11.1%), indicating limited awareness of or access to resources that could enable a transition toward more resilient agricultural practices (Tata et al., 2024).

Table 5: Regression Model Summary (Predictors of Livelihood Sustainability)

Variable	β Coefficient	p-value	Interpretation
Role of Natural Assets	0.640	<0.001	Strong positive predictor
Challenges/Barriers	0.238	0.001	Significant negative influence
Model Summary	$R^2 = 0.586$	<0.001	Explains 58.6% of variance

Source: Field survey, 2025

Table 5 confirms natural assets as the most significant predictor of livelihood sustainability ($\beta = 0.640$, $p < 0.001$), accounting for 58.6% of variance. Barriers exert a significant constraining influence, underscoring that structural obstacles must be addressed alongside resource availability to achieve long-term livelihood stability.

The findings from Billiri LGA reveal that women farmers' livelihood responses to climate change are predominantly characterized by distress diversification rather than proactive adaptive strategies. High dependence on seasonally variable natural assets (91.6% well access, primarily wet-season) and small, fragmented land holdings (77.4% in one location) limit long-term resilience. While 89.8% engage in crop farming and 49.8% in animal rearing, transformative practices like agroforestry remain low (11.1%), despite 77.1% recognizing environmental degradation impacts. This pattern aligns with literature on rural Africa, where women often resort to reactive coping under gendered constraints (Asfaw et al., 2017; Bene et al., 2016).

Natural assets play a significant positive role in livelihood sustainability ($\beta = 0.640$, $p < 0.001$), explaining 58.6% of variance, yet barriers, limited ownership rights (74.9%), cultural restrictions (79.6%), and financial constraints (77.4%), push responses toward short-term survival tactics. Droughts and erosion reduce productive land access for 77.1% of respondents, forcing reliance on immediate activities like water management (43.0%) rather than investment in sustainable options. This pattern reflects distress diversification, where households spread risk under unpredictable crises but often erode their asset base rather than building long-term resilience (Allison & Horemans, 2006; Ellis, 2000).

In the Gombe State context, women crop farmers moderately diversify their livelihoods, encompassing on-farm crops and livestock, off-farm marketing and processing, and non-agricultural activities, but predominantly from necessity rather than opportunity (Tata et al., 2024). Gendered tenure insecurity and extension gaps constrain women to reactive strategies, mirroring patterns across northern Nigeria where female-headed households exhibit higher vulnerability and lower adoption of climate-smart agriculture (Ayanlade et al., 2023; Oluwatimilehin & Ayanlade, 2023).

The paradox of reported equity in access (87.0%) versus persistent barriers highlights complex customary and statutory tenure realities, where women may have use rights but lack ownership and control for long-term investments (Agarwal, 1994; Meinzen-Dick & Mwangi, 2009). This reinforces that current responses prioritize immediate household needs over transformative adaptation, perpetuating poverty cycles in semi-arid drylands (Maziya et al., 2024). Limitations include reliance on self-reported data and focus on three wards, which limits generalizability.

Conclusion and Recommendations

Women farmers in rural Billiri LGA, Gombe State, face acute climate pressures that compel livelihood responses leaning toward distress diversification, short-term, necessity-driven coping, rather than adaptive strategies that build long-term resilience. Heavy reliance on seasonal natural assets, small land holdings, and barriers such as limited rights, cultural norms, and financial exclusion result in reactive activities with low uptake of transformative practices like agroforestry. Natural assets significantly predict sustainability, yet environmental degradation and gendered constraints undermine their potential benefits. Without targeted interventions, these responses risk perpetuating vulnerability and poverty cycles. To shift toward genuine adaptation, the following gender-transformative approaches are recommended:

- Secure land tenure for women through policy reforms recognizing customary and statutory rights, enabling long-term investments such as agroforestry and irrigation.
- Improve access to year-round water via community boreholes, solar pumps, and rainwater harvesting to reduce seasonal dependency.
- Strengthen extension services with gender-sensitive training on climate-smart practices, targeting women's groups for better reach and adoption.
- Promote financial inclusion through microcredit, cooperatives, and savings schemes to overcome financial barriers and support livelihood diversification.
- Integrate gender into climate policies at state and national levels to prioritize women's roles in resilience-building.
- Support women's organizations for collective bargaining, resource access, and advocacy.

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