African Solutions Journal (AfSol Journal)
Volume 5, Issue 2, 2024 (pp. 21)

Energy, Vulnerability and Human Security in Zambia: A Capability Approach to an Inclusive Energy Transition

Biggie Joe NDAMBWA[1]

To Cite this Article

Ndambwa, B. J. (2024). Energy, Vulnerability and Human Security in Zambia: A Capability Approach to an Inclusive Energy Transition. *African Solutions (AfSOL) Journal* 5(2), pp.21.

Manuscript History

Received: 14 August 2024

Accepted: 06 December 2024

Published: 16 December 2024

Link to this Article: https://afsol.ipss-addis.org/browse-journal/current-issue/

Editor-In-Chief: Dr. Andrew E. Yaw Tchie

Managing Editor: Cynthia Happi

ISSN: 2518-8135

[1] Biggie Joe Ndambwa, Lecturer of political science at the University of Zambia and PhD Candidate at the University of South Africa. joe.ndambwa@unza.zm **ORCID ID:** https://orcid.org/0009-0009-1286-4483

Abstract

Over Zambia is one of the countries in Sub-Saharan Africa facing energy challenges due to climate vulnerability caused by the El Nino Southern Oscillation (ENSO). The study uses Amartya Sen and Martha Nussbaum's Capability Approach to analyse the vulnerabilities resulting from Zambia's quest for energy transition. This theoretical framework is critical to understanding the challenges in ensuring an inclusive energy transition process in the country. The methodology and data were mainly from secondary sources. The main argument in this article is that although Zambia has embarked on an energy transition, it is important to consider key human security vulnerabilities in this process. The article shows that Zambia's electricity generation capacity has continued to dwindle primarily due to a decrease in hydro generation, which is highly dependent on rainfall. The study also shows that the Zambian government has devised several strategies and policies aimed at energy transitioning to alleviate the problem. These strategies and policies include promoting non-renewable energy sources like coal, oil, and natural gas to renewable and sustainable energy sources like solar. However, the study shows that while Zambia's energy transition offers long-term benefits, it poses immediate and significant security challenges for the country. These include economic disruptions, infrastructure vulnerabilities, environmental conflicts and policy and regulatory challenges. This article contributes to the ongoing discourse regarding the human security challenges and opportunities for energy transition in Global South countries.

Keywords: Human Security, Vulnerability, Energy Transition and Zambia.

Introduction

Zambia has been facing severe energy shortages due to persistent droughts caused by the El Nino Southern Oscillation (ENSO) and increased demand, which has led to fluctuating hydroelectric energy output (Libanda et al., 2019). As a result, the country has been grappling with significant energy shortages due to its reliance on hydroelectric power, with the Kariba Dam on the Zambezi River being a considerable source, contributing approximately 80 per cent of the country's electricity according to recent estimates (World Bank, 2020). The recurring droughts in the region have drastically reduced water levels in the dam, severely compromising the dam's power generation capacity (Musonda et al., 2020). It must be underscored that this dependency on hydroelectricity leaves Zambia particularly vulnerable to climatic variations, with ENSO-induced droughts becoming more frequent and intense in recent years (Ministry of Energy, 2024).

The droughts in Zambia's energy sector have been devastating and have reduced water levels in the Kariba Dam, directly translating into decreased electricity production, leading to power rationing and energy deficits across the country (Republic of Zambia, 2022). Zambia has also been heavily reliant on hydroelectric power, which accounts for about 85% of installed generation capacity, and the drought has greatly reduced water levels in reservoir dams, leading to a severe decrease in electricity generation in recent years (Musonda et al. 2020; Kesselring, 2017). This situation has affected the country's urban areas and exacerbated challenges in rural areas, where access to reliable electricity is already limited (Ministry of Energy, 2024). As a result, small and medium enterprises and households have been facing energy disruptions, leading to a slowing down in economic activities across key industrial sectors in the country (World Bank, 2019).

The article aims to analyse the key human security vulnerabilities as Zambia transitions its energy sector to renewable sources. The main argument in this article is that as Zambia transitions into renewable sources, it will need to deal with human security vulnerabilities. A theoretical framework focusing on Amartya Sen and Marth Nussbaum's capability approach will follow the introduction. The article outlines the methodology used in collecting and analysing the data collected from various sources. This will be followed by analysing the significance of energy transition within the context of the country grappling with El Nino induced drought. Thereafter, it discusses the challenges of balancing energy transition and human security by outlining key vulnerabilities that Zambia faces in the energy transition process. In conclusion, the article summarises key points and suggests policy recommendations to ensure an inclusive approach to energy transition in Zambia.

Theoretical Framework: Amartya Sen and Martha Nussbaum's Capability Approach

To critically analyse how Zambia's energy transition to renewable sources will affect human security, this article uses the Capability Approach developed by Amartya Sen and Martha Nussbaum. This approach focuses on important aspects of human security, such as fundamental freedoms and opportunities for people to enjoy a meaningful life rather than just having resources, such as energy, at their disposal. According to Sen (1999), human development should be about enhancing people's capabilities—their ability to function in a way that they value and have reason to value. In the Zambian situation, Sen's arguments are essential in understanding how adopting renewable energy will impact the ability of vulnerable sections of society. In particular, Sen's approach seeks to ensure that vulnerable people's capabilities are enhanced, particularly regarding access to energy, economic opportunities, health, education, and political participation. A transition to renewable energy can either expand or restrict these capabilities depending on how the transition is managed equitably.

Therefore, using Sen's approach, this article seeks to underscore that access to energy is a central capability in human development. This is because access to affordable energy is a fundamental enabler of other capabilities—such as education, health, and employment opportunities—especially in a country like Zambia, where millions lack reliable electricity (World Bank, 2019). This is why renewable energy sources, particularly solar power, should have the potential to expand access to energy in remote and rural areas of Zambia and ultimately enhance people's capability to lead healthier, more productive lives. However, suppose the transition is poorly managed or vulnerable. People in rural areas of the country are not considered. In that case, the energy shift may exacerbate inequalities, limiting the capabilities of vulnerable groups and exacerbating existing socio-economic disparities. Thus, the Sens' Capability Approach urges policymakers to focus on technological transition and how this energy shift should enhance or restrict the freedoms of the poorest and most marginalised populations in Zambia.

In addition, Nussbaum's extension of Sen's approach to human security also provides a critical framework for identifying fundamental human capabilities necessary for inclusive human development. Nussbaum (2011) proposes a list of ten central capabilities, including health, education, personal security, and the ability to participate in political and social life. Using this approach, the transition to renewable energy in Zambia should be viewed within the extent to which the shift would impact these capabilities. For instance, a shift to clean energy would reduce air pollution, enhancing

people's health and ability to function in society. Similarly, increased access to renewable energy could also improve educational outcomes by powering schools, enabling school-going children to have electricity at night. However, this development in technological infrastructure that supports access to energy has the potential for displacement and land use conflicts associated with large-scale renewable projects. In the Zambian context, this could potentially threaten the human capabilities of local communities who rely on land for agriculture and livelihoods, as it happened during the construction of the Kariba Dam when most rural communities around that area were displaced (Chanda, 2002).

Therefore, using this approach to human security underscores the importance of agency, that is, the ability of individuals or groups of people to participate in decisions that affect their lives (Robeyns, 2003; Sen, 1999). In the context of Zambia's energy transition, the extent to which communities are involved in planning and implementing renewable energy projects could influence whether the energy transition will enhance or limit their human security in the immediate and long-term. On the one hand, if local populations, particularly those in rural areas, are excluded from the decision-making process, there is a risk of further marginalisation, undermining their capability to influence energy policies that directly affect their socio-economic livelihoods. On the other hand, empowering communities through participation and capacity-building efforts could strengthen their agency and improve their socio-economic situation, thereby ensuring that the energy transition will contribute to enhanced human security. As Sen once argued, true development requires the active participation of individuals in shaping their futures, which is essential for realising their full potential (Sen 1999).

Methodology and Data

This study uses a qualitative approach using secondary data to explore Zambia's energy transition and its implications for human security vulnerability. Secondary data sources, including peer-reviewed journal articles, government and NGO reports, policy documents, and energy sector publications, were analysed to gain insights into Zambia's energy transition process. These sources offered a detailed account of energy access, the shift towards renewable energy, and the broader socio-economic impacts of energy policies on vulnerable populations in primarily rural areas of Zambia. The focus was on documents that addressed energy policies and debate in Zambia, the role of renewable energy in development, and the interconnections between energy access and human security issues such as poverty, health, education, and environmental sustainability.

The data was analysed using a thematic content analysis approach, where key themes related to Zambia's energy transition and human security vulnerabilities were identified. In addition, A capability framework, based on the ideas of Sen and Nussbaum, was applied to assess how the energy transition affects people's ability to live fulfilling lives. This involved evaluating the impact of energy policies on critical capabilities, such as access to education, healthcare, and economic opportunities. By critically analysing existing literature, the study uncovered how energy transition policies in Zambia may exacerbate or mitigate vulnerabilities, offering insights for future policy directions to improve human security through sustainable energy practices.

Significance of Energy Transition in Zambia

The importance of energy transition in Zambia is underscored by the country's heavy reliance on hydroelectric power. This dependence makes Zambia highly vulnerable to the impacts of climate change, mainly the increasing frequency of droughts that reduce water levels in its major hydropower reservoirs. For instance, during the 2023-2024 drought, Zambia faced severe electricity shortages that significantly affected industries, businesses, and households. Diversifying the energy mix by investing in alternative sources like solar, wind, and geothermal power is essential to mitigating these risks and ensuring a more reliable and resilient energy system. According to the International Renewable Energy Agency (IRENA), Zambia has considerable potential for solar power, with some of the highest solar radiation levels in the world, which could be harnessed to reduce the country's dependence on hydropower (IRENA, 2018).

Energy transition is also vital for Zambia's economic development and industrialisation goals. The country's growing economy and expanding population demand more reliable and affordable energy sources. The potential to scale up renewable energy, particularly solar, presents an opportunity to drive down energy costs and foster industrial growth. Zambia's National Energy Policy (2022) emphasises the need for a diversified energy base to stimulate socio-economic development. The Zambian government has been actively working with international partners and financial institutions, such as the World Bank and the African Development Bank, to develop renewable energy projects that could create jobs, stimulate economic activities, and attract foreign investment. According to the World Bank (2020), Zambia has the potential to create up to 300 thousand new jobs by 2030 through the development of renewable energy infrastructure, contributing to a more sustainable and resilient economy.

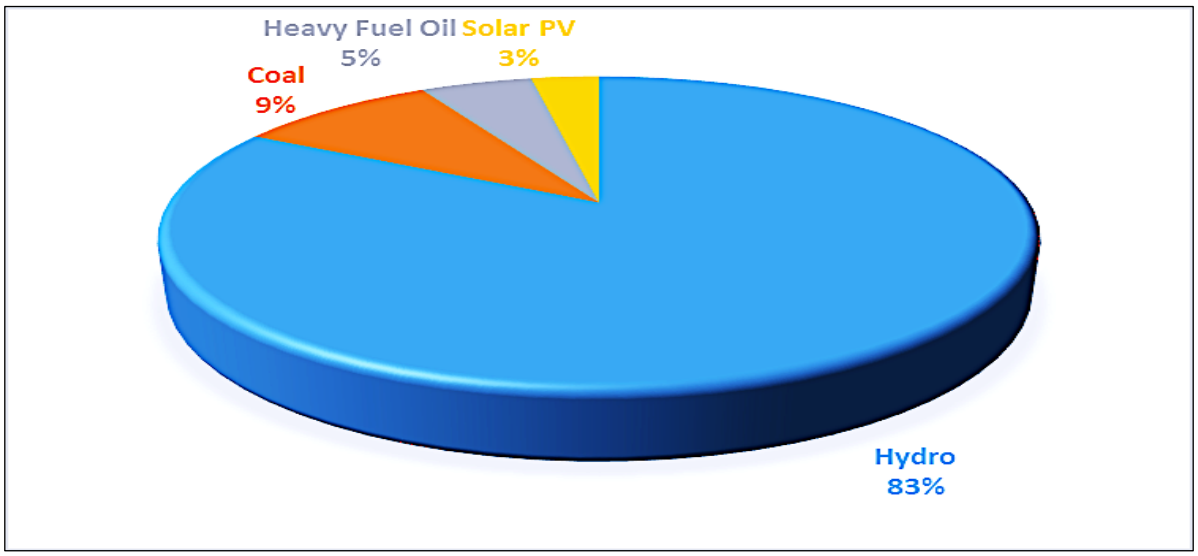
Furthermore, Zambia's energy transition aligns with its commitment to climate action and achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). As a signatory to the Paris Agreement, Zambia has pledged to reduce its carbon emissions, and transitioning to renewable energy is a key strategy in achieving this goal. A study by the UN Development Programme (UNDP) (2020) notes that renewable energy development in Zambia offers significant environmental benefits, including reducing greenhouse gas emissions and enhancing ecosystem sustainability. This transition supports Zambia's climate commitments and improves its standing in global climate negotiations, potentially attracting climate finance and investments to foster sustainable development.

It should be noted that by reducing the country's reliance on fossil fuels and promoting renewable energy, Zambia can contribute to global climate goals while boosting its economic and environmental resilience. As a significant source of greenhouse gas emissions, fossil fuels are a key driver of climate change, and by transitioning away from them, Zambia could significantly reduce its carbon footprint (Republic of Zambia, 2022). This shift would align the country with international efforts, such as those outlined in the Paris Agreement, which aims to limit global warming. Although Zambia's emissions are relatively small globally, its contribution to the fight against climate change is essential. By promoting renewable energy sources like solar, wind, and hydropower, Zambia can actively address environmental challenges and support global sustainability efforts.

In addition to the environmental benefits, transitioning to renewable energy could boost Zambia's economic and environmental resilience (Imasiku et al., 2020; Rose, 2017). This shift could create new industries and job opportunities, attract investment, and reduce reliance on imported fossil fuels, often leading to price volatility. This diversification would help stabilise Zambia's economy in the long term, making it less vulnerable to external economic shocks. Investing in renewable energy can protect the country from the negative impacts of climate change, such as extreme weather events and resource scarcity. By adopting cleaner energy practices, Zambia could build a more resilient economy and environment, ensuring long-term prosperity and stability.

However, Zambia's hydroelectric power, which accounts for approximately 83% of the country's electricity generation capacity, is susceptible to climate change effects, particularly droughts, which affect water levels and, thus, electricity production compared to other energy sources (see Figure 1 below).

Figure 1: Zambia's Installed Generation Capacity



Source: Ministry of Energy. (2024). Zambia's Energy Sector Overview (available at https://www.moe.gov.zm/?page_id=2198 accessed 31st August, 2024)

The installed generation capacity in Zambia stands at about 3,300 Megawatts, with hydropower being the predominant source (Ministry of Energy, 2024). This heavy reliance on hydropower reflects Zambia's vast water resources and exposes the country to climate change and water variability vulnerabilities. Coal, heavy fuel oil, and solar contribute 9%, 5%, and 3% to the installed capacity.

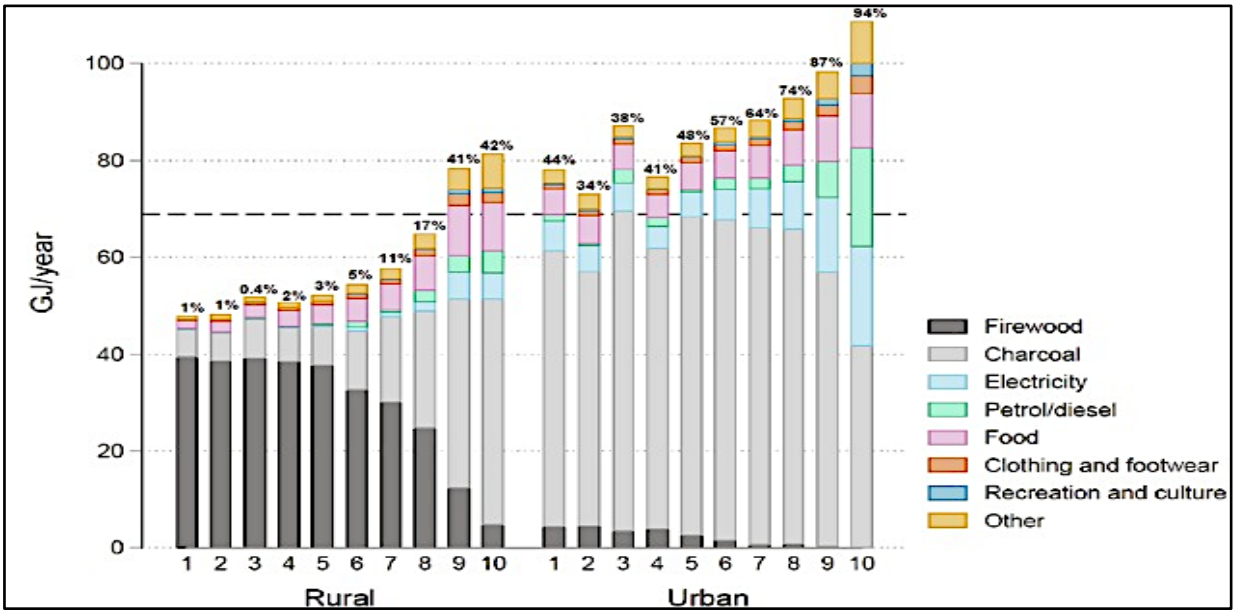
However, despite the significant generation capacity, only 34% of the Zambian population has access to electricity (Ibid). This low electrification rate indicates substantial disparities in energy access between urban and rural areas, posing a challenge to socio-economic development and highlighting the need for policies and investments to increase electricity access. Therefore, energy transition is critical to growing investments in solar and other renewable sources to mitigate these risks and enhance energy security (Sikamo et al., 2016).

The mining sector's substantial electricity consumption underscores its importance to Zambia's economy. However, this also indicates a high dependency on the energy-intensive mining industry, which can pose risks if global demand for minerals fluctuates. There is a need to balance industrial power consumption with expanding electricity access to domestic users, promoting inclusive development (IEA, 2020). In addition, the single-buyer market model with ZESCO as the sole off-taker has advantages in centralised coordination but also presents challenges. ZESCO's financial

difficulties can affect the entire energy supply chain, leading to inefficiencies and potential power shortages (GIZ, 2015).

Further, the low electrification rate, with only 34% of the population having access to electricity, is a significant barrier to socio-economic development. Expanding access requires substantial investments in infrastructure, particularly in rural areas. Innovative solutions such as mini-grids and off-grid solar systems could enhance electricity access and support local development (IRENA, 2019).

Figure 2: Energy Consumption Patterns in Urban and Rural Zambia



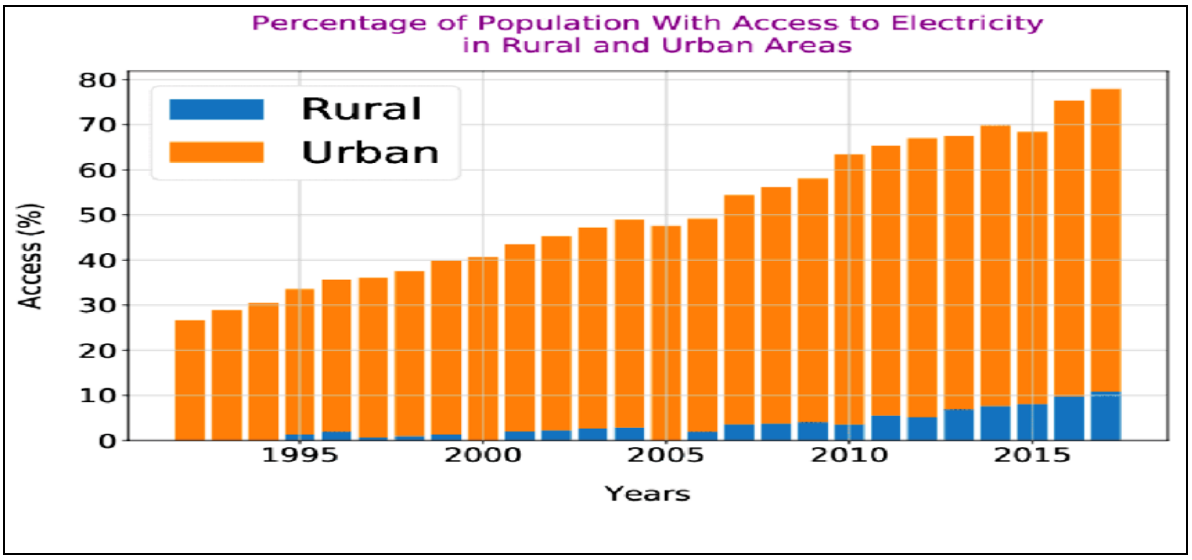
Source: Republic of Zambia (2022) Energy Consumption Patterns in Urban and Rural Zambia https://www.erb.org.zm/wp-content/uploads/files/esr2022.pdf

From the information presented in Figure 2 above, it is essential to underscore that limited access to reliable energy services exacerbates inequality, particularly in rural and low-income areas, restricting their quality of life and economic opportunities (Ministry of Energy, 2019). Therefore, the transition to renewable energy, while essential for sustainable development, poses potential risks and challenges for vulnerable populations in Zambia. One significant risk is the economic cost associated with adopting new technologies. Low-income households and rural communities may find it challenging to afford the initial investment required for renewable energy systems, such as solar, without adequate financial support or subsidies (World Bank, 2021).

Further, infrastructure poses a risk, as rural and low-income areas may lack the infrastructure required to support new energy technologies, potentially perpetuating disparities in energy access (UNDP 2022). In addition, the shift away from traditional energy sources may disrupt established livelihoods, particularly in communities dependent on biomass. To address these disruptions, the Zambian government must implement supportive measures and transition strategies that mitigate adverse effects, such as community participation and capacity building (Energy Regulation Board, 2023). These measures should ensure that communities effectively use and maintain new energy technologies. Without proper training, the benefits of renewable energy may not be fully realised, potentially limiting its positive impact (UNDP, 2022).

It is important to underscore that the percentage of people with access to electricity in Zambia has been increasing over the years (see Figure 4 below). In the past, many rural communities in Zambia relied on biomass fuels such as wood and charcoal for cooking and heating. The transition to renewable energy sources, such as solar power, is gaining traction, but the country faces several challenges. For instance, solar home systems are being implemented in rural areas, benefiting from improved lighting and reduced reliance on kerosene lamps. However, these systems are often costly and may not be affordable for all households, leading to uneven access to the benefits of energy transition (World Bank, 2022).

Figure 3: Percentage of Population with Access to Electricity in Rural and Urban Zambia



Source: Republic of Zambia (2022) Energy Consumption Patterns in Urban and Rural Zambia
https://www.erb.org.zm/wp-content/uploads/files/esr2022.pdf

In addition, there are highly densely populated informal settlements in the capital, Lusaka, like the Kanyama Compound, where residents predominantly use biomass and coal for cooking (Chiwele et al., 2022). The transition towards cleaner energy, including biogas and improved cookstoves, is under and supported by various NGOs and government initiatives. For example, the Zambian government and development partners have promoted the adoption of improved cookstoves that reduce smoke and fuel consumption. Despite these efforts, the transition faces hurdles such as high initial costs and limited awareness about the benefits of these technologies (UNDP, 2023).

In the Copperbelt Province, a key mining region, the energy transition is driven by local and industrial needs. It is essential to underscore that efforts are being made to replace coal and diesel with renewable energy sources, such as solar and hydroelectric power. For instance, introducing solar-powered water pumps in agricultural areas aims to support farming activities and reduce dependency on diesel. Nonetheless, the region faces challenges related to infrastructure and integrating energy sources into existing systems, affecting the smooth adoption of these technologies (AfDB, 2022). Vulnerable groups, including low-income households in both urban and rural areas, are increasingly adopting improved cookstoves designed to be more efficient and less polluting. These cookstoves use less biomass and produce less smoke, which helps reduce health risks associated with indoor air pollution. NGOs and community-based organisations have played a crucial role through subsidised programs and awareness campaigns. However, the high upfront costs and maintenance requirements can still be barriers for some households, according to the World Health Organisation (WHO, 2022).

Solar energy initiatives are being implemented in rural areas to address energy access issues. Programs that provide affordable solar home systems and solar lanterns are helping communities reduce their reliance on kerosene lamps and improve lighting conditions. Yet, the sustainability of these initiatives is often challenged by maintenance issues and the need for ongoing financial support (Energy Regulation Board, 2023). Communities are also developing local adaptation strategies to cope with the changes brought by energy transitions. This shift not only reduces fuel costs but also supports sustainable agricultural practices. However, the success of these strategies depends on the availability of technical support and the affordability of renewable technologies (AfDB, 2022).

Energy Transition and Human Security: Key Vulnerabilities in Zambia

While essential for sustainable development and climate action, the transition to renewable energy sources presents several human security vulnerabilities, especially in countries like Zambia, where access to energy is limited and socio-economic conditions are fragile (Ikenberry et al., 2006). Human security refers to protecting individuals from threats that affect their well-being, including economic, environmental, food, health, personal, community, and political security (Gasper, 2005). The shift to renewable energy, although beneficial in the long term, can lead to short-term challenges that exacerbate existing vulnerabilities, particularly for vulnerable communities that are already struggling with poverty and limited access to essential services like electricity and healthcare.

One of the primary human security concerns for a country like Zambia is economic vulnerability resulting from energy transition (Nawrotzki & De Waard, 2017). For example, the energy transition could also negatively affect the agriculture industry. This could jeopardise food security in Zambia, especially for its rural population, who are highly dependent on agriculture. Moreover, there is the potential for job losses in sectors related to fossil fuel industries. Although Zambia has a small oil and gas sector, the future of coal mining and related jobs could be threatened as the world moves toward decarbonisation. This shift could lead to unemployment and economic displacement, particularly in areas where coal mining is a significant source of income.

In addition, while renewable energy can provide long-term cost savings, the initial costs of transitioning from a hydroelectric-dominant system to renewable sources, such as solar or wind, can be prohibitive for developing countries. The infrastructure required for renewables—such as solar panels, wind turbines, and storage systems—requires significant capital investment, which might divert resources from other critical sectors such as education, health, or agriculture. According to the International Energy Agency (IEA), although renewable energy can help reduce long-term energy costs, the financial burden of upfront investments can create economic challenges, particularly for countries with limited financial resources and capacity for large-scale infrastructural projects (IEA, 2020). This economic pressure can lead to more significant disparities between regions or social groups, benefiting wealthier urban areas. At the same time, rural and poorer populations may not have access to the benefits of clean energy.

Another vulnerability is energy access and social inequality (Resnick & Thurlow, 2014). While renewable energy can enhance access to electricity, particularly in remote or off-grid areas, the transition may inadvertently deepen existing social inequalities if not carefully managed. The initial lack of infrastructure and investment in rural or marginalised areas means that these populations might not immediately benefit from the switch to renewables. A report by the World Bank (2019) highlights that rural communities in Sub-Saharan Africa, including Zambia, often face "energy poverty", defined as the lack of access to modern energy services. Suppose renewable energy systems are not designed with inclusivity in mind. In that case, those living in rural areas or informal settlements may continue to experience energy deprivation, which affects their access to education, healthcare, clean water, and other services essential for human security. The unequal distribution of energy resources could reinforce social exclusion and inequality, making it harder for vulnerable populations to escape cycles of poverty.

In addition, a significant portion of the population in Zambia, especially in remote and rural areas of the country, still lack consistent access to electricity, relying on charcoal and firewood for cooking and heating, according to the Zambia National Statistics Agency (ZamStats, 2022). As the country shifts towards renewable energy sources, transitioning to solar, wind, or other clean technologies might be prohibitive for these vulnerable communities. Furthermore, the financial burden of adopting renewable energy solutions, such as solar home systems or clean cooking technologies, could disproportionately impact low-income households, leaving them further marginalised. Without targeted policies to address these disparities, Zambia's energy transition could inadvertently deepen existing social and economic divides, particularly in rural and disadvantaged areas.

According to Cai et al. (2011), job displacement and labour market impacts also pose significant human security risks during the transition to renewable energy. While the renewable energy sector is expected to create jobs, particularly in the installation and maintenance of renewable technologies, there is also the potential for job losses in traditional sectors related to fossil fuels or large-scale hydroelectric projects. Zambia, for example, has significant hydroelectric infrastructure, and a shift to solar or wind power may displace workers in the hydropower sector. The transition also risks leaving behind workers who may lack the skills required for new renewable energy jobs, creating a labour market divide. The International Labour Organization (ILO, 2021) underscores that transitioning to a green economy must be managed with attention to retraining and reskilling workers to avoid creating "green unemployment." Without targeted programs to support displaced workers,

these vulnerabilities can contribute to economic instability and social unrest, especially in communities heavily reliant on existing energy infrastructure for employment.

Further, environmental displacement also represents a significant vulnerability, particularly in countries where renewable energy projects may require large land areas to construct solar farms or wind turbines (Du et al., 2019). While renewable energy is cleaner and more sustainable, it can also have unintended consequences for local populations who depend on land for agriculture or grazing. In Zambia, the expansion of large-scale renewable projects, if not carefully planned, could lead to the displacement of local communities, affecting their livelihoods. A report by the World Resources Institute (WRI, 2019) points out that while renewable energy projects generally have lower environmental impacts than fossil fuels, land-use conflicts may arise, especially when local populations are not involved in decision-making. Displacement can increase the vulnerability of affected communities, particularly in rural areas where people rely on natural resources for food security and cultural practices.

Furthermore, climate change and environmental risks associated with the renewable energy transition can exacerbate vulnerabilities (Du et al., 2019). While renewables are intended to reduce greenhouse gas emissions and mitigate climate change, some renewable technologies, such as bioenergy or hydropower, can have environmental impacts that may affect local communities. For example, despite being a renewable energy source, hydropower has often been associated with the displacement of populations, changes in water availability, and disruptions to local ecosystems. In Zambia, where hydropower is a dominant energy source, reducing dependence on this form of generation may mitigate water shortages during drought risks, but it also introduces new environmental concerns related to other renewable technologies. For instance, the expansion of solar energy requires substantial land, and improper land-use planning could lead to habitat loss or desertification, affecting local agricultural practices. Therefore, addressing these environmental concerns is critical to ensuring that the energy transition does not inadvertently worsen the vulnerabilities of those dependent on the land and natural resources.

Finally, governance and political security are central to the energy transition's success. Still, poor governance or weak institutional frameworks can undermine efforts to ensure that renewable energy benefits all sectors of society. According to the World Bank (2020), good governance is crucial for ensuring that energy policies align with national development goals and that the benefits of renewable energy are shared equitably. Without strong institutions to oversee the transition, there is a risk that

vested political interests may dominate decision-making, sidelining vulnerable groups and exacerbating tensions between different stakeholders. This could lead to conflicts over energy access, land use, and employment, thus compromising the broader goal of achieving human security through a just and sustainable energy transition.

Conclusion

It should be underscored that Zambia's transition to renewable energy sources holds significant potential to address the country's pressing energy challenges while promoting sustainable development and human security. By shifting from a hydroelectric-dominant system to more diversified sources such as solar and wind, Zambia can reduce its vulnerability to climate-related shocks, expand energy access, and create new economic opportunities. However, as highlighted through Amartya Sen and Martha Nussbaum's Capability Approach, the energy transition is challenging. The success of this shift will depend on how effectively it enhances the capabilities of individuals and communities, especially those in rural and marginalised rural communities of Zambia, to access reliable energy, participate in the decision-making process, and achieve well-being.

While renewable energy has the potential to improve human security by enabling better health, education, and economic outcomes, there are significant risks of exacerbating existing inequalities if the transition is not managed inclusively. Economic vulnerabilities, job displacement, and social exclusion could undermine the benefits of renewable energy if proper attention is not given to the equitable distribution of resources and opportunities. In addition, issues such as land-use conflicts and the displacement of communities for large-scale renewable energy projects must be carefully addressed to prevent further marginalisation of vulnerable populations. Thus, ensuring that the energy transition is people-centred and aligned with the principles of justice, equity, and participation will be crucial for maximising its positive impacts on human security.

Ultimately, Zambia's energy transition presents challenges and opportunities for human development. By applying the Capability Approach, this study underscores the importance of focusing on the technical and economic aspects of renewable energy and the broader human dimensions of the transition. In this context, policymakers must ensure that the shift to renewable energy is inclusive, empowering individuals and communities to enhance their well-being and capabilities. If done thoughtfully, Zambia's renewable energy transition can be a powerful catalyst for sustainable development, human security, and a more resilient future for all its citizens.

Several key recommendations must be considered to ensure that Zambia's transition to renewable energy enhances human security and promotes inclusive development. First, the Zambian government should prioritise equitable access to renewable energy by ensuring that rural and marginalised communities are not left behind, with targeted investments in off-grid solar and wind projects that can reach remote areas. Second, skills development and job retraining programs should be established to support workers displaced by the shift away from fossil fuels or hydropower, enabling them to take advantage of new opportunities in the renewable energy sector. In addition, the Zambian government should carefully address land use and displacement issues by incorporating comprehensive environmental and social safeguards into the design and implementation of renewable energy projects. Finally, regional and international partnerships should be leveraged to secure the financial and technical resources necessary for a sustainable energy transition. By adopting these strategies, Zambia can ensure that the energy transition contributes to broader human development goals while enhancing social equity and environmental sustainability.

Lastly, Zambia's energy transition presents an opportunity to reflect on the significance of the Capability Approach by Amartya Sen and Martha Nussbaum in protecting vulnerable populations in rural and peri-urban areas. The Capability Approach emphasises enhancing individuals' freedoms and abilities to achieve well-being, focusing on empowering people rather than improving economic outputs. This framework can guide policies that ensure the transition to renewable energy improves the lives of vulnerable communities, particularly in rural and peri-urban areas. In this way, energy access is a critical component of the Capability Approach. In rural Zambia, many people lack access to reliable electricity and rely on traditional energy sources like firewood or kerosene, which harm health and the environment. Transitioning to renewable energy, such as solar power, can expand access to electricity, directly improving people's education, health, and economic participation capabilities. Solar energy, for instance, can power schools, healthcare facilities, and homes, reducing the time spent collecting firewood and improving living standards.

Secondly, the creation of sustainable livelihoods is key to the capability framework. In rural areas, many people rely on agriculture or energy-intensive industries. The energy transition can foster new employment opportunities in renewable energy sectors, such as solar panel installation, maintenance, and agro-processing, providing alternative sources of income. However, retraining programs and skills development are essential to ensure inclusivity, especially for workers who may lose jobs in coal mining or other fossil fuel-related industries. This allows individuals to transition into green jobs,

expanding their economic opportunities and capabilities. Participatory governance is central to Sen and Nussbaum's approach. Ensuring that rural and peri-urban communities are actively involved in decisions regarding the energy transition—such as the choice of technologies or energy pricing—empowers them to have a voice in shaping their futures. Local ownership of energy solutions can further strengthen social cohesion and resilience. In this way, Zambia's energy transition can protect vulnerable rural and peri-urban populations by improving their access to energy, creating sustainable livelihoods and fostering active population, ultimately enhancing their well-being and capabilities.

Acknowledgements

I would like to sincerely thank the reviewers for their invaluable feedback and thoughtful comments on this article. Their insights have greatly enhanced the quality and clarity of this work and I appreciate the time and effort they dedicated to reviewing this article from the initial stage up to the final publication.

Declaration of Interest Statement

The author has reported no potential conflict of interest.

Biographical Note

Biggie Joe Ndambwa is lecturer of political science at the University of Zambia. He holds a Master of Arts in Political Science and Bachelor of Arts in Political Science both from the University of Zambia and is currently a PhD candidate at the University of South Africa. His research interests are in environmental politics, political theory, public policy and international relations. His most recent works include the following: Decentralising Climate Governance in the Global South: Lessons from the Kafue wetlands, Zambia published by the Journal of Contemporary Governance and Public Policy 2024; Democratisation and Survival of Liberation Movements in Southern Africa: The Case of Zambia's United National Independence Party published by the Konrad Adenuar Stiftung, 2023).

ORCID ID:

Biggie Joe Ndambwa - https://orcid.org/0009-0009-1286-4483

References

-Abdenur, Adam, R. (2017). Defining and measuring economic resilience from a societal, environmental and security perspective. *Integrated disaster risk management*. https://doi.org/10.1007/978-981-10-1533-5

-AfDB. (2022). Environmental and Social Assessment: Zambia Renewable Energy Financing Framework. Available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/Zambia_-_Zambia_Renewable_Energy_Financing_Framework_%E2%80%93_ESMF.pdf

-AU., UNECA., AfDB., & UNDP. (2023). *2023* Africa Sustainable Development Report. Available at: https://repository.uneca.org/bitstream/handle/10855/49956/b12038799.pdf?sequence=5&isAllowed=y

-Cai, W., Wang, C., Chen, J., & Wang, S. (2011). Green economy and green jobs: Myth or reality? The case of China's power generation sector. Energy, 36(10), 5994–6003. https://doi.org/10.1016/j.energy.2011.08.016

-Chanda, L. (2002). A History of the Gwembe Valley Tonga since the Construction of Kariba Dam, 1958-1998 (University of Zambia MA History Dissertation). Available at: https://dspace.unza.zm/server/api/core/bitstreams/cdf0a6ba-9bf6-4c0a-910c-93e3e94897e4/content accessed 21st November, 2024)

-Chiwele, D. et al. (2022) Informal Settlements in Lusaka: Policy Brief (Habitat for Humanity). Available at: https://www.theigc.org/sites/default/files/2022/02/Informal-settlements-in-Lusaka-web.pdf

-Dahlman, C. J. (1979). *The Governance of Energy: Theory and Practice.* University of Chicago Press.

-Du, K., Li, P., & Yan, Z. (2019). Do green technology innovations contribute to carbon dioxide emission reduction? Empirical evidence from patent data. Technological Forecasting and Social Change, 146, 297–303. https://doi.org/10.1016/j.techfore.2019.06.010

-Gasper, D. (2005). Securing Humanity: Situating 'Human Security' as Concept and Discourse. Journal of Human Development, 6(2), 221–245. https://doi.org/10.1080/14649880500120558

-Green, J., & Thorogood, N. (2009). Qualitative methods for health research. Choice Reviews Online, 47(02), 47–0901. https://doi.org/10.5860/choice.47-0901

-Harvey, D. (2005). *A Brief History of Neoliberalism.* Oxford University Press.

-Ikenberry, G. J., MacFarlane, S. N., & Khong, Y. F. (2006). Human Security and the UN: A Critical History. Foreign Affairs, 85(5), 159. https://doi.org/10.2307/20032086

-Imasiku, K., Thomas, V. M., & Ntagwirumugara, E. (2020). Unpacking Ecological Stress from Economic Activities for Sustainability and Resource Optimization in Sub-Saharan Africa. *Sustainability*, *12*(9), 35-38. https://doi.org/10.3390/su12093538
-International Energy Agency**.** (2020). *World Energy Outlook.* Available at: https://iea.blob.core.windows.net/assets/a72d8abf-de08-4385-8711-b8a062d6124a/WEO2020.pdf

-IRENA. (2019). Opportunities to accelerate national energy transitions through advanced deployment of renewables. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Nov/IRENA_G20_Opportunities_2018.pdf

-IRENA. (2021). Renewable Energy Statistics 2021. Available at: https://www.irena.org//media/Files/IRENA/Agency/Publication/2021/Aug/IRENA_Renewable_Energy_Statistics_2021.pdf

-IRENA. (2022). Renewable energy targets in small island developing states. Available at: https://www.irena.org/Technical-Papers/Renewable-energy-targets-in-SIDS

-IRENA. (2024). World Energy Transitions Outlook 2024: 1.5°C Pathway. Available at: (https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2024/Nov/IRENA_World_energy_transitions_outlook_2024.pdf

-IUCN. (2024). IUCN WCPA Technical Note No.19. Available at: https://iucn.org/sites/default/files/2024-11/renewables-technical-note-19.pdf

-Kesselring, R. (2017). The electricity crisis in Zambia: Blackouts and social stratification in new mining towns. Energy Research & Social Science, 30, 94–102. https://doi.org/10.1016/j.erss.2017.06.015

-Libanda, B., Zheng, M., & Ngonga, C. (2019). Spatial and temporal patterns of drought in Zambia. *Journal of Arid Land*, *11*(2), 180–191. https://doi.org/10.1007/s40333-019-0053-2

-Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook. Journal of Environmental Psychology, 14(4), 336–337. https://doi.org/10.1016/s0272-4944(05)80231-2

-Mitchell, T. (2011). *Carbon Democracy: Political Power in the Age of Oil.* Verso Books.

-Moore, J. W. (2015). *Capitalism in the Web of Life: Ecology and the Accumulation of Capital.* Verso Books.

-Musonda, B., Jing, Y., Iyakaremye, V., & Ojara, M. (2020). Analysis of Long-Term Variations of Drought Characteristics Using Standardised Precipitation Index over Zambia. Atmosphere, 11(12), 1268. https://doi.org/10.3390/atmos11121268

-Nawrotzki, R. J., & DeWaard, J. (2017). Putting trapped populations into place: climate change and inter-district migration flows in Zambia. Regional Environmental Change, 18(2), 533–546. https://doi.org/10.1007/s10113-017-1224-3

-Nussbaum, M. C. (2001). *Women and Human Development: The Capabilities Approach.* Cambridge University Press.

-Ostrom, E. (2005). *Understanding Institutional Diversity.* Princeton University Press.

-Peluso, N. L. (1992). *Rich Forests, Poor People: Resource Control and Resistance in Java.* University of California Press.

-Resnick, D., & Thurlow, J. (2014). The Political Economy of Zambia's Recovery: Structural Change without Transformation? *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.2405715

-Sen, A. (1999). *Development as Freedom.* Oxford University Press.

-Stevens, P. (2013). *Energy Security: A Global Perspective.* Routledge.

-UN. (2021). Theme Report on Energy Transitions: Towards the Achievement of SDG 7 and Net-Zero Emissions. Available at: https://www.un.org/sites/un2.un.org/files/2021/11/2021-twg_2.pdf

-UNDP. (2020). Energy and Human Development: The National Human Development Report Paraguay 2020. Available at: https://www.undp.org/sites/g/files/zskgke326/files/migration/py/UNDP-PY-engINDH_Py_2020_Summary.pdf

-UNDP. (2022). United Nations Development Programme Strategic Plan, 2022 – 2025. Available at: https://www.undp.org/sites/g/files/zskgke326/files/migration/germany/Strategic-Plan-Brochure-2022-25-English.pdf

-Van de Graaf, T. (2012). *The Politics of Oil: Energy and Security in the 21st Century.* Routledge.

-World Bank Group. (2019). Zambia Beyond Connections: Energy Access Diagnostic Report based on the Multi-Tier Framework. Available at: https://documents1.worldbank.org/curated/ar/477041572269756712/pdf/Zambia-Beyond-Connections-Energy-Access-Diagnostic-Report-Based-on-the-Multi-Tier-Framework.pdf

-World Bank Group. (2021). Financing renewable energy Options for Developing Financing Instruments Using Public Funds. Available at: https://documents1.worldbank.org/curated/en/196071468331818432/pdf/765560WP0Finan00Box374373B00PUBLIC0.pdf

-WHO. (2021). WHO global air quality guidelines. Available at: https://iris.who.int/bitstream/handle/10665/345329/9789240034228-eng.pdf

-WHO. (2019). Non-communicable diseases and air pollution. Available at: https://iris.who.int/bitstream/handle/10665/346416/WHO-EURO-2019-3641-43400-60937-eng.pdf

-WHO. (2024). Compendium of WHO and other UN guidance on health and environment. Available at: https://cdn.who.int/media/docs/default-source/who-compendium-on-health-and-environment/who_compendium_chapter2.pdf?sfvrsn=14f84896_8

-Energy Regulation Board. (2023). *Energy Sector Report.* Available at: https://www.erb.org.zm/wp-content/uploads/files/esr2023.pdf

-Energy Regulation Board. (2022). Annual Report. Available at: https://www.erb.org.zm/wp-content/uploads/ERB-2022-Annual-Report.pdf

-Republic of Zambia. (2022). Renewable Energy Strategy and Action Plan. Available at: https://www.moe.gov.zm/wp-content/uploads/2022/08/Renewable-Energy_final-file_for-web.pdf

-Republic of Zambia. (2019*). Zambia National Energy Policy 2019.* Available at: https://www.moe.gov.zm/wp-content/uploads/2024/10/Zambia_The-National-Energy-Policy-2019.pdf

-Zambia National Statistical Office. (2022). *Poverty and Inequality Report.* Retrieved from: https://www.zamstats.gov.zm

-Ministry of Energy. (2024). Zambia's Energy Sector Overview. Available at: https://www.moe.gov.zm/?page_id=2198