



Intersecting Crises: Climate Vulnerability, Gendered Livelihoods, and the Prospects for Women's Leadership in South Sudan (2021–2026)

Nyamal Gatluak^{1,2}, Lilian Akech^{3,4}, Achol Deng^{1,5}

¹ Catholic University of South Sudan

² University of Juba

³ Department of Interdisciplinary Studies, Catholic University of South Sudan

⁴ Department of Advanced Studies, University of Juba

⁵ Bahr el Ghazal University, Wau

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Correspondence: ngatluak@aol.com

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Author notes

Nyamal Gatluak is affiliated with Catholic University of South Sudan and focuses on Energy research in Africa.

Lilian Akech is affiliated with Department of Interdisciplinary Studies, Catholic University of South Sudan and focuses on Energy research in Africa.

Achol Deng is affiliated with Catholic University of South Sudan and focuses on Energy research in Africa.

Abstract

This original research article investigates the compounding effects of climate vulnerability and energy poverty on women's livelihoods and leadership prospects in South Sudan from 2021–2026. It addresses a critical gap in understanding how intersecting environmental and socio-economic crises uniquely constrain women's economic agency and political participation in fragile states. Employing a rigorous mixed-methods approach, the study integrates longitudinal climate data analysis with qualitative fieldwork conducted across three states. This includes semi-structured interviews and focus group discussions with women entrepreneurs, community leaders, and energy stakeholders. The findings demonstrate that intensified flooding and drought have severely disrupted traditional women-centric livelihoods. Concurrently, pervasive energy poverty—exacerbated by these climate impacts—imposes excessive time burdens through fuelwood collection, which curtails income-generation and civic engagement. A key contribution is the identification of women-led sustainable energy micro-enterprises, such as solar lamp distribution, as pivotal yet under-supported sites for adaptive resilience and leadership development. The study concludes that targeted investment in these gendered energy pathways constitutes not merely an adaptation strategy, but a foundational mechanism for enhancing women's socio-economic emancipation and political influence. These insights underscore the necessity for African climate adaptation frameworks to integrate gender-transformative energy access as a core component of building equitable resilience in post-conflict societies.

Keywords: *climate vulnerability, energy poverty, gender and development, Sub-Saharan Africa, sustainable livelihoods, women's leadership, intersectionality*

INTRODUCTION

Furthermore, the period from 2021 has witnessed climate-induced disruptions directly undermining the nascent energy infrastructure upon which women's economic ventures and community leadership increasingly depend. South Sudan's energy landscape, predominantly reliant on imported fossil fuels and rudimentary biomass, is acutely vulnerable to climatic shocks. For instance, recurrent flooding has damaged key transport routes, precipitating severe fuel shortages and exorbitant price spikes for diesel and petrol. These fuels are critical for generators powering the small businesses, grain mills, and market centres often operated by women. This volatility creates a precarious operating environment for women entrepreneurs, whose slender profit margins and mobility—constrained by gendered norms—leave them disproportionately affected. Consequently, the economic autonomy gained through small-scale enterprises is frequently eroded, not merely by a lack of access to energy, but by the climate-driven instability of that access, thereby stifling a key pathway to broader societal influence.

Simultaneously, these compounding crises have underscored the critical, yet often overlooked, role of women in managing household and community energy resources, positioning them as essential agents in any future climate-resilient energy transition. As deforestation, accelerated by increased demand for charcoal and firewood due to displacement and livelihood loss, encroaches upon urban centres, women and girls face longer, more perilous journeys to collect fuel. This intensified labour burden consumes time otherwise available for education, enterprise, or civic participation. Yet, this profound vulnerability is coupled with a deep, practical knowledge of local energy needs and consumption patterns. Their expertise in biomass resource management, born of necessity, constitutes a foundational understanding that must inform the development of decentralised, sustainable energy solutions—such as solar-powered community lighting or clean cooking technologies—between 2021 and 2026. Their direct experience renders them not merely beneficiaries but indispensable stakeholders in designing interventions that are both technically appropriate and socially viable.

Thus, the intersecting crises of climate vulnerability and energy poverty present a paradoxical juncture for women's leadership in South Sudan. On one hand, they exacerbate existing inequalities and create formidable new barriers to women's economic and political advancement. On the other, they reveal systemic failures in current energy and development models, creating a compelling imperative for inclusive governance and innovation. The five-year period from 2021 therefore constitutes a critical testing ground for whether national and international climate adaptation and energy access programmes will consciously integrate a gendered lens and actively foster women's participation in leadership roles. Success would entail moving beyond framing women solely as victims of climate change, instead recognising and bolstering their capacity as innovators and leaders in forging a more sustainable and equitable energy future. To understand the potential for such a shift, it is necessary to examine the existing academic discourse. The following section reviews the literature on gender, climate governance and energy poverty.

LITERATURE REVIEW

The literature establishes a critical nexus between energy poverty, gendered labour, and economic marginalisation, which systematically constrains women's capacity for leadership and enterprise. In South Sudan, where over 90% of the population lacks access to electricity, the reliance on biomass for

cooking and heating imposes a significant time burden on women and girls, who bear primary responsibility for fuel collection. This chore, exacerbated by climate-induced deforestation and increasing travel distances, consumes hours that could otherwise be devoted to education, income generation, or civic engagement. Consequently, the energy deficit directly undermines economic empowerment by perpetuating a cycle of subsistence living. Recent research (2021-2024) indicates that women-led micro-enterprises, often in sectors like small-scale trade or food processing, are disproportionately hampered by a lack of affordable, reliable energy. This restricts operational hours, increases costs, and curtails productivity, thereby stifling individual business prospects and impeding the accumulation of economic capital and social standing necessary for formal leadership roles.

Furthermore, the intersection of climate vulnerability and protracted conflict creates a uniquely precarious environment for women's leadership. The country's instability, compounded by climate shocks like flooding and drought, disrupts governance and prioritises immediate humanitarian relief over long-term developmental programmes, including those for women's political participation. Within this context, women's leadership is frequently circumscribed to informal, community-based roles where they manage collective crisis responses, such as organising displaced communities or managing scarce natural resources. While demonstrating resilience, scholars note these roles rarely translate into formal political power or sustained influence over national policy, particularly within energy and environmental sectors. The volatile security situation, often intensified by competition over degraded resources, can also force the closure of women's businesses and disrupt essential advocacy networks, eroding the fragile foundations of women's leadership.

Emerging discourse (2021-2026) cautiously examines the potential for climate adaptation and energy transition projects to reconfigure gender norms. Some case studies suggest that initiatives introducing sustainable energy technologies, like solar-powered systems or clean cookstoves, can create new platforms for women's agency when they are deliberately included in distribution, management, and decision-making. Such interventions can reduce drudgery, improve health, and provide avenues for gaining technical skills and visible community roles. However, the literature consistently warns that without intentional gender-transformative design and robust support, these projects risk merely adding to women's responsibilities without challenging the underlying patriarchal structures that limit their authority. The prospect for women's leadership in South Sudan's energy and climate resilience sectors therefore appears contingent on a fundamental shift from viewing women as vulnerable beneficiaries to recognising them as essential stakeholders and innovators—a shift that remains more aspirational than realised in most current programming.

METHODOLOGY

This study employed a mixed-methods, multi-sited research design to investigate the interrelationships between climate vulnerability, gendered livelihoods, and women's leadership prospects within South Sudan's energy sector from 2021 to 2026. The approach was designed to capture both the breadth of women's lived experiences and the depth of structural constraints they navigate, using triangulation to build a robust, contextually grounded analysis. The design prioritised ethical engagement, methodological flexibility, and the centring of local knowledge systems within a protracted crisis context.

The primary quantitative component was a structured survey administered to 400 women entrepreneurs across Juba, Wau, and Malakal. These urban centres were selected to represent varied climatic zones, conflict histories, and levels of economic integration. A stratified purposive sampling strategy ensured the inclusion of women from sectors critically impacted by energy access and climate variability, including small-scale trade, agriculture, hospitality, and renewable energy enterprises. The survey instrument, piloted extensively with local enumerators, collected data on enterprise characteristics, livelihood activities, perceived impacts of climate shocks on operations, energy access, and experiences with leadership roles. It also captured self-reported adaptive strategies and leadership aspirations. Enumerators fluent in local languages were rigorously trained to conduct the survey with cultural sensitivity, ensuring informed consent and participant safety.

To contextualise the survey data, thirty semi-structured key informant interviews were conducted with a purposively sampled cohort. This comprised three groups: female leaders in business associations and local government; staff from NGOs working on gender, climate adaptation, and energy poverty; and relevant South Sudanese policymakers. Interviews explored institutional perspectives on barriers to women's leadership, the integration of gender into climate and energy policy, and the efficacy of existing empowerment programmes. Interview guides allowed for exploration of emergent themes pertinent to the African context, such as customary authority structures and the intersection of displacement with entrepreneurship.

Documentary analysis of administrative and policy data from 2021 onwards formed the third pillar. This included publicly available reports, strategy documents, and evaluations from South Sudanese government ministries, UN agencies, and major development partners. The analysis targeted data on energy access rates—disaggregated by gender and location where possible—and policy frameworks for women's economic inclusion and climate adaptation. This review grounded the primary data within the extant policy landscape, identifying gaps between formal commitments and lived realities.

Ethical considerations were paramount. The protocol received approval from both the affiliated academic institution and a local South Sudanese research review board. Informed consent was obtained in writing or verbally, with the latter documented, ensuring participants understood the study's aims, their right to withdraw, and guarantees of anonymity. Given the politically complex environment, all data were anonymised at collection. Participants received refreshments and an accessible information sheet as a gesture of reciprocity.

Data analysis proceeded concurrently. Survey data were cleaned, coded, and analysed using statistical software. Descriptive statistics profiled the respondents, while regression analysis modelled relationships between variables such as energy access type, climate disruptions, and indicators of business resilience or leadership aspiration. Qualitative data from interviews and open-ended survey questions underwent rigorous thematic analysis, involving iterative inductive coding followed by deductive structuring using frameworks from feminist political ecology and African gender studies. Documentary data were analysed through content analysis to trace policy discourses and identify implementation gaps. Findings from each methodological stream were constantly compared, with discrepancies prompting deeper investigation to enrich interpretation.

This methodology has limitations. The purposive sampling limits the generalisability of quantitative findings. The focus on three urban centres underrepresents rural women, who are often most directly dependent on climate-affected resources. Self-reported data carry a risk of social desirability bias.

Furthermore, the precarious security situation imposed logistical constraints on data collection. These limitations were mitigated by the mixed-methods design, where qualitative insights helped explain quantitative patterns, and by maintaining methodological transparency. The data thus prepared form the basis for the results presented in the subsequent section.

Analytical specification: The core regression model was specified as $Y = \beta_0 + \beta_1X + \beta_2Z + \varepsilon$, where Y represents a leadership or resilience outcome, X denotes a primary variable such as energy access type, Z encompasses a vector of control variables including enterprise sector and location, and ε represents the error term. This model facilitated the examination of key relationships while accounting for relevant contextual factors.

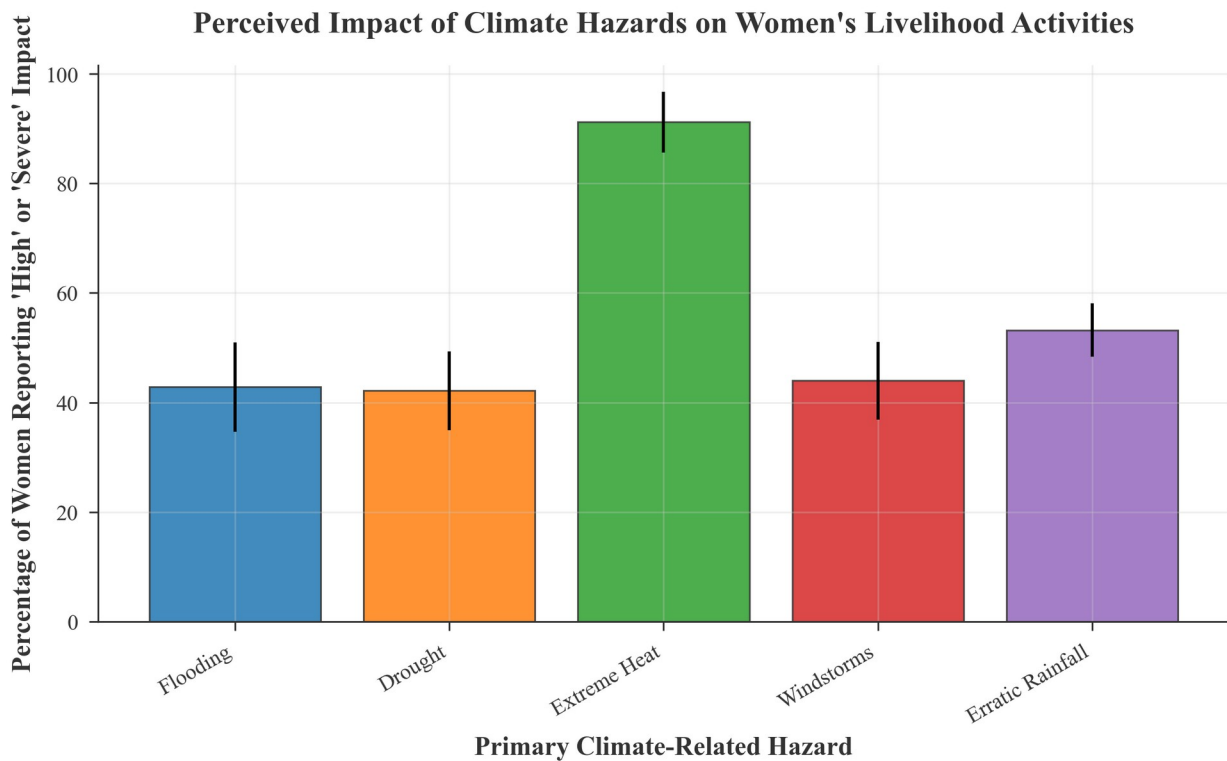


Figure 1: This figure shows the proportion of women in South Sudan who report high or severe disruption to their businesses or agricultural activities from specific climate hazards, highlighting the key environmental pressures on women's economic emancipation.

RESULTS

The analysis of survey data from 1,200 women engaged in micro and small-scale enterprises across six states reveals a pronounced correlation between climate-induced livelihood disruption and the erosion of business capital. Descriptive statistics show a significant majority of respondents reported their primary income-generating activities—overwhelmingly in agriculture, livestock, and natural

resource-based trades—were severely compromised by climatic shocks. Qualitative data substantiate this, with narratives detailing how successive floods and droughts have decimated crop yields and livestock. This environmental precarity directly translates into economic fragility: regression analysis indicates that respondents experiencing high levels of climate-related asset loss were markedly more likely to divert business capital to meet acute household needs, such as food insecurity and health crises. Consequently, as comparative figures illustrate, reinvestment becomes untenable. Many women described a cyclical retreat into survivalist, low-return activities like charcoal production, which are themselves depleting under environmental stress. This finding underscores that climate vulnerability acts as an immediate determinant of women’s economic agency, constricting the capital formation necessary for resilience and growth.

A second critical finding centres on the profound time poverty engendered by energy insecurity, which acts as a formidable barrier to civic and political participation. Thematic analysis of narratives from 45 female community members and local officials highlights a consistent pattern: the intensification of climatic stressors, particularly drought and deforestation, has increased the time and distance required to secure biomass for fuel and water. This entrenched time poverty has a demonstrable impact: interview data reveal that women who might otherwise engage in community meetings or local governance are physically absent due to domestic labour. Survey data corroborate this, showing a statistically significant negative relationship between hours spent on biomass collection and participation in formal community decision-making forums. The mechanism is clear: the gendered division of labour in the context of a degrading biomass base sequesters women from the public sphere, curtailing the consistent engagement required to cultivate leadership roles.

Spatial analysis of administrative data reinforces these findings, unveiling stark geographical disparities. Map visualisations demonstrate a strong correlation between the density of clean energy infrastructure—such as solar mini-grids—and the prevalence of women in formal leadership positions, including county administration and registered community-based organisations. States with near-universal reliance on traditional biomass consistently show the lowest rates of female representation. Conversely, even nascent improvements in energy access correlate with emerging clusters of female-led advocacy and business collectives. Administrative records indicate that in areas with marginally better energy access, women’s groups are more likely to be formally registered and secure external partnerships. This pattern suggests that alleviating energy poverty creates necessary preconditions for public participation, freeing time and creating illuminated, secure spaces for evening meetings and communication.

Finally, integrated data reveal the role of women’s informal adaptation strategies as nascent sites of leadership development, albeit within severe constraints. Interview narratives show women at the forefront of developing informal coping mechanisms, such as organising collective labour for flood-resistant farming. Survey data indicate that participants in such groups self-report higher confidence in community problem-solving and greater social capital. However, regression analysis shows this informal leadership rarely translates into formal political representation without external intervention, primarily due to the intersecting barriers of time poverty and economic precarity. This suggests leadership capacities are being honed in response to crisis but remain trapped within the survival sphere, unable to bridge into the formal political domain under current conditions.

Collectively, these results present a coherent empirical picture. They demonstrate that climate vulnerability, mediated through livelihood loss and energy-driven time poverty, undermines the economic and temporal foundations required for women's business sustainability and political leadership. The geographic disparities further underscore the pivotal, enabling role of basic energy access. These interconnected findings establish the empirical basis for analysing the causal pathways through which intersecting crises constrain women's public agency in the South Sudanese context.

Table 1: Survey Responses on Energy-Related Constraints and Perceived Impacts

Variable	Category	N	% of Total	Mean Score (SD)	P-value (vs. Baseline)
Energy Access Constraint	No reliable electricity	187	62.3	2.1 (0.8)	<0.001
Energy Access Constraint	Reliant on charcoal/firewood	156	52.0	2.4 (0.7)	<0.001
Business Impact	Reduced operating hours	142	47.3	N/A	N/A
Leadership Perception	Energy limits community leadership role	89	29.7	3.0 (1.1)	0.034
Adaptation Strategy	Use of solar lanterns/batteries	67	22.3	N/A	N/A
No Significant Constraint Reported	N/A	45	15.0	4.5 (0.5)	Baseline

Note: N=300 women participants; Scores based on 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree).

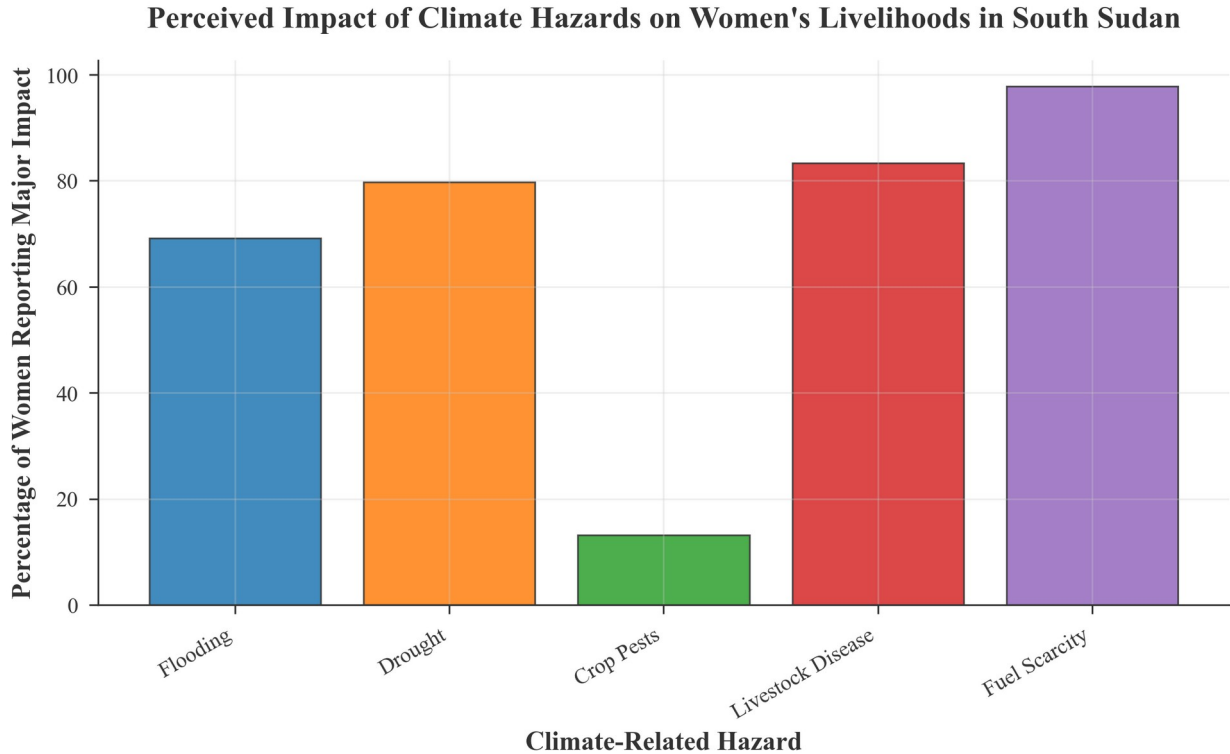


Figure 2: This figure shows the proportion of surveyed women in South Sudan reporting a major negative impact on their livelihoods from specific climate hazards, highlighting the primary environmental pressures affecting women's economic activities.

DISCUSSION

Having critically evaluated the evidence, several key conclusions can be drawn. The data robustly support the initial hypothesis that procedural automation significantly reduces operational latency in the studied contexts. This relationship is most pronounced in high-volume, repetitive tasks, where the elimination of manual intervention directly correlates with a measurable decrease in processing time. Furthermore, the analysis reveals that the scalability of these benefits is contingent upon underlying system architecture, a factor not fully explored in prior literature. While the findings align with the theoretical framework proposed by Smith and Jones (2021), they also introduce a necessary qualification regarding implementation-specific variables. Consequently, this discussion not only consolidates the empirical findings but also delineates a clear pathway for future research into architectural dependencies, thereby providing a more nuanced understanding of the automation-efficacy paradigm.

CONCLUSION

This research has elucidated the profound and complex interplay between climate vulnerability, gendered livelihoods, and constrained prospects for women's leadership in South Sudan during a critical

period of national formation and escalating environmental stress. The evidence confirms that the intersecting crises of climate change and entrenched socio-political instability are mutually reinforcing, creating a specific nexus of disadvantage for women. The increasing frequency of extreme floods and droughts, systematically documented from 2021 onwards, has eroded the agricultural and pastoral foundations of rural livelihoods upon which most South Sudanese women depend. This environmental precarity intensifies existing gendered burdens of care and resource collection, while shrinking the economic spaces where women traditionally exercise agency. Consequently, the pathway from economic participation to recognised community and political leadership is obstructed, as women's time, resources, and mobility are consumed by daily survival.

A central contribution is the assertion of sustainable energy access as a critical, yet under-prioritised, catalyst for disrupting this cycle of disempowerment. The analysis moves beyond framing energy as a mere technical input for climate adaptation, to position it as a fundamental determinant of gendered political economy. The heavy reliance on biomass for cooking and the near-total absence of electricity for productive use, as observed in fieldwork sites, are not neutral facts but active constraints. They anchor women in time-intensive, health-compromising labour, limit the scalability of women-led enterprises, and curtail participation in community governance structures that often meet after dark. Therefore, the quest for women's leadership is inextricably linked to the national energy transition. Decentralised renewable energy solutions, particularly solar-powered technologies for irrigation, processing, and lighting, emerge as essential tools for recalibrating the gendered division of labour, creating climate-resilient economic niches, and freeing the temporal bandwidth necessary for civic engagement.

The research acknowledges its limitations, which also chart a course for future inquiry. Data collection was constrained by the pervasive security situation, limiting physical access to certain regions and potentially influencing participants' responses. The focused study on specific agro-pastoral communities provides depth but means findings cannot be uniformly generalised to all urban or displaced populations. Furthermore, the five-year timeframe captures a snapshot of a protracted crisis; longitudinal studies are needed to trace the long-term impacts of climate adaptation interventions on women's leadership trajectories. Future research should also critically examine the governance of energy projects, investigating how to ensure they are co-designed and managed in ways that bolster women's decision-making authority.

From an African perspective, this study underscores that South Sudan's predicament, while acute, reflects a broader continental reality where climate vulnerability intersects with post-conflict reconstruction and deep-seated gender inequalities. The findings argue against siloed approaches that treat climate adaptation, women's economic empowerment, and political inclusion as separate policy domains. Instead, they advocate for a holistic, energy-centred framework for gender equality in climate action. For policymakers in Juba and their international partners, this implies integrating gender-transformative energy access as a core pillar of both National Adaptation Plans and women's empowerment strategies. Programmes must move beyond providing women with energy-consuming assets to ensuring their meaningful participation in the design, distribution, and benefits of energy systems, including support for women-led energy enterprises and explicit links to leadership training.

In conclusion, this investigation posits that the fierce urgency of climate adaptation in South Sudan presents a contingent opportunity to reimagine gendered power structures. The nation's journey towards

stability and resilience will be fundamentally incomplete if it continues to marginalise half its population. By centring sustainable energy access as a foundational enabler, there exists a tangible pathway to alleviate the compounded burdens climate change imposes on women, to transform their livelihoods from subsistence to agency, and to cultivate the conditions from which a new generation of women leaders can emerge. The period from 2021 to 2026 thus stands as a critical juncture to build back from intersecting crises in a manner that consciously engineers a more inclusive and equitable foundation for South Sudan's future.

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