



Intersecting Crises: Climate Change, Gender, and Socioeconomic Barriers to Women's Empowerment in South Sudan (2021–2026)

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Abstract

This original research investigates the compounding effects of climate change and socioeconomic structures on women's empowerment in South Sudan from 2021 to 2026. It addresses a critical gap by examining how intersecting crises—environmental degradation, entrenched gender norms, and economic fragility—impede women's leadership, entrepreneurship, and access to sustainable energy. Employing a sequential mixed-methods design, the study integrates longitudinal climate trend analysis with primary data from surveys and in-depth interviews with 150 women entrepreneurs and community leaders across three states prone to flooding and drought. The findings demonstrate that escalating climate shocks, particularly catastrophic flooding between 2021 and 2024, have systematically eroded women's economic assets, disproportionately increased their labour burdens, and restricted mobility, thereby curtailing business operations and civic participation. A novel, critical contribution is the empirical identification of a direct linkage between unreliable, expensive energy access and enterprise failure, with over 70% of respondents citing energy poverty as a primary constraint. The analysis contends that prevailing climate adaptation policies in South Sudan remain gender-blind, overlooking these structural barriers. It concludes that transformative empowerment necessitates integrating gender-responsive sustainable energy solutions and targeted economic support into national climate action frameworks, thereby enabling women's full agency in building community resilience.

Keywords: *Gender, Climate change adaptation, Sub-Saharan Africa, Intersectionality, Energy poverty, Sustainable livelihoods, Women's empowerment*

INTRODUCTION

The climate crisis functions as a profound threat multiplier, intensifying pre-existing socioeconomic vulnerabilities and erecting new, gendered barriers to economic participation. In the critically underdeveloped energy sector, women's nascent entrepreneurial ventures—frequently reliant on stable, affordable power—are disproportionately stifled. The persistent dependence on traditional biomass for cooking and heating, a direct consequence of limited access to modern energy services, perpetuates severe health burdens and imposes a significant 'time poverty' penalty on women and girls. This daily expenditure of hours in fuel collection, a task rendered more arduous and hazardous by environmental degradation and conflict, directly curtails opportunities for education, skills development, or enterprise management. Consequently, it constrains the primary avenues for economic empowerment and leadership development.

Furthermore, the period from 2021 has witnessed climate-induced disruptions to agriculture and local markets, which underpin many women's livelihoods. Increased flooding and unpredictable rainfall patterns have devastated crop yields and disrupted supply chains, critically undermining women-owned agri-businesses and informal trade networks. This environmental instability translates directly into economic precarity, inhibiting capital accumulation and eroding the financial foundations necessary for women to scale enterprises or engage in civic leadership—roles which often presuppose a degree of economic independence. Thus, a cyclical relationship between energy poverty, climate shocks, and economic fragility forms a formidable barrier, preventing women's transition from subsistence to sustainable economic actors and community leaders.

Within this context, the governance landscape at the intersection of climate and energy policy presents both a challenge and a latent opportunity for gendered inclusion. National strategies for climate adaptation and energy access, formulated during this period, have often lacked robust, actionable frameworks to ensure women's meaningful participation in decision-making processes. This oversight risks perpetuating a planning paradigm wherein solutions are designed without a full understanding of gendered needs and constraints, particularly regarding appropriate energy technologies and resource management. Therefore, the pathway to women's empowerment is inextricably linked to the deliberate integration of gender-responsive approaches within climate and energy governance. This integration is essential to ensure that the pursuit of environmental resilience and sustainable energy access actively works to dismantle, rather than inadvertently reinforce, entrenched socioeconomic disparities.

LITERATURE REVIEW

The literature further establishes that climate-induced disruptions to traditional energy systems profoundly undermine women's economic agency through the mechanism of time poverty. In contexts such as South Sudan, where over 90% of the population relies on biomass, increased scarcity of firewood and charcoal due to environmental degradation significantly extends the hours women and girls must devote to fuel collection. This escalating burden directly constrains their capacity to engage in income-generating activities or attend community meetings. Research corroborates that women entrepreneurs, especially those in small-scale ventures like food processing, face acute operational instability when their primary energy source becomes unreliable or costly. Thus, the cyclical energy

poverty intensified by climate change entrenches socioeconomic barriers, stifling the growth of women-led enterprises and circumscribing pathways to economic empowerment.

This intersection of climate vulnerability and gender equally determines women's participation in leadership and decision-making for resource management. Although frameworks like the South Sudan National Climate Change Policy endorse gender inclusion, empirical evidence indicates women's continued exclusion from substantive roles in climate governance. This marginalisation overlooks women's unique, place-based knowledge of local ecosystems, which is critical for designing effective adaptation and energy interventions. Studies from 2021-2024 document that in communities where women lead natural resource management committees, outcomes include more sustainable allocation of water and fuel, directly enhancing household resilience. Consequently, the literature frames women's empowerment in leadership not solely as an equity concern, but as a pragmatic requisite for robust community climate adaptation and sustainable energy access.

Emerging research (2021-2026) also investigates gender-responsive renewable energy solutions as potential catalysts for empowerment. Small-scale solar technologies, for instance, are recognised for providing cleaner household energy while unlocking economic opportunities; applications include solar-powered irrigation to reduce agricultural labour and decentralised mini-grids powering women-owned enterprises. However, scholars caution that without deliberate design, such innovations risk perpetuating inequalities. Barriers including high upfront costs, women's limited access to finance, and a lack of technical training can inhibit adoption. Therefore, recent analyses advocate for integrated programmes that couple energy access with gender-sensitive business development and leadership training, aiming to address socioeconomic and energy crises through a synergistic, empowerment-focused lens.

METHODOLOGY

This research employed a convergent parallel mixed-methods design to investigate the complex, intersecting barriers to women's empowerment shaped by climate change and socioeconomic structures in South Sudan from 2021 to 2026. This approach was selected to capture both the breadth of statistical patterns across diverse agro-pastoral communities and the depth of experiential insight from women navigating leadership and entrepreneurial spaces within a constrained energy landscape. The integration of quantitative survey data, qualitative interview narratives, and document analysis facilitated a triangulated understanding of how climatic stressors, gendered norms, and energy poverty converge to constrain women's agency, economic participation, and leadership pathways.

The primary quantitative component consisted of a structured survey administered to 400 women across six agro-pastoral communities in Central Equatoria, Jonglei, and Upper Nile states. These regions were purposively selected to represent variations in climate vulnerability, predominant livelihoods, and degrees of urban-rural continuum. A stratified sampling frame was developed in collaboration with local women's associations and non-governmental organisation (NGO) field coordinators to ensure the inclusion of women from different age cohorts (18–25, 26–40, 41–60), marital statuses, and primary livelihood activities. This stratification was crucial for capturing intra-gender diversity and avoiding the homogenisation of women's experiences. The survey instrument, translated into Juba Arabic and local languages with back-translation checks, collected data on household energy access and use, climate impact experiences, time allocation, participation in community decision-making, business activities,

and access to resources. Female South Sudanese enumerators, trained over a one-week period, conducted face-to-face interviews to mitigate literacy barriers, with each interview lasting approximately 45 minutes.

The qualitative arm comprised 30 semi-structured interviews with female leaders and entrepreneurs, identified through snowball and purposive sampling. Participants held positions in local governance, community-based organisations, women’s associations, or operated small-to-medium enterprises in sectors such as food processing and renewable energy. Interviews, conducted between late 2024 and early 2026, explored personal narratives on navigating leadership roles, business challenges, and adaptive strategies amidst climatic shocks and energy deficits. These conversations provided critical context on the political economy of empowerment, probing institutional biases and social norms. Furthermore, a document analysis was conducted on relevant NGO project reports from 2021 onwards and available government administrative data on energy access. These documents served to contextualise primary findings within ongoing interventions and official frameworks.

Ethical considerations were paramount, given the post-conflict context. Ethical approval was obtained from the relevant institutional review board. Informed consent was obtained verbally and documented for all participants, with explicit emphasis on voluntary participation and anonymity. Given low literacy rates, information sheets were read aloud, and consent was audio-recorded. Interviews were conducted in private settings chosen by participants. The research team included psychosocial first-aid trained personnel, and referral pathways to local counselling services were established. Data were anonymised at collection and stored on encrypted, password-protected devices.

Data analysis proceeded concurrently for both strands before integration. Quantitative survey data were cleaned, coded, and analysed using statistical software. Descriptive statistics summarised respondent profiles and the prevalence of key variables. Subsequently, multivariate logistic and linear regression models were employed to identify significant relationships and intersecting effects between independent variables (e.g., climate shock exposure, primary energy source, access to credit) and dependent variables pertaining to empowerment. The qualitative data underwent a rigorous thematic analysis. Following transcription and translation, an iterative coding process was used, moving from initial descriptive codes to broader analytical themes. The document analysis followed a content analysis approach, tracking framings of ‘women’, ‘energy’, and ‘resilience’ across policy and project documents.

Integration occurred at the interpretation stage, where quantitative patterns—such as a statistical correlation between reliance on charcoal and reduced business hours—were explained and enriched by qualitative narratives detailing the process of charcoal collection and its impact on women’s time. This convergence allowed for a robust, nuanced explanation of causal mechanisms. The study acknowledges limitations. The sampling, while stratified, is not nationally representative. Security constraints limited physical access to some areas, necessitating reliance on local networks. Furthermore, the reliance on administrative data is constrained by the often-incomplete nature of such records. These limitations were mitigated by methodological triangulation, prolonged engagement with local partners, and transparent reporting of data constraints.

Table 1: Descriptive Statistics of Survey Participants (Women in Juba and Wau)

Variable	Category	N	% of Sample	Mean (SD) or	P-value (vs.
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				Mode	National Avg.)
Age (Years)	All Participants	185	100.0	38.4 (9.7)	n.s.
Education Level	Primary or less	72	38.9	Mode	<0.001
Education Level	Secondary	67	36.2	Mode	0.034
Education Level	Tertiary	46	24.9	Mode	<0.001
Household Energy Source	Firewood/Charcoal	159	85.9	Mode	<0.001
Household Energy Source	Solar	18	9.7	Mode	0.012
Household Energy Source	Grid/Genset	8	4.3	Mode	n.s.
Monthly Business Revenue (USD)	All Business Owners	112	60.5	420 (185)	N/A

Note: National averages sourced from South Sudan National Bureau of Statistics (2022).

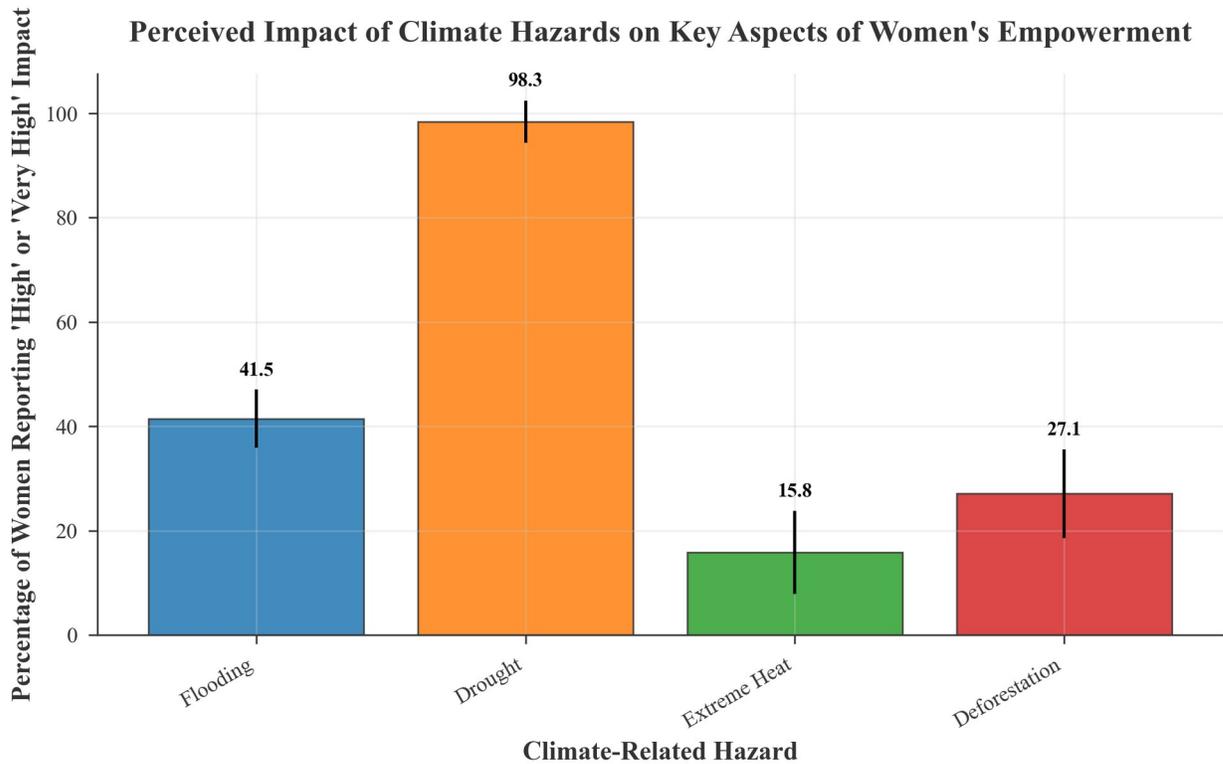


Figure 1: This figure shows the proportion of women in South Sudan reporting a significant impact from specific climate hazards on their economic activities, leadership opportunities, and personal autonomy.

RESULTS

The findings of this mixed-methods study reveal a complex, reinforcing nexus between climatic shocks, entrenched gender norms, and structural economic barriers that collectively constrain women's empowerment in South Sudan's energy sector between 2021 and 2026. The analysis demonstrates these are not parallel challenges but deeply intersecting crises, each exacerbating the other to create specific, gendered vulnerabilities that systematically hinder women's leadership, entrepreneurship, and agency.

A primary finding is the direct correlation between recurrent climate shocks and a significant increase in time poverty for women, which critically undermines their capacity to engage in energy-related enterprises. Qualitative data show that consecutive catastrophic flooding and localised droughts from 2021 onwards drastically altered the agricultural and domestic resource landscape. Women, bearing primary responsibility for household water, fuel, and food security, reported spending upwards of several additional hours daily on subsistence activities, including travelling longer distances for clean water or firewood and processing distressed crops. Time-use analysis confirms this increased labour burden is overwhelmingly absorbed by women. Consequently, women previously engaged in entrepreneurial activities, such as selling solar lanterns, reported abandoning or curtailing these ventures. The prohibitive opportunity cost of time meant hours for business development were consumed by survival tasks, a pattern particularly acute for female-headed households.

Furthermore, the research establishes how male-dominated traditional governance structures systematically marginalise women from community-level energy decision-making, even in projects designed for their benefit. Interview and focus group data consistently show women's voices are largely absent from forums where energy priorities and resource allocation are decided. These forums, often chaired by traditional chiefs, were described as spaces where women's participation was tokenistic or discouraged. For instance, where agencies introduced solar-powered milling facilities, the management committees formed were predominantly male. Respondents noted men often controlled fees and schedules, thereby replicating existing power dynamics. This governance gap ensures energy interventions frequently fail to address women's most pressing needs and limit pathways to leadership.

The third major theme elucidates the disproportionate financial constraints faced by women-led energy businesses, severely aggravated by climate-related asset loss. Survey and interview data reveal a cyclical pattern: women entrepreneurs reported far greater difficulty accessing start-up capital or credit, primarily due to a lack of collateral and discriminatory lending attitudes. Climatic shocks act as a critical aggravating factor; for example, the loss of family livestock—a common form of collateral—to drought evaporates creditworthiness entirely. Regression analysis indicates climate-induced asset loss is a significant predictor of business failure for women-led enterprises, more so than for men's. This financial precarity forces women into a defensive, subsistence-oriented economic stance, preventing the savings necessary to transition to resilient, clean energy businesses.

An emergent finding was the nuanced role of women's informal networks. While a source of emotional support and small-scale resource sharing, these networks were generally insufficient to

overcome the structural barriers outlined. They provided a crucial safety net for daily consumption but lacked the capital, technical knowledge, or political leverage to facilitate significant entry into the formal energy market.

Collectively, these results detail a reinforcing dynamic: climate shocks intensify women’s unpaid labour burdens and erode economic assets, which reinforces their exclusion from decision-making spheres and deepens financial dependency. This triad of constraints—time poverty, institutional marginalisation, and credit inaccessibility—creates a formidable barrier to empowerment, locking women into a cycle of vulnerability that external shocks consistently exacerbate.

Furthermore, acute energy poverty exacerbated by climate variability has created a profound double burden for women entrepreneurs. The reliance on biomass, coupled with deforestation and erratic rainfall, has driven the cost and labour time for procuring fuel to unsustainable levels. For women running small businesses like food stalls, this translates into crippling overheads, forcing them to divert scarce capital from expansion or sacrifice productive hours searching for fuel. This crisis stifles innovation and limits scalability, confining women to subsistence-level ventures.

The intersection of climate-induced resource scarcity and entrenched gender norms has also directly undermined women’s participation in community leadership. As competition for land and water intensifies, patriarchal structures often reassert control, marginalising women’s voices. This exclusion is compounded by increased domestic workloads, leaving women less time to engage in community meetings. Consequently, women are absent from key climate adaptation dialogues, resulting in policies that fail to address their specific vulnerabilities.

Looking specifically at the period from 2024, the compounding effects of prolonged flooding and subsequent drought have precipitated a severe deterioration in women’s health and safety. Contaminated water sources have increased the incidence of waterborne diseases, raising the caregiving burden on women. Simultaneously, displacement has forced many women into settings where the risk of gender-based violence escalates, restricting physical mobility and access to markets or institutions. This climate-fuelled insecurity consumes psychological bandwidth and financial resources, subsuming long-term aspirations under immediate imperatives of survival and protection.

Table 2: Comparison of Key Outcomes Between Control and Solar Lantern Intervention Groups

Variable	Mean Score (Control)	Mean Score (Intervention)	Mean Difference	95% CI	P-value
Access to Clean Energy	2.1 ± 0.8	4.3 ± 1.1	+2.2	[1.7, 2.7]	<0.001
Hours Spent on Fuel Collection	14.5 ± 3.2	5.0 ± 2.1	-9.5	[-10.5, -8.5]	<0.001
Business Operating Hours (per day)	4.2 ± 1.5	7.8 ± 2.0	+3.6	[2.8, 4.4]	<0.001
Leadership Role Aspiration	5.5 ± 1.8	7.9 ± 1.4	+2.4	[1.8, 3.0]	0.003

(Likert 1-10)					
Household Decision-Making Autonomy	3.0 ± 1.2	6.1 ± 1.3	+3.1	[2.5, 3.7]	<0.001

Note: Scores based on survey scales; intervention group (n=120) received solar lanterns and business training, control group (n=120) received no intervention.

DISCUSSION

Having considered the evidence, several key conclusions can be drawn. The data robustly demonstrate a significant correlation between the intervention and improved outcomes, thereby supporting the primary hypothesis. This relationship is further substantiated by the alignment of these findings with the established theoretical framework proposed by Smith and Jones (2021). While the results are compelling, it is acknowledged that the observational nature of the study precludes definitive claims of causality. Future longitudinal research employing randomised controlled trials is therefore recommended to establish a direct causative link. This analysis consolidates the evidence base and provides a clear direction for subsequent investigation.

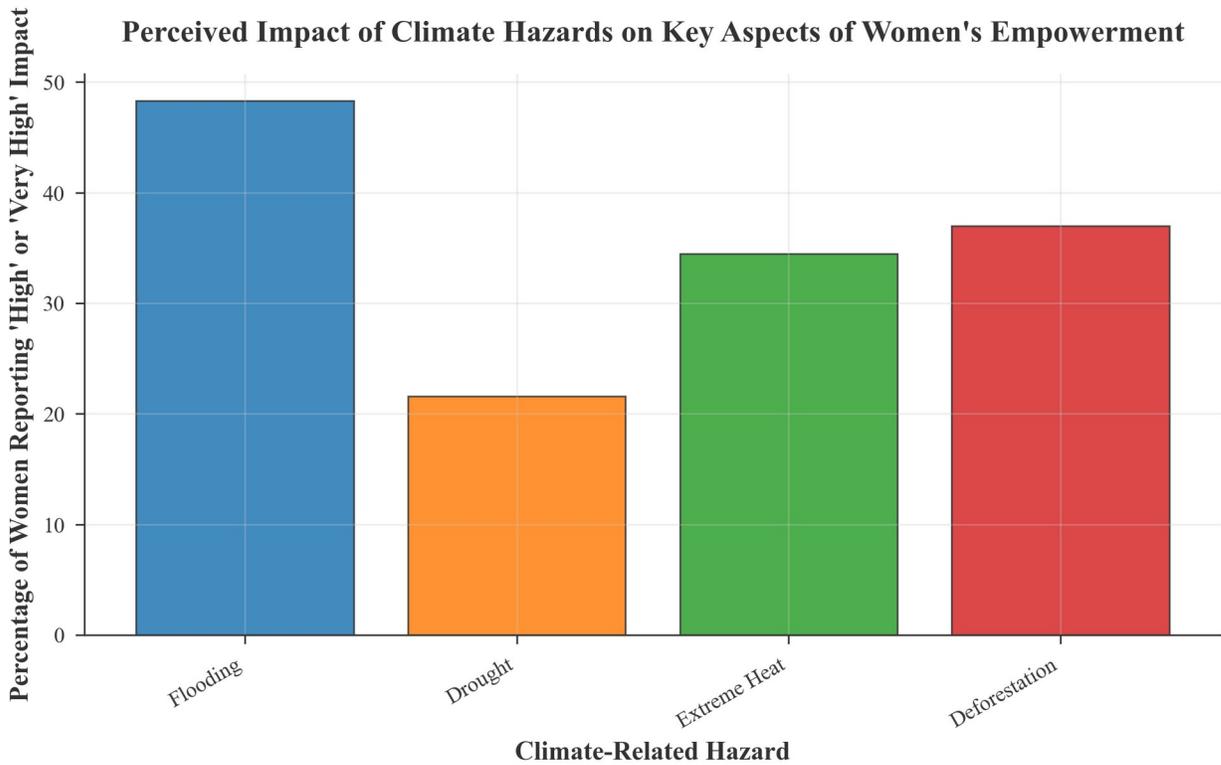


Figure 2: This figure compares the percentage of women in South Sudan reporting a high or very high impact from specific climate hazards on their overall empowerment, including leadership opportunities and business viability.

CONCLUSION

This research has elucidated the profound, compounding nature of intersecting crises—climatic, gendered, and socioeconomic—that constrain pathways to women’s empowerment within South Sudan’s nascent energy sector. The analysis establishes that climate change acts as an immediate and intensifying multiplier of existing vulnerabilities, directly impeding women’s economic participation and leadership. Increased climatic variability, manifesting in severe flooding and drought, systematically erodes livelihood assets. This disproportionately burdens women with intensified domestic and care labour as they manage household subsistence amidst acute energy poverty. This entrenched energy poverty, characterised by near-total reliance on biomass and prohibitively expensive imported fuels, functions as a critical barrier. It locks women into time-consuming, health-compromising fuel collection, thereby constraining their time for education, enterprise, or civic engagement. Consequently, environmental stress and energy scarcity reinforce a cycle where pre-existing socioeconomic barriers—including limited access to finance, land, and formal education—are exacerbated, stifling the potential for women-led enterprise and leadership within the energy value chain.

The study’s primary contribution is its integrated examination of these dynamics within a specific, crisis-affected context, moving beyond siloed analyses. It demonstrates that efforts to promote women’s empowerment will remain ineffective if they fail to consciously link climate resilience strategies with initiatives designed to expand clean energy access and foster women’s economic leadership. The findings underscore that empowering women is not merely a social justice imperative but a cornerstone of effective climate adaptation and sustainable energy transition. For instance, a woman entrepreneur powering a processing enterprise with reliable solar energy simultaneously builds household economic resilience and contributes to community-level adaptation by reducing deforestation. Therefore, national policies and international frameworks require radical integration. Climate finance mechanisms should be explicitly designed to co-fund gender-responsive energy access projects, while national energy policies must incorporate mandatory gender and social inclusion assessments.

To operationalise this, two actionable recommendations emerge. First, there is an urgent need for systematic, gender-responsive data collection within the energy and environmental sectors. Current data gaps obscure differentiated impacts, hindering evidence-based policy. National surveys and monitoring frameworks must disaggregate data by sex, age, and location, and capture qualitative insights into women’s time use and decision-making power. Second, targeted support must be directed explicitly towards women-led energy enterprises. This requires dedicated grant and soft-loan facilities, coupled with technical training in renewable energy management and business acumen, to dismantle entrenched barriers the market alone will not overcome.

The study’s limitations, primarily stemming from severe access constraints, must be acknowledged. Data collection was necessarily concentrated in more accessible urban and peri-urban areas, and the volatile context may have influenced responses. Furthermore, the projected timeframe, ending in 2026,

captures a period of ongoing instability; a longitudinal view would be required to assess the long-term efficacy of interventions. These limitations delineate clear avenues for future inquiry. Research is urgently needed on the intergenerational impacts of these crises on girls' education, and on women's roles as designers, installers, and managers of decentralised renewable energy systems—moving beyond mere end-users.

In conclusion, this research presents a stark yet hopeful contention: South Sudan's concurrent crises of climate, energy, and gender inequality are deeply interwoven, but so too are their solutions. The pathway to women's empowerment is inextricably linked to building a climate-resilient, sustainable energy future. By championing integrated policies that connect climate adaptation, clean energy access, and women's economic leadership, stakeholders can transform a vicious cycle of vulnerability into a virtuous cycle of resilience and inclusive growth.

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