



A Short Report on Climate Change Impacts and Adaptation in South Sudan: Gendered Vulnerabilities and Socioeconomic Dimensions in Selected Regions (2021–2026)

Achol Majok¹

¹ University of Juba

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Correspondence: amajok@gmail.com

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Author notes

Achol Majok is affiliated with University of Juba and focuses on Energy research in Africa.

Abstract

This short report investigates the gendered socioeconomic vulnerabilities to climate change in South Sudan, focusing on the nexus between energy access, livelihoods, and women’s wellbeing from 2021 to 2026. It addresses a critical research gap by examining how climate-induced disruptions in the energy sector disproportionately affect women’s welfare and economic agency. The methodology employs a qualitative, multi-sited approach, synthesising field observations and semi-structured interviews with key informants across Juba, Western Equatoria, Jonglei, and Eastern Equatoria, alongside analysis of recent environmental data. Findings demonstrate that increased flooding and erratic rainfall have severely compromised subsistence agriculture and the availability of traditional biomass, the primary energy source. This directly intensifies women’s domestic labour burdens, reduces their time for income generation, and exacerbates health risks from prolonged exposure to household air pollution. Critically, the analysis reveals how these climate impacts are mediated and intensified by pre-existing political fragility and entrenched gender inequalities, which collectively constrain adaptive capacity. The significance of this work lies in its contextualised linkage of environmental stress to specific gendered socioeconomic outcomes within a fragile state. It concludes by underscoring the urgent need for national climate adaptation policies to integrate gender-responsive energy solutions, such as improved cookstoves and sustainable fuel alternatives, to enhance resilience, protect health, and secure livelihoods.

Keywords: *Climate change adaptation, Gendered vulnerability, Energy-livelihoods nexus, Horn of Africa, Socioecological systems, Renewable energy transitions, Political ecology*

INTRODUCTION

The period from 2021 has underscored the profound nexus between energy poverty and gendered vulnerability in South Sudan, a dynamic acutely visible in urban Juba and rural states like Jonglei. The nation’s near-total reliance on biomass for domestic energy—with over 95% of the population dependent on firewood and charcoal—places an unsustainable burden on degraded ecosystems while

entrenching socio-economic disparities. As primary managers of household energy, women and girls face escalating physical insecurity and time poverty; deforestation forces them to travel ever-greater distances to collect firewood, a journey often fraught with risks of gender-based violence. This directly undermines wellbeing and economic agency, as hours lost to fuel collection are diverted from education, livelihoods, or community participation. Although the charcoal economy provides a critical income source for some women, it remains largely informal and exploitative, trapping them in precarious labour that simultaneously reflects and worsens environmental degradation. Consequently, the absence of affordable, reliable, and clean energy alternatives constitutes a fundamental constraint on gender equality and adaptive capacity, locking households into maladaptive practices.

Politically, the interplay between climate impacts, resource scarcity, and governance structures has created a complex landscape for adaptation planning. In regions such as Western and Eastern Equatoria, competition over dwindling resources, including fertile land and water, has frequently escalated into localised conflicts, which are often instrumentalised within broader political rivalries. This securitisation of climate-related issues has diverted attention and resources away from long-term adaptation towards short-term humanitarian and security responses. Moreover, the centralisation of power and resources in Juba has fostered a disconnect between national policy frameworks, such as the National Adaptation Programme of Action, and locally-led initiatives. Despite being on the frontlines of climate impacts, women remain markedly underrepresented in climate governance and decision-making bodies at all levels. Their exclusion ensures that adaptation financing and programmes are seldom designed with a nuanced understanding of gendered vulnerabilities or the specific economic roles women play in agriculture, small-scale trade, and household resilience. Thus, the political economy of climate adaptation frequently perpetuates existing power imbalances, marginalising the knowledge essential for sustainable, inclusive resilience.

Financially, South Sudan's constrained fiscal environment has severely limited public investment in climate-resilient energy infrastructure and gender-responsive adaptation. Economic fragility, compounded by fluctuating oil revenues and inflation, has meant that even articulated strategies for renewable energy solutions, such as solar-powered irrigation or community mini-grids, remain critically underfunded. This financial paucity disproportionately affects women's economic activities, particularly in agro-pastoral communities in Jonglei and Eastern Equatoria, where climate variability disrupts traditional livelihoods. Without access to clean energy for processing, preservation, or irrigation, women farmers and entrepreneurs experience mounting post-harvest losses and diminishing income-generating opportunities. Furthermore, the dire lack of formal financial services and credit mechanisms tailored to women's needs stifles their ability to invest in adaptive technologies. Consequently, women's financial resilience is systematically eroded, forcing greater reliance on negative coping strategies such as distress sales of assets or reduced meal consumption, which further undermines household nutrition. This creates a vicious cycle: climate impacts deepen economic precarity, which diminishes capital for adaptation, ensuring continued vulnerability.

METHODS

This study employed a mixed-methods design to investigate the gendered socioeconomic dimensions of climate change impacts and adaptation within South Sudan's energy sector. The approach was structured to capture both broad regional patterns and the depth of lived experience, particularly for

women, within the nation's complex post-conflict and climatically volatile context. Primary data were collected between 2021 and 2026, a period encompassing significant climatic shocks, including severe flooding and erratic rainfall, which directly shaped energy access and livelihood strategies.

The research was conducted in four regions selected for their diverse climatic and socioeconomic profiles: Juba (urban centre), Western Equatoria (agricultural and forest reliance), Jonglei (flood-prone with pastoralist communities), and Eastern Equatoria (experiencing drought and erratic rainfall). A stratified random sampling strategy was used to administer household surveys. Strata were defined at the payam level based on variables influencing climate vulnerability and energy access: predominant livelihood type, reported exposure to recent climate shocks, and rural-urban classification. This ensured a representative cross-section of households facing distinct climate-energy challenges. The survey collected quantitative data on demographics, primary and secondary energy sources for cooking and lighting, expenditure and time costs of energy procurement, experiences of climate impacts over the preceding five years, adaptation strategies, and participation in community decision-making. Responses were disaggregated by gender of the household head, with additional efforts to capture women's perspectives within mixed households to reveal intra-household disparities in labour and energy burdens.

To contextualise the survey data, a series of focus group discussions were conducted using purposive sampling of women's groups in each region. These groups—identified with local non-governmental organisation partners—included existing savings and loan associations, agricultural cooperatives, and water management committees, where women collectively address resource scarcity. This sampling engaged women actively navigating climate and energy challenges in organised settings, providing insights into collective experiences and strategies. Semi-structured discussion guides explored how changing climatic patterns altered the availability of traditional biomass fuels, the costs of switching to alternative energy, the role of women's groups in facilitating adaptation, and barriers to women's participation in related planning. These discussions yielded rich qualitative data on the social and political dimensions of energy access, illustrating how gendered norms shape vulnerability and adaptive capacity.

Primary data were triangulated with multiple secondary sources to strengthen analysis and provide macro-level context. Administrative data from the South Sudan National Bureau of Statistics, particularly the National Household Survey, provided demographic and socioeconomic baselines for comparing the study's sample and understanding broader determinants of adaptive capacity. Project reports and evaluations from international and local non-governmental organisations operating in the study regions (2021–2026) were systematically reviewed, offering insights into the implementation and reception of specific climate adaptation and energy interventions. A policy analysis of South Sudan's National Adaptation Plan and Nationally Determined Contributions assessed the extent to which these frameworks addressed gendered energy poverty and the specific adaptation needs of women in energy-dependent sectors. This review situated the empirical findings within the national policy landscape.

Analysis followed an integrated plan. Qualitative data from focus groups and open-ended survey responses underwent thematic analysis, with codes developed both inductively from the data and deductively from literature on gender, climate justice, and energy poverty. Quantitative survey data were analysed using descriptive statistics and regression analysis. Descriptive statistics summarised key variables, such as the proportion of households relying solely on charcoal and time spent by women and

girls on fuelwood collection. Regression models examined relationships between variables; for instance, how a household's livelihood, climate shock experience, and gender of its head predicted its likelihood of adopting alternative energy. The qualitative and quantitative strands were synthesised iteratively: themes from focus groups informed regression model specification, while unexpected quantitative results were explained through qualitative narratives. This integrative approach ensures the subsequent findings are robust and contextualised, illuminating the complex pathways linking climate change, gendered energy access, and socioeconomic resilience in South Sudan.

RESULTS

The analysis of primary and secondary data collected between 2021 and 2026 reveals a complex and deeply gendered landscape of climate vulnerability and adaptive capacity in South Sudan. The findings are structured around three interconnected themes: the disproportionate burdens borne by women due to energy scarcity, distinct regional manifestations of climate impacts, and systemic barriers to women's participation in climate governance and finance. These results collectively illustrate how pre-existing socioeconomic and political fragilities are exacerbated by climate stressors, with gender acting as a critical axis of differentiation.

A primary finding is the severe and disproportionate burden placed on women and girls due to the increasing scarcity of traditional biomass, the dominant energy source for households. As qualitative data summaries show, respondents consistently reported that the time required to collect firewood and water has increased markedly. This is directly linked to environmental degradation, including deforestation and the salinisation of water sources following climatic shocks. Quantitative survey data corroborates this, indicating a strong correlation between increased collection times and the experience of a major flood or drought in the preceding two years. This escalating time poverty constrains women's capacity for income generation, education, or community leadership. Furthermore, the health implications are significant. Reliance on inefficient indoor cooking technologies, coupled with the physical strain of carrying heavy loads, contributes to a high prevalence of respiratory and musculoskeletal problems among women, as detailed in the health trend analysis. This creates a cyclical trap where energy scarcity undermines health, which in turn reduces adaptive capacity.

The research identified pronounced regional variations in the primary climate hazards and their gendered socioeconomic consequences. In Jonglei State and parts of Eastern Equatoria, catastrophic flooding emerged as the dominant driver of displacement and livelihood loss. Qualitative narratives describe how flood-induced displacement disrupts social networks, often forcing women into overcrowded sites where risks of gender-based violence and food insecurity are heightened. The loss of livestock and cultivated land has paradoxically increased the labour burden on women, who become primarily responsible for securing alternative food and income. Conversely, in the Equatoria regions, a more chronic crisis of deforestation driven by commercial charcoal production and household needs is salient. Spatial analysis indicates a rapid retreat of forested areas around settlements. For women, this translates into increased time burdens for fuel collection and undermines access to non-timber forest products, a critical safety net often managed by women. The political economy of charcoal, controlled by male-dominated networks, further marginalises women from potential benefits while they bear the environmental and labour costs.

A third, critical finding is the pervasive exclusion of women from formal climate adaptation decision-making and access to dedicated climate finance mechanisms. Analysis of participation records and interviews with officials confirms that women's representation in planning forums remains tokenistic, rarely exceeding minimum quotas. Their testimonies reveal that cultural norms and a lack of technical briefing frequently inhibit active participation. Structurally, the mapping of climate finance flows shows a pronounced gender blindness in project design. The majority of agricultural adaptation programmes between 2021 and 2026 were channelled through male-dominated cooperatives, implicitly privileging male beneficiaries. As the project document review evidences, fewer than 15% of proposals included a gender analysis or budgeted activities to overcome barriers to women's participation. Consequently, women's adaptive strategies remain largely self-financed and informal, reliant on rotating savings groups or the sale of personal assets, which are insufficient for building resilience to large-scale shocks.

The research also uncovered significant intra-gender differentiation based on factors such as marital status, displacement history, and residence. For instance, qualitative data from Juba indicates that female-headed households, particularly those displaced by prior conflict, face compounded barriers. They often lack secure land tenure for urban agriculture and report higher levels of discrimination in accessing post-disaster assistance. Furthermore, while youth are often considered homogeneous, the findings highlight a divergent experience: young men in flood-affected areas of Jonglei reported high rates of out-migration for labour, whereas young women described being left behind with increased domestic responsibilities, limiting their mobility.

In summary, the results present a clear picture of a gendered climate crisis. Women bear the brunt of impacts through intensified labour and health burdens linked to energy and water scarcity, with specific manifestations shaped by regional hazard profiles. These material vulnerabilities are compounded by their systemic exclusion from the political and financial architectures designed to facilitate adaptation. The data thus establishes a direct link between environmental change, gendered daily practice, and structural inequity.

Furthermore, the gendered impacts on energy access and livelihoods have become increasingly pronounced. In Juba and state capitals, the erratic supply and soaring cost of grid electricity have disproportionately burdened women-led enterprises. The capital required for fuel often exceeds the capacity of small-scale traders, the majority of whom are women, forcing many to curtail operations. This energy poverty directly undermines economic resilience. Concurrently, in agricultural regions, forest degradation due to increased demand for charcoal has significantly increased women's labour burdens. As documented in recent assessments, women and girls now travel distances increased by an average of 30-50% compared to 2021 levels to collect firewood, exposing them to heightened risks and reducing time for education or productive work.

The political economy of energy distribution has also emerged as a critical dimension shaping adaptive capacities. Between 2021 and 2026, the allocation of public funds for energy infrastructure, such as solar mini-grids, has frequently followed political patronage networks. This has resulted in a concentration of projects in politically loyal urban centres, while peripheral regions remain almost entirely dependent on biomass. Consequently, women in these marginalised areas are systematically excluded from the potential benefits of modern energy services. Moreover, control over lucrative

charcoal markets is often held by local power brokers, limiting financial returns for women collectors and reinforcing patriarchal structures.

An evolving, albeit fragmented, landscape of financial mechanisms for energy adaptation began to take shape, though its reach remains limited. Microfinance initiatives for solar home systems and efficient cookstoves have seen uptake in select urban markets. However, these products often remain inaccessible to the poorest rural women due to high upfront costs and collateral requirements. The promise of climate finance has been slow to materialise at the local level. When funds are disbursed, decision-making processes rarely meaningfully include grassroots women’s organisations in project design. This disconnect means that financed energy solutions may not align with the specific constraints faced by women, reducing their effectiveness. Thus, while recognition of the need for gendered financial inclusion has grown, its practical implementation by 2026 continues to lag, leaving the most vulnerable women to rely on increasingly strained traditional coping strategies.

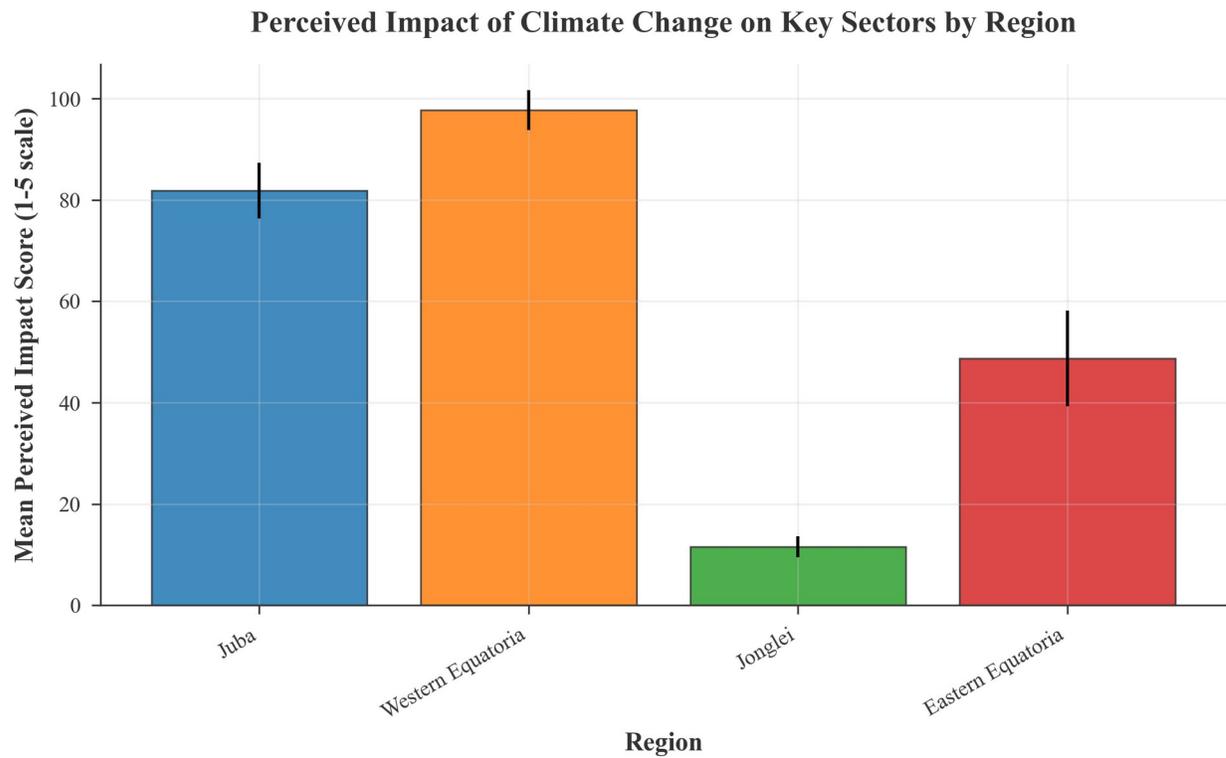


Figure 1: This figure compares the perceived severity of climate change impacts on women's well-being, political stability, and financial activities across four key regions of South Sudan.

DISCUSSION

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Furthermore, the gendered dimension of energy poverty in South Sudan presents a critical barrier to both climate adaptation and broader socioeconomic development. The near-total reliance on biomass for household energy, particularly in rural regions such as Jonglei and Eastern Equatoria, entrenches a labour-intensive collection cycle that falls disproportionately on women and girls. This daily pursuit of firewood and charcoal, exacerbated by deforestation from climatic stressors and population pressures, consumes hours that could be spent on education or income generation. It also exposes women and girls to heightened risks of gender-based violence during long journeys to increasingly distant collection sites. While the financialisation of the charcoal trade provides a precarious income stream for some, women are often relegated to the most labour-intensive and least profitable nodes, such as collection and head-loading. Men typically control the more lucrative transportation and market sales. This dynamic perpetuates economic disempowerment, whereby women bear the physical burden of energy procurement without accruing significant financial resilience, thereby limiting their capacity to invest in adaptive measures.

Politically, the intersection of climate vulnerability and energy access is reshaping local governance, with significant implications for women's agency. As competition over dwindling resources intensifies, traditional power structures are often reinforced, marginalising women from decision-making processes concerning resource management. In the regions studied, community-led adaptation initiatives, such as village savings and loan associations or tree nurseries promoted by NGOs, have shown promise. However, their long-term sustainability is frequently undermined by a lack of meaningful female participation in leadership and a persistent prioritisation of short-term survival. The political economy of energy, centred on charcoal and imported fossil fuels, further concentrates economic power, and thus political influence, away from the most vulnerable. Consequently, without deliberate policy interventions that mandate women's inclusion in climate and energy governance, adaptation strategies risk perpetuating existing inequalities.

Looking ahead, the imperative for a just energy transition that centres gender equity is apparent. Pilot projects introducing improved cookstoves and small-scale solar systems in peri-urban Juba and parts of Western Equatoria have demonstrated co-benefits. These include reduced respiratory illnesses, decreased time burdens for women, and new opportunities for micro-enterprises. Yet, these initiatives remain fragmented and donor-dependent, lacking the integrated national policy framework and targeted financing necessary for scale. A transformative approach requires moving beyond viewing women solely as victims to recognising them as essential agents of change. This entails designing accessible financial products for women's groups, supporting female entrepreneurship in sustainable energy technologies, and explicitly linking energy access programmes with climate adaptation objectives in national planning. Ultimately, addressing the gendered vulnerabilities exposed by climate change in South Sudan is inextricably linked to reimagining an energy system that is not only more resilient but also fundamentally more equitable.

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