Climate-Smart Agriculture and Food Security at the Climate-Conflict Nexus Evidence from Conflict Displaced Communities in Cabo Delgado, Mozambique

Henry Omara[1], Mark Kiiza[2], Runyararo Munondo[3]
[1]*Department of Environmental Management, Selinus University of Science and Literature, Rome, Italy*
[2]*Associate Professor, Faculty of Social Science, Kampala University, Kampala Uganda*
[3]*Climate and Environmental Resilience Specialist, Harare, Zimbabwe*
doi.org/10.64643/IJIRTV13I1-204745-459

Abstract—**The combined effects of conflict and climate change increasingly threaten agricultural livelihoods and food security in vulnerable regions, yet evidence on the effectiveness of Climate-Smart Agriculture (CSA) in conflict-displaced settings remains limited. This study assessed the impact of CSA on food security among conflict-displaced communities in Mocímboa da Praia District, Cabo Delgado, Mozambique, a region affected by protracted insurgency, recurrent droughts, and flooding. A mixed-methodology approach was adopted and enabled collection of required data, combining household survey data from 202 households with focus group discussions, interviews, and field observations conducted across four communities. The findings indicate that CSA practices, particularly drought-tolerant cassava cultivation, short-cycle crop varieties, and mulching, contributed to improved food availability and strengthened household resilience to climate- and conflict-related shocks. However, the adoption and effectiveness of these practices were constrained by limited access to extension services, certified agricultural inputs, and institutional support. Conflict-related losses of livestock, farming tools, and other productive assets further undermined agricultural recovery and livelihood restoration. Food insecurity remained widespread, characterized by seasonal food shortages, reduced meal frequency, and low dietary diversity, with household diets heavily dependent on starchy staple crops. Female-headed households, especially widows, experienced disproportionate labour and resource constraints that heightened their vulnerability. The study concludes that CSA represents an important resilience-building strategy in conflict-affected contexts but cannot, on its own, overcome the structural barriers that perpetuate food insecurity. Strengthening agricultural extension systems, improving access to productive assets and quality inputs, promoting labour-saving CSA technologies, and integrating CSA interventions with livelihood recovery and peacebuilding initiatives are essential for enhancing food security and fostering long-term resilience among conflict-displaced populations.**

Index Terms—**Climate-Smart Agriculture, Food Security, Conflict-Displaced Communities, Resilience, Conflict-Affected Settings**

I. INTRODUCTION

Across Sub-Saharan Africa, the combined effects of climate variability, fragile governance, and protracted conflict are increasingly undermining agricultural production and food security (Akinsemolu et al., 2024). Rather than operating independently, climate and conflict shocks often interact to create a "climate conflict nexus" that intensifies livelihood vulnerability and reduces households' capacity to cope with recurrent crises. In conflict-affected regions, climate-related hazards such as droughts, floods, and erratic rainfall not only reduce agricultural productivity but also exacerbate existing socio-economic inequalities and resource pressures, thereby deepening food insecurity and displacement (Nshakira-Rukundo et al., 2026).

Mozambique's Cabo Delgado Province exemplifies this nexus. Since the outbreak of insurgency in 2017, widespread violence has resulted in large-scale population displacement, destruction of productive assets, and disruption of agricultural livelihoods (Sturridge, 2022; UNHCR, 2025). At the same time, recurrent cyclones, droughts, flooding, and rainfall variability have further weakened the predominantly

rain-fed agricultural systems on which rural households depend (Chabwera et al., 2025; Domingos & De Sousa, 2025). Consequently, internally displaced persons (IDPs), returnees, and host communities face persistent food insecurity driven by restricted access to farmland, labour shortages, disrupted markets, and declining agricultural productivity (IPC, 2024; FEWS NET, 2025). While humanitarian responses have focused largely on emergency food assistance, less attention has been given to interventions that strengthen long-term resilience in contexts characterized by recurrent and overlapping shocks (Pereira et al., 2020).

Jena et al., (2024) affirms that, Climate-Smart Agriculture (CSA) has emerged as a widely promoted approach for addressing the interrelated challenges of food insecurity, climate adaptation, and sustainable agricultural development. CSA encompasses practices such as conservation agriculture, agroforestry, improved crop varieties, and water management techniques that aim to increase productivity, enhance adaptive capacity, and contribute to environmental sustainability (Omotoso & Omotayo, 2024; Tilahun et al., 2025). In Mozambique, development and humanitarian actors, including the Food and Agriculture Organization (FAO) and the World Food Programme (WFP), have increasingly integrated CSA into recovery and resilience-building programmes (FAO, 2021; WFP, 2024). Existing studies generally report positive outcomes associated with CSA adoption, including improved yields, enhanced climate resilience, and better food security outcomes (Tilahun et al., 2023; Nshakira-Rukundo et al., 2026).

Despite these advances, important knowledge gaps remain. First, most CSA research has been conducted in relatively stable rural environments, with limited attention to conflict-displaced populations whose livelihoods are shaped by insecurity, forced migration, and asset loss. Second, existing studies frequently examine climate vulnerability and conflict separately, overlooking how their interaction influences agricultural decision-making, technology adoption, and food security outcomes (Wang et al., 2025). Third, there is limited empirical evidence on whether CSA can effectively improve food security in contexts where households face simultaneous climate and conflict-related shocks. As a result, the extent to which CSA contributes to resilience and livelihood recovery among conflict-displaced communities remains poorly understood.

This study addresses these gaps by examining the impact of CSA on food security among conflict-displaced communities in Mocímboa da Praia District, Cabo Delgado Province. Unlike previous studies that focus primarily on climatic risks or agricultural performance, this research explicitly situates CSA within the climate conflict nexus and investigates how displacement, insecurity, institutional constraints, and asset losses shape both adoption and outcomes. The study therefore contributes novel empirical evidence from one of Africa's most complex humanitarian settings, extending the CSA literature beyond stable agricultural systems and providing insights into the role of CSA under conditions of protracted conflict and climate stress (Benkeblia, 2022).

The study is informed by the Sustainable Livelihoods Framework (SLF) and the Diffusion of Innovations (DOI) Theory. The SLF provides a lens for understanding how households mobilize human, social, natural, physical, and financial capital within a vulnerability context shaped by conflict and climate shocks (Miller et al., 2025). DOI complements this perspective by explaining how the perceived characteristics of innovations, social networks, and institutional support influence CSA adoption. Together, these frameworks facilitate a comprehensive analysis of both the determinants and outcomes of CSA adoption in conflict-displaced settings.

II. METHODOLOGY

The study adopted a descriptive parallel mixed-methods approach, enabling the collection of both quantitative and qualitative data (Kiiza, 2022). This approach provided a systematic and theoretically grounded analysis of the variables under investigation (Ciccio et al., 2022). Guided by the positivist philosophical assumption, the study draws on epistemological and ontological principles that inform the research process.

A. Research Design

The study adopted a case research design that enabled in-depth understanding of the variables under investigation (Adu & Miles, 2023). Research design and the combination with mixed-methods eased the collection of both quantitative and qualitative

approaches to examine the impact of Climate-Smart Agriculture (CSA) on food security among conflict-displaced households. This design was selected to enable triangulation of findings and provide both measurable outcomes and contextual understanding of CSA adoption in a complex climate–conflict setting.

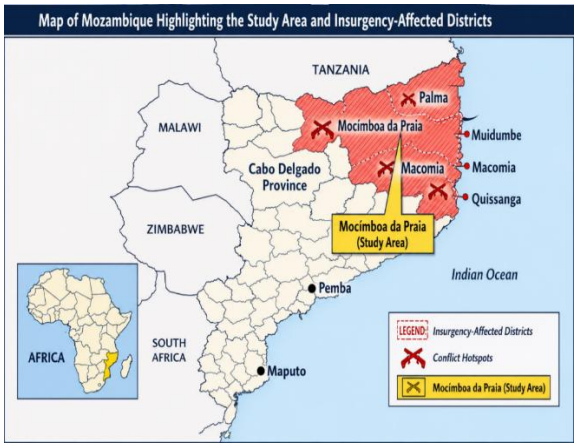
B. Study Population

The study population comprised conflict-displaced households, returnees, and host community members in Mocímboa da Praia District, Cabo Delgado Province, Mozambique (Al-Hroub et al., 2024). The district represents a climate–conflict nexus characterized by insurgency-related displacement, agricultural disruption, and recurrent climate shocks, including droughts, floods, and cyclone

C. Study Area

The study was conducted in Mocímboa da Praia District, Cabo Delgado Province, Mozambique. This location was justified by its high levels of conflict-induced displacement (Sturridge, 2022; UNHCR, 2025; ACAPS, 2023), significant climate vulnerability (including cyclones, erratic rainfall, droughts, and floods) (Chabwera et al., 2025; The IGC, 2025), and the presence of ongoing humanitarian and agricultural interventions (FEWS NET, 2025; GNAFC, 2023). Mozambique, in general, was identified as highly susceptible to climate shocks, making the study of Climate-Smart Agriculture (CSA) critical for food security in this context (MDPI, 2024). The interplay of conflict and climate shocks in Cabo Delgado created a complex humanitarian crisis, severely impacting food security and livelihoods (IECAH, 2023).

Figure 1: Map of Mozambique, highlighting the Study Area and Insurgency-Affected Districts



D. Sampling Strategy

The study adopted enabled collection of both quantitative and qualitative sampling approaches (Veridata Insights, 2026). Quantitative sampling employed a multi-stage technique stratified by displacement status and CSA adoption (Roy et al., 2025), improving representativeness and statistical power through proportional subgroup selection (Luth Research, 2026). Sample size was determined using established statistical guidelines to ensure validity and generalizability (Zrineh et al., 2026; Ali, 2026). For the qualitative aspect, purposive sampling was used to select government officials, NGO staff, and community leaders with relevant expertise and contextual knowledge (Zhang et al., 2025; Cash et al., 2022; Lokot, 2021; Onyango et al., 2025).

E. Data Collection

Data collection combined multiple methods to achieve a comprehensive understanding of the study problem (Chu et al., 2025). Quantitative data were collected through structured household surveys covering CSA adoption, food consumption, income, and assets (World Bank, 2024; CleverX, 2026). Qualitative data came from Key Informant Interviews with institutional stakeholders (Onyango et al., 2025; GeoPoll, 2024) and Focus Group Discussions exploring community experiences and coping strategies regarding CSA and food security (Hall et al., 2025; Kamalu et al., 2024). Field observations assessed farming conditions and CSA practices directly (Cash et al., 2022), while NGO reports, government statistics, and climate data supplemented primary data sources (Lim et al., 2025).

F. Data Analysis

Quantitative data were analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviations to summarize household characteristics and key variables (Schwitter, 2025). Cross-tabulations and comparative tables examined differences between CSA adopters and non-adopters in food security outcomes. Qualitative data were analyzed thematically through systematic coding of KIIs and FGDs to identify recurring patterns related to CSA adoption, resilience, and food security in conflict-displaced settings (Farias et al., 2025; MAXQDA, 2026).

G. Validity and Reliability

Credibility and trustworthiness were strengthened through methodological cross referencing using household surveys, KIIs, FGDs, and secondary data (Opdenakker & Cuijpers, 2025). Reliability was enhanced through the use of authoritative sources and knowledgeable participants (Noble & Smith, 2015; Lim et al., 2025), while transparency in data collection and analysis improved methodological rigor (Yin, 2018).

H. Ethical Considerations

Ethical standards were maintained throughout the study. Participation in surveys, KIIs, and FGDs was voluntary, and informed consent was obtained from all participants (Green, 2019). Confidentiality and anonymity were protected, and data were used strictly for academic purposes (Hwang, 2023). Academic integrity was ensured through accurate representation of participants' views and proper acknowledgment of sources (APA, 2020; Sozon et al., 2024). A conflict-sensitive approach was also adopted to minimize harm and protect participants within the fragile context of Mocímboa da Praia District (Merten & Kagee, 2013; International Alert, 2024).

III. RESULTS/FINDINGS

Table 1: Comparative Findings

Theme	FGD-Nanil	FO-Nanil	FGD-Ntende	KII-Gov	KII-NGO (Acted)	Questionnaire
CSA Adoption Practices	Use drought-resistant cassava, mulch, manual irrigation, and soil conservation.	Observed: Intercropping, compost, drought-resistant crops, and rainwater harvesting.	Use timely sowing, drought-resistant cassava, and mulching (no burning grass).	Promotes short-cycle seeds, drought-tolerant cassava/sweet potato, and row seeding.	Focus on agroecological methods (no chemicals) and manual irrigation.	94% rely on traditional knowledge; only ~4% access formal government extension.
Food Security	Scarcity Nov–Apr; diet is cassava flour and leaves; coping via meal reduction and asset sales.	Observed: Healthy crops but no harvest yet; visible dependence on distributed aid items.	Scarcity Dec–Apr; diet is dried cassava; coping via loans and migration.	Reports some yield/diversification gains in specific inland communities.	Malnutrition cases worsening; high dependence on humanitarian aid.	81.2% report shortages (peak Jan–Mar); 67.3% reduce portions; 94.6% rely on cassava.
Climate Stress	Reports erratic rainfall, droughts, and frequent crop failures.	Observed: Seasonal water shortages and significant pest/disease damage.	Soil nutrient depletion forces travel to inland areas (risking terrorist encounters).	Drought-tolerant varieties are the primary promotion for resilience.	CSA used to contribute to livelihood recovery after climate shocks.	70% of households impacted by drought; 95% report yield reduction or failure.
Conflict Impact	Asset destruction and fear of terrorists in inland forests limit movement to fertile land.	Observed: Restricted movement and partially abandoned farmland.	Land occupied by others; destruction of essential farming tools.	Communities cannot safely access the most productive inland areas.	Extremist movement leads to abandoned infrastructure and	97% are returnees who lost tools and livestock; 100% cite conflict as

					subsistence-only focus.	the primary shock.
CSA Benefits	Improved yields/availability; drought-resistant cassava survives periods of displacement.	Observed: Evidence of collective farming and local innovations in Nanil.	Increased diversification and better performance during droughts.	Notable gains in productivity and food diversity for adopting groups.	Transition from aid to local production; recovery of livelihoods after return.	Adopters report faster recovery after shocks; resistant varieties allow immediate harvest upon return.
CSA Challenges	High cost of inputs and significant knowledge/training gaps.	Observed: Very minimal/no tools available; precarious storage (open bags).	Knowledge gaps and difficulty accessing resources.	Limited resources for monitoring/follow-up; weak extension in coastal areas.	Seed quality issues; high labor burden not always compensated by income.	48.5% have no formal education; institutional collapse (only 8 access government extension).
Gender & Inclusion	Women face higher workloads as primary farmers; widows are the most vulnerable.	Observed: Active participation in collective farming efforts.	Widows are in "total dependence"; youth need awareness that agriculture has "no age".	Women are identified as the most vulnerable group in the district.	Elderly and female-headed households are the primary focus of aid.	70.3% of respondents are female; high dependency in large households (7-10 members).
Community Solutions	Need tools, training, and irrigation; joint responsibility of Gov/NGO/Community.	Observed: Use of shared resources and indigenous knowledge.	Certified seeds, technical assistance for pests, and improved market transport.	Coordination between partners and community engagement is essential.	Practical training via demonstration result fields (CDR) and community agents.	Calls for tool restoration, asset replacement, and non-written extension methods.

Source: Author's Field Survey and Questionnaire Dataset (2026)

Table 1 provides a comprehensive assessment of the research findings, integrating quantitative survey data with qualitative insights from Focus Group Discussions, Key Informant Interviews, and Field Observations. It presents a thematic analysis of CSA adoption, seasonal food scarcity, and the "Returnee-Asset Paradox" to illustrate how conflict and climate shocks intersect across the four target communities.

1. Socio-Demographic and Environmental Determinants of Livelihood

Table 2: Demographic Profile of Respondents

Category	Question / Variable	Result / Summary (Count)	Percentage (%)
Community	Where do you live?	Ntende (53), Nanduadua (51), Pamunda (50),	100%

		Nanil (48)	
Gender	Gender of Respondent	Female (142), Male (60)	70.3% 29.7%
Displacement	Residence Status	Returnee (196), Refugee (5), Recently Displaced (1)	97.0% (Returnees)
Education	Level of Education	No formal education (98), Primary (63), Secondary (29), Other (7), Adult Literacy (5)	48.5% (No School)
Household Size	Number of members	4–6 members (98), 7–10 members (72), 1–3 members (30), 11+ members (2)	48.5% (Medium)
Livelihood	Main Source	Agriculture (Solely or Mixed): 172 respondents	85.1%

Source: Author's Field Survey (2026)

A. Household Demographics and Educational Disparities

The livelihood profiles of the 202 respondents across the study area are defined by high dependency and institutional fragility. Respondents were predominantly female (70.3%), qualitative evidence also indicates many female-headed or widow-headed households, with participants reporting during FGDs "total dependence" after losing their husbands to conflict. Large families dominate Ntende, where 27 households (50.9%) support 7–10 members, while Nanil and Pamunda host households exceeding 11 members. Educational attainment is critically low: 48.5% have no formal education, and several elderly respondents (e.g., Index 70, 113) attained only the "3rd or 4th class" during the "tempo colonial". This literacy gap explains why 94% of farmers rely on traditional knowledge and collective coping strategies, while only ~4% access formal government extension. Adoption is environmentally stratified; the Government Extension Supervisor confirmed adoption is "very weak in coastal areas" like Nanil but "somewhat acceptable inland" due to resource-starved extension networks and displacement-related land loss. These socio-demographic barriers to resilience align with Synnestvedt (2025) regarding gendered food systems in northern Mozambique and are corroborated by Onyango et al. (2025) regarding demographic hurdles to smallholder CSA adoption.

Diversified Livelihoods and Economic Buffers

Table 3: Multi-Dimensional Indicators of Food Insecurity and Livelihood Stress

Indicator / Question	Response Category	Count	Percentage (%)
Food Shortages (Last 12 Months)	Yes (Moderate, Severe, or Mild)	164	81.2%
	No	38	18.8%
Reduced Meal Portions (Last 30 Days)	Yes (Frequently, Sometimes, or Rarely)	136	67.3%
	No	66	32.7%
Primary Drivers for Reduction*	Lack of Food	104	76.5%
	Lack of Money	69	50.7%
	Other (Saving/Managing Stock)	23	16.9%
Daily Meal Frequency	2 Meals (Modal Frequency)	119	58.9%
	3 Meals	63	31.2%
	1 Meal (Critical Scarcity)	19	9.4%
	>3 Meals	1	0.5%

Dietary Staple Persistence	Consumed Roots/Tubers (Cassava)	191	94.6%
Livelihood Composition	Agriculture (Sole or Mixed Source)	172	85.1%
	Non-Agricultural Only (Fishing, Trade, Aid)	30	14.9%

*Respondents could select multiple reasons; percentages for drivers are calculated out of the 136 households that reported reducing portions. (Source: Author's Field Survey 2026)

Although agriculture is a primary livelihood for 85.1% (172 respondents), households rely on fragile secondary activities to survive harvest failures. In Nanduadua, families engage in "venda de bolinhos" (selling small fried cakes/snacks), food preparation, and "compra e venda de mariscos" (buying and selling seafood/shellfish), while Ntende residents mentioned "pedreiro" (working as masons/bricklayers) and Pamunda residents reported handicrafts and selling alcohol. Despite these strategies, poverty remains severe: among the 136 households that reduced meal portions, 50.7% (69) cited a "lack of money" and 76.5% (104) cited a "lack of food" as primary reasons. Approximately 9.4% (19 households) survive on just one meal daily. Field Observations in Nanil confirmed a visible "dependence on aid" (items from distribution) and limited agricultural activity. The NGO Project Manager linked worsening malnutrition and this humanitarian dependence to conflict-related livelihood losses and the abandonment of productive inland areas. This aligns with what ACAPS (2023) found regarding how conflict in Cabo Delgado erodes agricultural assets and is corroborated by FEWS NET (2025) findings on how the nexus of climate shocks and insecurity drives persistent food crises.

B. Biological and Environmental Shocks Beyond Climate

Agricultural recovery is constrained not only by conflict, drought, and floods, but also by biological shocks. While 100% experienced conflict and 70% reported drought, respondents in Ntende and Nanil highlighted wildlife destruction of crops. One farmer stated: ""Há macacos invadindo as áreas de produção na minha machamba" (Monkeys are invading the crop production areas in my farm). Combined with "pragas" (pests) affecting crops such as rice and watermelon, these pressures contribute to the 95% rate of reduced yields or crop failure. Field Observations confirmed widespread "pest/disease damage." These findings support Sturridge (2022), who argues that insecurity in Cabo Delgado disrupts long-term agricultural recovery by preventing families from remaining on their land long enough to manage biological threats.

C. Elderly Vulnerability and Labor Constraints

The study reveals severe "dependency despair" among elderly returnees, for whom labor-intensive CSA practices are difficult to sustain. Although 97% of participants are returnees, many lost their assets during the insurgency. One elderly respondent stated: "Hunger affects us more, because at our age, we can no longer do much. We are dependent." FGDs in Ntende similarly described widows and elderly households as being in "total dependence" due to the loss of male labor. These labor shortages limit adoption of demanding CSA practices such as composting, mulching, and terracing. This supports Synnestvedt (2025), who emphasizes the role of gender and protection risks in displacement-related food systems. Field Observations further confirmed the "Physical Capital" gap, noting "very minimal/no tools" and an absence of irrigation infrastructure, leaving most households trapped in subsistence survival.

2. Climate-Smart Agriculture, Food Security, and Livelihood Resilience

A. CSA Adoption and Practices

The study reveals CSA as a critical but under-resourced survival mechanism. Adoption is fundamentally constrained by institutional breakdown: 94% of respondents rely exclusively on "Own experience/traditional knowledge", while only ~4% access formal extension services or NGO training, a gap worsened by the fact that half of the respondents have no formal education. In coastal communities (Ntende, Pamunda, Nanduadua) report "somewhat acceptable" use of timely sowing, mulching, and crop diversification, while inland community of Nanil shows "very weak" adoption. Respondents in Nanil during FGD emphasized cassava's resilience, noting that even after forced

displacement they found the crop "well developed", with field observations confirming mixed cropping, compost preparation, and rainwater harvesting structures. Government and NGO sources highlight short-cycle seeds and row seeding showing productivity gains in Ntende. However, the 67% female-headed household demographic faces severe labor constraints that hinder labor-intensive practices like organic composting or terracing.

B. Food Security Outcomes

Table 4: Food Security and Dietary Diversity (24-Hour Recall)

Category	Question / Variable	Result / Summary (Count YES)	Percentage (%)
Meal Frequency	Meals per day	2 meals (119), 3 meals (63), 1 meal (19), >3 meals (1)	58.9% (2 meals)
Coping	Reduced portions?	Yes – sometimes (84), No (66), Rarely (32), Yes – frequently (20)	67.3% (Total Yes)
Food Gaps	Shortages (12 months)	Yes – moderate (127), No (38), Yes – mild (27), Yes – severe (10)	81.2% (Total Yes)
Diversity	Roots/Tubers	Consumed: 191	94.6%
	Meat/Fish/Seafood	Consumed: 168	83.2%
	Cereals	Consumed: 156	77.2%
	Legumes	Consumed: 155	76.7%
	Oils/Fats	Consumed: 138	68.3%
	Sugar/Honey	Consumed: 100	49.5%
	Fruits	Consumed: 93	46.0%
	Vegetables	Consumed: 87	43.1%
	Eggs	Consumed: 28	13.9%
	Milk Products	Consumed: 14	6.9%

Source: Author's Field Survey (2026)

Food insecurity in the district peaks between January and March, with 81.2% (164 out of 202) of households reporting moderate to severe scarcity within the last 12 months. This "hunger gap" is community-specific, extending from November to April in Nanil and December to April in Ntende. Approximately 67.3% (136 households) resort to reducing meal portions as a coping strategy, with the vast majority citing "lack of food" and "lack of money" as the primary drivers for this reduction. Nutritional diversity remains critically low, defining a "Cassava-Starch Monoculture": while 94.6% (191 respondents) consumed roots or tubers (primarily cassava) in the 24 hours prior to the study, 86.1% (174 respondents) consumed no eggs, 56.9% (115 respondents) consumed no vegetables, and only 6.9% (14 respondents) consumed milk products. The modal meal frequency is 2 meals per day (reported by 119 households), though 9.4% (19 respondents) are restricted to just one meal.

Climate-Smart Agriculture (CSA) practices, such as drought-resistant varieties and short-cycle seeds, act as a strategic buffer. Adopters report faster recovery after shocks, noting that resistant cassava varieties can survive periods of abandonment during displacement, allowing for immediate harvest upon return. However, a significant returnee-asset paradox persists: 97% (196 out of 202) of respondents are returnees who lost essential tools, livestock, and infrastructure to the conflict. Consequently, while CSA practices improve

productivity, they currently only moderate rather than eliminate the hunger gap, leaving households to cycle through asset sales and a continued dependence on humanitarian aid.

C. Climate and Conflict Stressors

A synergistic interaction between climate variability and conflict undermines agricultural recovery. All 100% of the 202 respondents have been directly impacted by conflict, resulting in widespread "Loss of assets" and "Destruction of tools." Environmental stressors compound this: 70% reported drought and 40% reported floods as major disruptors, with many households facing a "triple burden" of conflict, climate, and biological stressors including "Pragas/doenças agrícolas" (pests/diseases) and invasions by "macacos" (monkeys) in Ntende and Nanil. The cumulative result is a 95% reported rate of reduced crop yields or total crop failure. In Nanil, during FGD, it was reported that erratic rainfall has rendered traditional planting windows unreliable while in Ntende, soil impoverishment forces families into "dangerous zones" near insurgent activity. This "fertility-security trade-off" restricts households to impoverished soils near their homes, resulting in persistently low productivity.

D. CSA Benefits and Challenges

CSA practices are perceived as beneficial, though impact is typically rated "Moderate" or a "Slight improvement" rather than transformative. In Nanil, drought-resistant cassava provided a critical survival buffer, with returnees finding the crop "well developed" after months of forced absence as reported during FGD, while in Ntende short-cycle seeds enabled faster post-shock recovery. Yet for many, these practices deliver only a "Minimal effect" against recent shocks. Structural barriers persist:

- The Labor-Gender Gap: 67% of households are female-headed, predominantly widows, facing severe labor shortages that make mulching, terracing, and organic composting unsustainable.
- The Education Barrier: More than 48.5% of household heads have no formal education and another 30% reached only primary school, making written agricultural instructions largely inaccessible.
- Institutional Breakdown: 94% rely solely on "Own experience/traditional knowledge," with formal extension access at critically low ~4%.
- Asset Depletion: The 97% returnee population remains trapped by "Lack of agricultural inputs (seeds, tools)" and "High cost of inputs", the top challenges identified in the questionnaire.

These findings confirm that without addressing labor constraints of conflict widows and the near-total lack of certified seeds and tools, CSA benefits will remain structurally limited.

E. Gender and Social Inclusion

Gender-based vulnerability is a defining characteristic of the study area, with 67% of the 202 households (~135 respondents) identified as female-headed. In Ntende, a high concentration of widows whose husbands were killed during the insurgency leaves these households in "total dependence," facing both heavy childcare workloads and labor shortages that prevent adoption of physically demanding CSA practices like terracing or intensive mulching. The "fertility-security trade-off" further forces women to farm on impoverished soils near their homes rather than risk movement into fertile but "dangerous zones," resulting in low yields regardless of CSA adoption. Youth engagement is similarly constrained, with FGDs in Ntende highlighting migration and a lack of agricultural awareness programs as primary reasons for declining participation. Gender and protection risk thus function as primary barriers to agricultural resilience, not merely social concerns.

F. Community Solutions and Recommendations

Across the study area, local agencies remain a survival foundation. FGDs in Nanil and Ntende emphasized mutual assistance, collective farming, and crop diversification, focusing on drought-resistant cassava and sweet potato, as core buffers against shocks. Field observations confirmed local innovations including composting and rainwater harvesting structures, though these remain small-scale and lack formal support. Institutional actors advocate for a coordinated Government-NGO-Community mechanism to bridge humanitarian relief and long-term resilience. Given that over 48.5% of household heads have no formal education, informants stressed visual and oral extension methods, demonstration plots and farmer field schools over written protocols. Critical

recommendations include restoring agricultural assets (certified seeds and tools) to break the "returnee-asset paradox" and developing low-labor CSA technologies tailored to the labor constraints of the region's high population of widow-headed households.

G. Association between CSA Adoption and Food Security Outcomes

The study demonstrates a positive but moderated association between CSA adoption and food security outcomes among the 202 respondents in Mocímboa da Praia District. While adoption directly contributes to food availability and dietary diversity, corroborating Tilahun et al. (2023), this relationship is fundamentally constrained by the "climate-conflict nexus," with 95% of households reporting reduced crop yields or total crop failure and 100% identifying conflict as the primary disruptor.

- Nanil (48 respondents): Adoption is "very weak," with only 4% accessing formal extension services. Households adopting drought-resistant crops reported during FGD improved resilience; cassava acted as a strategic buffer, with returnees noting "even after displacement and return, we found the crop well developed". Despite this, the scarcity period remains the longest — November to April, due to reliance on manual irrigation and limited infrastructure.
- Ntende (53 respondents): Participants emphasized crop diversification and mulching to reduce drought risk, which affected 70% of the total sample. Though inland adoption rates were "somewhat acceptable," food security remains precarious: ~67% of households are female-headed, many widows in "total dependence," whose labor shortages moderate CSA benefits, with ~90% still reducing meal portions during the December–April scarcity period.
- Pamunda (50 respondents): Adoption improves food availability but not utilization or stability. Food scarcity peaks between January and March; while 94.6% consumed roots/tubers (cassava), meat and dairy were nearly absent and 86.1% reported consuming no eggs in the preceding 24 hours.
- Nanduadua (51 respondents): Consistent intercropping and drought-resistant crop use is undermined by the "returnee-asset paradox": although 97% (196 of 202) are returnees, destruction of tools and seeds during conflict prevents effective farming, confirming Pereira et al. (2020) that immediate humanitarian needs overshadow long-term resilience-building.

Institutional perspectives reinforce these findings: the government supervisor recorded "good results in productivity and food diversification" where row seeding was adopted, while NGOs observed "improvements in food availability" through agroecological methods. However, with 94% of farmers relying solely on traditional knowledge and near-total collapse of formal support networks, CSA impact remains localized rather than systemic. Consistent with Nshakira-Rukundo et al. (2026), CSA buffers households against shocks but its effectiveness is non-linear, contingent on location, household labor capacity, and restoration of physical assets.

IV. RESILIENCE IMPLICATIONS FOR CONFLICT-DISPLACED AGRIFOOD SYSTEMS

Beyond its contribution to food production, the findings suggest that Climate-Smart Agriculture (CSA) plays an important role in strengthening resilience within conflict-displaced agrifood systems. The study demonstrates that resilience is not a single outcome but a combination of capacities that enable households to cope with, adjust to, and recover from interacting climate and conflict-related shocks.

The evidence suggests that certain CSA practices, particularly drought-tolerant cassava and short-cycle crop varieties, strengthen absorptive capacity by enabling households to maintain minimum levels of food availability during periods of displacement, climatic stress, and livelihood disruption. However, the persistence of seasonal hunger, limited dietary diversity, and continued dependence on humanitarian assistance indicate that absorptive capacity alone is insufficient to achieve sustainable food security.

The findings further suggest that adaptive capacity remains constrained by structural factors that extend beyond agricultural practices themselves. Limited access to extension services, low literacy levels, inadequate access to quality inputs, and conflict-related loss of productive assets reduce the ability of households to fully benefit from CSA interventions. These constraints are particularly evident among

female-headed households, where labour shortages further limit adoption of labor-intensive practices.

Most importantly, the study highlights the importance of transformative resilience. The returnee-asset paradox demonstrates that physical return to communities does not automatically restore productive capacity, livelihoods, or food security. Strengthening resilience in such contexts therefore requires investments not only in CSA technologies, but also in asset restoration, climate information services, institutional strengthening, inclusive extension systems, and livelihood diversification. These findings reinforce the view that resilience-building within the climate-conflict-food security nexus requires integrated humanitarian, development, and peace-oriented approaches that address the underlying drivers of vulnerability.

V. NEW KNOWLEDGE CONTRIBUTIONS

This study advances the understanding of Climate-Smart Agriculture (CSA) in conflict zones by identifying its role as a displacement buffer rather than just a tool for yield enhancement. Unlike research in stable environments, these findings reveal that drought-resistant cassava and short-cycle seeds provide a critical safety net because they remain viable during periods of abandonment, allowing returnees to harvest immediately upon their return. However, the study establishes a returnee-asset paradox, where 97% of households have returned to their communities but remain trapped in food insecurity because physical return does not equal the restoration of productive capacity without the tools, livestock, and land access lost during the insurgency.

Furthermore, the research identifies food insecurity in Cabo Delgado as a gendered labor crisis, noting that the high labor requirements of agroecological CSA practices create an unsustainable burden for the 70.3% of respondents who are female household heads, many of whom are widows, which qualitative data identify as particularly exposed to labor constraints. It also provides specific evidence of a localized institutional collapse, where a high illiteracy rate and a near-total absence of formal extension services, particularly in coastal villages, force 94% of farmers to rely exclusively on traditional knowledge. These insights shift the policy focus from mere input distribution to the necessity of asset restoration and non-written knowledge transfer within the humanitarian-development-peace nexus.

VI. DISCUSSION

The findings reveal CSA adoption as a critical but severely constrained survival strategy. With 97% of the 202 respondents identifying as returnees, the data illustrates a population rebuilding livelihoods amid near-total institutional collapse, where only 4% access formal extension services, leaving 94% dependent on traditional knowledge.

Households face a "triple burden" of shocks: 100% of respondents experienced conflict/violence, while 70% reported drought and 40% reported floods in the last three years, compounded by "Pragas/doenças agrícolas" (crop pests/diseases) and qualitative reports from Ntende and Nanil of crop destruction by "macacos" (monkeys). This convergence resulted in a 95% reported rate of reduced crop yields or total failure, rendering traditional farming windows unreliable.

While 94.6% of households consumed roots/tubers (primarily cassava) and 77.2% consumed cereals, nutritional diversity remains critically deficient with 56.9% consumed no vegetables, 86.1% had no eggs, and 93.1% didn’t consumed milk or dairy products in the preceding 24 hours. This "Cassava-Starch Monoculture" is driven by necessity, returnees in Nanil noted cassava survives without care during displacement, yet it does not bridge the "hunger gap," which peaks January–March. Scarcity extends November–April in Nanil and December–April in Ntende, forcing 67.3% of households to reduce meal portions, with 9.4% surviving on one meal per day and 58.9% consuming two.

A defining finding is that physical return does not equate to restoration of agricultural capacity. Though 97% (196 of 202) respondents are returnees, they return to "total dependence," with conflict directly resulting in 95% reporting reduced yields due to "destruction of tools" and "loss of assets." Many report "Não tenho machamba" (I don't have farmland) or being "sem terras" (without land) as fertile ancestral fields become "dangerous zones." One Ntende respondent summarized: "Jã não tenho machamba, perdí depois de retornar do conflito" (I no longer have a farmland, I lost it after returning following the conflict). Households are thus forced onto

impoverished coastal soils where, as NGO project managers noted, even improved seeds fail where soil fertility is low and security constraints prevent access to more productive areas.

CSA effectiveness is further filtered through a severe gendered labor crisis, with 67% of households (~135 of 202) female-headed, heavily concentrated with widows whose husbands were killed during the insurgency. These households face a "labor-intensity barrier" where demanding practices like terracing and organic composting are abandoned. As Ntende participants explained during FGD: "Not all women can adopt CSA because they have many responsibilities, others are widows because their husbands lost their lives due to insurgency and they are in total dependence". This labor shortage directly impacts food utilization: while 94.6% consumed roots/tubers in the preceding 24 hours, 86.1% consumed no eggs and 93.1% doesn't consumed milk or dairy products, as the loss of male labor correlates with loss of livestock and the capital to replace them.

VII. STUDY LIMITATIONS

This study provides important insights into the role of Climate-Smart Agriculture (CSA) in supporting food security and resilience among conflict-displaced communities in Mocímboa da Praia District. However, several limitations should be considered when interpreting the findings.

First, the study employed a cross-sectional research design, capturing household experiences and perceptions at a single point in time. While this approach enabled the identification of important associations between CSA adoption and food security outcomes, it does not allow for definitive conclusions regarding causality or the long-term impacts of CSA interventions.

Second, some findings relied on respondents' recall of past experiences related to food shortages, climate shocks, displacement, and agricultural performance. As with many household surveys conducted in humanitarian settings, recall bias may have influenced the accuracy of some responses, particularly where respondents were asked to reflect on events occurring over extended periods.

Third, the study was conducted within a complex conflict-affected environment where security considerations influenced access to certain locations and populations. Although efforts were made to ensure representation across the selected communities, some of the most insecure or inaccessible areas could not be reached, potentially limiting the extent to which the findings capture the full diversity of experiences across Mocímboa da Praia District.

Furthermore, the study focused on a specific geographical and socio-political context characterized by protracted conflict, displacement, and climate-related shocks. Consequently, while the findings offer valuable lessons for similar fragile and conflict-affected settings, they may not be directly generalizable to more stable agricultural systems or other regions with different institutional and environmental conditions.

Despite these limitations, the use of a mixed-methods approach combining household surveys, focus group discussions, key informant interviews, and field observations strengthened the credibility of the findings through methodological triangulation. The study therefore provides a robust evidence base for understanding how interacting climate and conflict risks influence agricultural recovery pathways, adaptive capacity, and food security outcomes, while highlighting the opportunities and constraints associated with resilience-building in fragile and conflict-affected contexts.

VIII. CONCLUSION

The findings indicate that Climate-Smart Agriculture (CSA) in Mocímboa da Praia functions primarily as a constrained survival strategy rather than a pathway to sustainable food security. With 97% of the 202 respondents identified as returnees, households are rebuilding livelihoods in a context of near-total institutional fragility, where only 4% access formal extension services and the vast majority rely on traditional knowledge systems.

Households face a "triple burden" of shocks: universal exposure to conflict and violence (100%), alongside drought (70%) and floods (40%) over the past three years. These stresses are compounded by agricultural pests and wildlife crop destruction, as reported in Ntende and Nanil. The convergence of these shocks has resulted in widespread agricultural collapse, with

95% of households reporting reduced yields or total crop failure, undermining the reliability of established farming cycles.

Food consumption patterns reflect severe nutritional deprivation and high dependence on staple crops. While 94.6% of households consumed roots and tubers (primarily cassava) and 77.2% consumed cereals, dietary diversity is critically limited: 56.9% reported no vegetable intake, 86.1% no egg consumption, and only 11% access to milk or dairy products in the preceding 24 hours. This reflects a "cassava-starch monoculture" shaped by necessity, as cassava remains the most resilient crop during displacement. However, it is insufficient to bridge the seasonal "hunger gap," which peaks between January and March and extends for up to six months in some areas. Consequently, 90% of households reduce meal portions, with 16% surviving on one meal per day.

A key finding is that physical return does not translate into restored productive capacity. Despite high return rates, 95% of households report reduced yields due to loss of tools, livestock, and access to fertile land, which is often abandoned or rendered insecure. Many households describe being "without fields" or "without land," with production shifting to degraded coastal soils where even improved seeds perform poorly under conditions of low fertility and persistent insecurity.

These constraints are intensified by a pronounced gendered labor burden. With approximately 67% of households' female-headed many led by widows, labor-intensive CSA practices such as terracing, composting, and diversified cropping are often unfeasible. The loss of male labor further reduces livestock ownership and household capital, reinforcing low dietary diversity and limited access to animal-source foods.

Overall, CSA in the district operates as a "displacement buffer" that mitigates crisis but does not transform underlying vulnerability. While drought-tolerant and short-cycle crops provide essential coping mechanisms, their effectiveness is constrained by what can be termed a "returnee–asset paradox": although populations have returned, productive assets, fertile land access, and livestock systems remain largely destroyed.

The district remains locked in a structurally fragile food system dominated by cassava and cereals, with minimal dietary diversification and persistent seasonal hunger. This situation is exacerbated by weak institutional capacity, as diffusion of agricultural innovations is constrained by high illiteracy and limited extension reach, with only a small minority of households accessing formal advisory services.

Ultimately, food insecurity in Mocímboa da Praia is shaped by the intersection of conflict-driven asset loss and gendered labor constraints. Addressing it requires moving beyond a short-term humanitarian equilibrium toward an integrated humanitarian–development–peace approach that prioritizes restoration of productive assets (tools, livestock, and land access), strengthened non-written extension systems, and complementary livelihood diversification, including climate-resilient fisheries. Without resolving the structural losses caused by conflict, CSA will remain a coping mechanism that moderates crisis rather than a pathway to food sovereignty.

IX. RECOMMENDATIONS

The study demonstrates that Climate-Smart Agriculture (CSA) serves as an important resilience-building and livelihood recovery strategy within conflict-displaced communities. However, the findings also reveal that food insecurity is driven by a complex interaction of climate risks, conflict-related asset loss, institutional weaknesses, and social vulnerabilities that cannot be addressed through agricultural interventions alone. Strengthening resilience within the climate-conflict-food security nexus therefore requires coordinated investments in productive assets, agricultural services, climate information systems, livelihood diversification, and inclusive institutional support mechanisms. The following recommendations are proposed to support both immediate recovery and longer-term resilience-building in Mocímboa da Praia District.

1) Restore Productive Assets and Livelihood Capacity

The findings demonstrate that food insecurity in Mocímboa da Praia is strongly influenced by conflict-related losses of agricultural assets, including tools, livestock, seeds, and access to productive land. Government institutions, humanitarian agencies, and development partners should prioritize the restoration of productive assets as a foundation for agricultural recovery. Interventions should include the provision of certified seeds, farming tools, livestock restocking

programmes, and support for the rehabilitation of productive farmland. Addressing the returnee-asset paradox is essential for enabling households to move beyond subsistence coping strategies and re-establish sustainable livelihoods.

2) Strengthen Agricultural Extension and Community-Based Learning Systems

The study revealed extremely limited access to formal agricultural extension services, with most households relying on traditional knowledge despite rapidly changing climatic and security conditions. Strengthening extension systems should therefore be prioritized through increased deployment of trained extension personnel, improved logistical support, and stronger collaboration between government and development partners. Given the high levels of illiteracy among farming households, extension approaches should emphasize Farmer Field Schools, demonstration plots, peer-to-peer learning, and locally appropriate visual and participatory training methods that promote practical learning and sustained adoption of Climate-Smart Agriculture (CSA) practices.

3) Strengthen Climate Information Services and Anticipatory Action Mechanisms

The increasing frequency of droughts, floods, erratic rainfall, and other climate-related shocks highlights the need for improved access to climate and weather information. Government agencies and development partners should invest in community-based climate information services, seasonal forecasting systems, and locally accessible early warning mechanisms. Integrating climate information with agricultural advisory services can support more informed decisions regarding planting dates, crop selection, and risk management. In addition, anticipatory action mechanisms should be strengthened to enable households and institutions to take early measures before forecasted shocks occur, thereby reducing losses and protecting livelihoods.

4) Promote Gender-Responsive and Labour-Sensitive CSA Interventions

The study highlights the disproportionate burden faced by female-headed households, particularly widows, who often experience labour shortages and limited access to productive resources. CSA interventions should therefore be designed with greater attention to gender and labour constraints. This includes promoting labour-saving technologies, supporting collective farming arrangements, strengthening women's access to land, inputs, financial services, and training opportunities, and ensuring that agricultural recovery programmes actively address barriers faced by women and youth. Such measures are essential for improving both adoption and effectiveness of CSA practices.

5) Support Livelihood Diversification and Household Resilience

While agriculture remains the primary livelihood source, households increasingly depend on informal trade, fishing, casual labour, and other supplementary activities to cope with recurrent shocks. Development partners and local authorities should support diversified livelihood opportunities that reduce dependence on a narrow range of climate-sensitive agricultural activities. This may include strengthening climate-resilient fisheries, small enterprise development, vocational skills training, savings and credit groups, and market-oriented value chain initiatives that enhance household income stability and adaptive capacity.

6) Improve Access to Agricultural Finance and Recovery Support

Limited financial resources continue to constrain investment in productive assets and adoption of improved agricultural practices. Expanding access to financial services through savings and credit associations, revolving funds, input voucher schemes, microfinance initiatives, and climate-risk financing mechanisms can help households recover from conflict-related losses and invest in resilient livelihood systems. Financial inclusion programmes should particularly target vulnerable groups, including female-headed households, returnees, and resource-poor farmers.

7) Strengthen Integrated Resilience Programming within the Climate-Conflict-Food Security Nexus

The findings demonstrate that food insecurity in Mocímboa da Praia cannot be addressed through agricultural interventions alone. Effective resilience-building requires integrated approaches that simultaneously address climate risks, conflict-related vulnerabilities, institutional weaknesses, and

livelihood recovery needs. Government agencies, humanitarian actors, and development partners should strengthen coordination mechanisms that bridge humanitarian response, development programming, and peacebuilding efforts. Such integrated approaches are essential for addressing the structural drivers of vulnerability and supporting long-term food security and resilience in conflict-affected communities.

ACKNOWLEDGEMENTS

The author expresses appreciation to the Johanniter staff in Mocimboa da Paria for their support during data collection of the study. The author is deeply thankful to all participants who voluntarily took part in the study and contributed to its successful completion.

REFERENCES

[1] ACAPS. (2023). Mozambique: Impact of the five-year conflict in Cabo Delgado. https://www.acaps.org/fileadmin/Data_Product/Main_media/20230707_ACAPS_Thematic_report_Mozambique_impact_of_the_five-year_conflict_in_Cabo_Delgado.pdf

[2] Adu, P., & Miles, D. A. (2023). Dissertation Research Methods: A Step-by-Step Guide to Writing Up Your Research in the Social Sciences. Taylor & Francis.

[3] Akinsemolu, A. A., Onyeaka, H. N., & Tamasiga, P. (2024). Climate-smart agriculture as a possible solution to mitigate climate change impact on food security in Sub-Saharan Africa. Food and Energy Security, 13(1), e509. https://doi.org/10.1002/fes3.509

[4] Al-Hroub, A., Reis, S., Madaus, J., & Shuayb, I. (2024). Serving Vulnerable and Marginalized Populations in Social and Educational Contexts. Frontiers Media SA.

[5] Ali, Faizan. (2026). Sample size practices and guidelines in services marketing research. Journal of Services Marketing, 40(1), 1-15. https://doi.org/10.1080/02642069.2026.2612706

[6] APA. (2020). Publication manual of the American Psychological Association (7th ed.). American Psychological Association.

[7] Ayodeji, I. O. (2025). Assessing CAADP's role in food security: strategies for the climate-conflict stricken Sahel. Discover Sustainability, 6, 723. https://doi.org/10.1007/s43621-025-01355-x

[8] Benkeblia, N. (2022). Climate Change and Agriculture: Perspectives, Sustainability and Resilience. John Wiley & Sons.

[9] Brzoska, M. (2018). Weather extremes, disasters, and collective violence: Conditions, mechanisms, and disaster-related policies in recent research. Current Climate Change Reports, 4(4), 320–329. https://doi.org/10.1007/s40641-018-0117-y

[10] Cash, P., Stanković, T., & Štorga, M. (2022). Sampling in design research: Eight key considerations. Design Studies, 78, 101077. https://doi.org/10.1016/j.destud.2021.101077

[11] Chabwera, N., Makuwira, A., & Manda, M. (2025). Climate risk country profile: Mozambique. World Bank Group. https://climateknowledgeportal.worldbank.org/sites/default/files/country-profiles/17258-WB_Mozambique%20Country%20Profile-WEB.pdf

[12] Chu, H., Liu, Y., Wang, Y., Tian, M., Yang, Z., Zeng, L., Li, N., Wu, Y., Zhao, Y., Chi, C., Chen, Y., & Zhan, S. (2025). Mixed methods research in general practice: Key points of design and implementation and case analysis. Chinese General Practice Journal, 2(3), 100070. https://doi.org/10.1016/j.cgpj.2025.100070

[13] Ciccio, C. D., Dijkman, R., Ortega, A. del R., & Rinderle-Ma, S. (2022). Business Process Management: 20th International Conference, BPM 2022, Münster, Germany, September 11–16, 2022, Proceedings. Springer Nature.

[14] CleverX. (2026). How to Calculate Research Sample Size: A Practical Guide for User and Market Research. https://cleverx.com/blog/how-to-calculate-research-sample-size-a-practical-guide-for-user-and-market-research/

[15] Domingos, D. A., & De Sousa, L. S. (2025). Climate change and food insecurity in Mozambique: A review on the effects of climate events on agricultural practices, production models and food availability. International Journal of Food Science and Nutrition, 10(2), 71–77. https://www.foodsciencejournal.com/assets/archives/2025/vol10issue2/10031.pdf

[16] FAO. (2021). Northern Mozambique crisis: Agriculture and food security response plan

2021–2023. https://openknowledge.fao.org/handle/20.500.14283/cb4873en

[17] FAO. (2022). The state of food security and nutrition in the world 2022. Food and Agriculture Organization of the United Nations.

[18] Farias, J. P., Silva, R. M., & Santos, L. C. (2025). Mastering thematic analysis: A step-by-step guide for beginners. International Journal of Qualitative Methods, 24, 1-12. https://doi.org/10.1177/16094069251384401

[19] FEWS NET. (2025). Mozambique food security outlook update: Crisis outcomes expected from climate and conflict. https://fews.net/southern-africa/mozambique/food-security-outlook-update/august-2025

[20] GeoPoll. (2024). Key Informant Interviews: An In-Depth Guide for Researchers. https://www.geopoll.com/blog/key-informant-interviews/

[21] GNAFC. (2023). Global Report on Food Crises 2023. https://www.fightfoodcrises.net/publication/global-report-on-food-crises-2023

[22] Green, R. M. (2019). Ethical considerations. In Principles of Regenerative Medicine (pp. 119-130). Elsevier. https://doi.org/10.1016/B978-0-12-809880-6.00076-X

[23] Hailu, A. A., Thornhill, S., & Lahiff, E. (2025). Household food insecurity and women's dietary diversity in Seqota Declaration pilot woredas across the Tekeze River Basin of Amhara and Tigray Regions. Food Science & Nutrition, 13(7). https://doi.org/10.1002/fsn3.70633

[24] Hall, J., Ainamani, H. E., Vassiliou, P. T. B., Döring, S., Gredebäck, G., Peltonen, K., Scharpf, F., Sen, U., Sutter, M., Walsh, J. I., & Hecker, T. (2025). Combining mental health and climate-smart agricultural interventions to improve food security in humanitarian settings: Study protocol for the THRIVE cluster-randomized controlled trial with mothers in Nakivale refugee settlement, Uganda. Trials, 26, 243. https://doi.org/10.1186/s13063-025-09042-y

[25] Hwang, H. J. (2023). The importance of anonymity and confidentiality for conducting survey research. Journal of Research and Publication Ethics, 3(1), 1-8. https://www.koreascience.or.kr/article/JAKO202311663080074.pdf

[26] IECAH. (2023). Crisis in northern Mozambique: Cabo Delgado exhausted after 5 years of conflict. Instituto de Estudios sobre Conflictos y Acción Humanitaria. https://iecah.org/en/crisis-in-northern-mozambique-cabo-delgado-exhausted-after-5-years-of-conflict/

[27] International Alert. (2004). Conflict-sensitive approaches to development, humanitarian assistance and peacebuilding: A resource pack. https://www.international-alert.org/publications/conflict-sensitive-approaches-development-humanitarian-assistance-and-peacebuilding/

[28] IPC. (2024). Mozambique: Acute food insecurity situation. Integrated Food Security Phase Classification. https://www.ipcinfo.org/

[29] Jena, P. R., Managi, S., & Majhi, R. (2024). Natural Capital and Climate Smart Agriculture: Measuring Progress towards Sustainability and Policy Making in India. Taylor & Francis.

[30] Kamalu, I., Niyomwungere, F., & Etikan, İ. (2024). A comprehensive analysis of cluster sampling versus multi-stage sampling techniques: Methodologies, applications, and comparative insights. Pioneer Journal of Biostatistics and Medical Research, 2(1), 21–30. https://doi.org/10.61171/v02.01.52

[31] Kiiza, M. (2022.). Modern research methodology handbook for junior scientists made simple: An exciting discipline for graduates.

[32] Lim, W. M., Rasul, T., & Saridakis, G. (2025). What is qualitative research? An overview and guidelines. Australasian Marketing Journal, 33(1), 1-15. https://doi.org/10.1177/14413582241264619

[33] Lohr, S. L. (2022). Sampling: Design and analysis (3rd ed.). Chapman and Hall/CRC.

[34] Lokot, M. (2021). Whose voices? Whose knowledge? A feminist analysis of the value of key informant interviews. International Journal of Qualitative Methods, 20, 1-10. https://doi.org/10.1177/1609406920948775

[35] Luth Research. (2026). Why Use Multi-Stage Sampling for National Studies. https://luthresearch.com/glossary/why-use-multi-stage-sampling-for-national-studies/

[36] MAXQDA. (2026). Thematic Analysis (2026): Step-by-Step Guide. https://www.maxqda.com/research-guides/thematic-analysis

[37] MDPI. (2024). Using Household Dietary Diversity Score and Spatial Visualization to Inform Food Governance in Chile. https://www.mdpi.com/2072-6643/16/17/2937

[38] Merten, S., & Kagee, A. (2013). Research ethics in conflict settings: Challenges and recommendations. Journal of Empirical Research on Human Research Ethics, 8(4), 1-12. https://doi.org/10.1525/jer.2013.8.4.1

[39] Miller, F., Shrestha, K. K., & Wright, S. (2025). Handbook on Climate Change Vulnerability, Environments and Communities. Edward Elgar Publishing.

[40] Natarajan, N., & O'Connell, L. (2022). A sustainable livelihoods framework for the 21st century. World Development, 155, 105898. https://doi.org/10.1016/j.worlddev.2022.105898

[41] Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. Evidence-Based Nursing, 18(2), 34–35. https://doi.org/10.1136/eb-2015-102054

[42] Nshakira-Rukundo, E., Tabe-Ojong, M. P. J., Gebrekidan, B. H., Agaba, M., Surendran-Padmaja, S., & Dhehibi, B. (2026). Adoption of climate-smart agricultural technologies and practices in fragile and conflict-affected settings. Communications Earth & Environment, 7(1), 304. https://doi.org/10.1038/s43247-025-03171-7

[43] OCHA. (2025). Mozambique access snapshot: Cabo Delgado province. https://www.unocha.org/publications/report/mozambique/mozambique-access-snapshot-cabo-delgado-province-31-july-2025

[44] OECD. (2022). The humanitarian-development-peace nexus: Interim progress review. OECD Publishing. https://doi.org/10.1787/2f620ca5-en

[45] Omotoso, A. B., & Omotayo, A. O. (2024). Enhancing dietary diversity and food security through the adoption of climate-smart agricultural practices in Nigeria: Micro level evidence. Environment, Development and Sustainability. https://doi.org/10.1007/s10668-024-04681-8

[46] Onyango, R., Nzengya, D., & Lihasi, L. (2025). Engendering climate-smart agriculture in Mt. Kenya East: How farmer demographics shape smallholder adoption. International Journal of Sustainable Development Research, 11(2), 115–132. https://doi.org/10.11648/j.ijsdr.20251102.16

[47] Opdenakker, R., & Cuijpers, C. (2025). Design Science Methodology for the Management Sciences. Springer. https://link.springer.com/book/10.1007/978-3-031-84853-7

[48] Pereira, L. M., Drimie, S., Maciejewski, K., Tonissen, P. B., & Biggs, R. (2020). Food system transformation: Integrating a political–economy and social–ecological approach to regime shifts. International Journal of Environmental Research and Public Health, 17(4), 1313. https://doi.org/10.3390/ijerph17041313

[49] Roy, P., Singh, R., & Kumar, A. (2025). Endogenous Switching Regression for Analyzing the Impact of Climate Adaptation Strategies in Agriculture. Journal of Agricultural Economics, 76(1), 1-15. https://www.researchgate.net/publication/389389904_Endogenous_Switching_Regression_for_Analyzing_the_Impact_of_Climate_Adaptation_Strategies_in_Agriculture

[50] Savari, M., Shokati Amghani, M., & Malekian, A. (2025). Application of the diffusion of innovation theory to identify factors affecting the use of treated wastewater in crop irrigation: A study in Tehran province. Cleaner Engineering and Technology, 29, 100901. https://doi.org/10.1016/j.clet.2025.100901

[51] Schwitter, N. (2025). The importance of data description in social research. International Journal of Social Research Methodology, 28(1), 1-15. https://doi.org/10.1080/13645579.2025.2531384

[52] Sozon, M., Alkharabsheh, O. H. M., Fong, P. W., & Chuan, S. B. (2024). Cheating and plagiarism in higher education institutions (HEIs): A literature review. F1000Research, 13, 788. https://doi.org/10.12688/f1000research.147140.2

[53] Sturridge, C. (2022). Climate, disasters and conflict in Cabo Delgado. https://storymaps.arcgis.com/stories/68a62d7d7ea4450595483e64fa0bc360

[54] Synnestvedt, T. (2025). Gender dynamics within food systems in displacement settings: Evidence from northern Mozambique. Frontiers in Sustainable Food Systems, 9, 1740395.

https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2025.1564638/full

[55] The IGC. (2025). Global warming and vulnerability to food insecurity in Mozambique: Local adaptation will be key. https://www.theigc.org/publications/global-warming-and-vulnerability-food-insecurity-mozambique-local-adaptation-will

[56] Tilahun, G., Bantider, A., & Yayeh, D. (2025). Empirical and methodological foundations on the impact of climate-smart agriculture on food security studies: Review. Heliyon, 11(1), e41242. https://doi.org/10.1016/j.heliyon.2024.e41242

[57] UNHCR. (2025). Mozambique displacement overview. United Nations High Commissioner for Refugees. https://data.unhcr.org/en/country/moz.

[58] UNHCR. (2025). Mozambique Operational Update. https://www.unhcr.org/sites/default/files/2025-08/UNHCR%20Mozambique%20Operational%20Update%20%28Apr-Jun%202025%29_0.pdf

[59] Veridata Insights. (2026). Mixed methods research: Key benefits explained in 2026. https://veridatainsights.com/mixed-methods-research-key-benefits-explained/

[60] Wang, S., Lu, J., Liu, Y., & Grant, J. (2025). Environmental Resilience and Sustainable Agri-food System Management. Frontiers Media SA.

[61] WFP. (2026). Food Consumption Score. https://vamresources.manuals.wfp.org/docs/food-consumption-score

[62] World Bank. (2024). Capturing What Matters. Essential Guidelines for Designing Household Surveys (second edition). https://www.worldbank.org/en/programs/lsms/publication/CapturingWhatMattersEssentialGuidelinesforDesigningHouseholdSurveys

[63] World Benchmarking Alliance. (2024). Methodology for the 2026 Food and Agriculture Benchmark. https://assets.worldbenchmarkingalliance.org/app/uploads/2024/10/FAB_Methodology_2026_Final_1.1.pdf

[64] Yimenu, A. A., Melaku, Y. A., & Gebremedhin, S. (2026). Barriers to water, sanitation, and hygiene (WASH) cluster coordination during emergencies in sub-Saharan Africa: A scoping review. PLOS Water, 5(2), e0000434. https://doi.org/10.1371/journal.pwat.0000434

[65] Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). Sage Publications.

[66] Zhang, Y., Wang, L., & Liu, H. (2025). Two-stage sampling for better survival model performance. BMC Medical Research Methodology, 25, 125. https://pmc.ncbi.nlm.nih.gov/articles/PMC12570514/

[67] Zrineh, A., Al-Usta, M., & Alwawi, A. (2026). Sampling methods and sample size determination in clinical research: An educational review. Journal of General and Family Medicine, 27(1), e70096. https://doi.org/10.1002/jgf2.70096