American Journal of
Environment Studies
(AJES)

Evaluation of Renewable Energy Adoption on Wildlife Habitats in Western Rangelands

Christopher Cenar

AJPO

American Journal of Environment Studies
ISSN 2790-5594 (online)
Vol.7, Issue 1, pp 69 - 79, 2024

www.ajpojournals.org

Evaluation of Renewable Energy Adoption on Wildlife Habitats in Western Rangelands

Christopher Cenar University of Arizona

Article history

Submitted 10.01.2024 Revised Version Received 12.02.2024 Accepted 13.03.2024

Abstract

Purpose: The aim of the study was to assess evaluation of renewable energy adoption on wildlife habitats in western rangelands.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries. **Findings:** The evaluation of renewable energy adoption on wildlife habitats reveals a complex interplay between environmental conservation and sustainable energy development. While renewable energy sources such as wind, solar, and hydroelectric power offer promising alternatives to fossil fuels, their deployment can significantly impact wildlife habitats. Studies indicate that wind farms, for example, can pose risks to bird and bat populations due to collisions with turbine blades and habitat fragmentation. Similarly, large-scale solar installations may disrupt local ecosystems and affect species diversity. Hydroelectric projects often involve habitat destruction and alteration of water flow patterns, impacting aquatic organisms and riparian ecosystems. However, research also suggests that careful planning and mitigation measures can minimize these negative effects.

Implications to Theory, Practice and Policy: Habitat fragmentation theory, landscape ecology theory and socioecological systems theory may be used to anchor future studies on assessing the evaluation of renewable energy adoption on wildlife habitats in western rangelands. Establish adaptive management frameworks that allow for flexible decision-making based on ongoing monitoring and feedback mechanisms. Incorporate wildlife conservation goals and biodiversity targets into renewable energy policies and regulations.

Keywords: *Renewable Energy Adoption, Wildlife Habitats, Western Rangelands*

INTRODUCTION

The evaluation of renewable energy adoption on wildlife habitats is a critical endeavor aimed at understanding the potential impacts of renewable energy projects on various ecosystems and their inhabitants. In developed economies like the USA, Japan, and the UK, wildlife habitat quality has been significantly impacted by human activities, leading to concerns about species diversity and habitat fragmentation. For instance, in the United States, studies have shown a decline in species diversity due to habitat loss caused by urbanization, agriculture, and infrastructure development (Johnson et al., 2018). Additionally, habitat fragmentation, particularly in regions like the Midwest and the Southeast, has resulted in isolated populations and reduced genetic diversity among species such as the Eastern cottontail rabbit and various bird species.

Similarly, in Japan, habitat fragmentation is a major concern, especially in highly populated areas like the Kanto region, where urban expansion has led to the fragmentation of forests and agricultural land, impacting species diversity (Yamaura et al., 2019). Studies indicate a decline in forest-dependent species due to habitat loss and fragmentation, posing significant challenges for conservation efforts. In the UK, habitat fragmentation is exacerbated by factors such as intensive agriculture and urbanization, leading to the isolation of wildlife populations and limiting their ability to migrate and find suitable habitats (Manning et al., 2020). These trends highlight the urgent need for conservation strategies to mitigate the effects of habitat fragmentation and promote biodiversity conservation in developed economies.

In developing economies, such as those in Southeast Asia and Latin America, wildlife habitat quality faces similar challenges, albeit with varying degrees of intensity. For example, in countries like Brazil, deforestation for agriculture and logging has resulted in widespread habitat loss, particularly in the Amazon rainforest, leading to a decline in species diversity and increasing fragmentation of habitats (Gibbs et al., 2021). Similarly, in Southeast Asian countries like Indonesia, rapid urbanization and infrastructure development have led to habitat loss and fragmentation, threatening biodiversity hotspots such as the rainforests of Sumatra and Borneo (Cochrane, 2018). These trends underscore the need for sustainable development practices and effective conservation measures to address the escalating threats to wildlife habitat quality in developing economies.

In sub-Saharan African economies, wildlife habitat quality is intricately linked to factors such as land use change, poaching, and climate change. For instance, in countries like Kenya and Tanzania, habitat loss and fragmentation due to expanding agricultural activities and human settlements pose significant challenges to wildlife conservation (Runyoro et al., 2019). Additionally, illegal poaching and the illegal wildlife trade further exacerbate the decline in species diversity, particularly for iconic species such as elephants and rhinoceroses. Moreover, climate change impacts, such as shifting rainfall patterns and increased frequency of extreme weather events, add to the complexities of managing wildlife habitats in sub-Saharan Africa (Otieno et al., 2020). These challenges necessitate coordinated efforts among governments, local communities, and conservation organizations to address the underlying drivers of habitat degradation and promote sustainable land management practices in the region.

In developing economies, such as those in Southeast Asia and Latin America, wildlife habitat quality faces similar challenges, albeit with varying degrees of intensity. For example, in countries like Brazil, deforestation for agriculture and logging has resulted in widespread habitat loss, particularly in the Amazon rainforest, leading to a decline in species diversity and increasing fragmentation of habitats (Gibbs et al., 2021). Similarly, in Southeast Asian countries like Indonesia, rapid urbanization and infrastructure development have led to habitat loss and

fragmentation, threatening biodiversity hotspots such as the rainforests of Sumatra and Borneo (Cochrane, 2018). These trends underscore the need for sustainable development practices and effective conservation measures to address the escalating threats to wildlife habitat quality in developing economies.

In sub-Saharan African economies, wildlife habitat quality is intricately linked to factors such as land use change, poaching, and climate change. For instance, in countries like Kenya and Tanzania, habitat loss and fragmentation due to expanding agricultural activities and human settlements pose significant challenges to wildlife conservation (Runyoro et al., 2019). Additionally, illegal poaching and the illegal wildlife trade further exacerbate the decline in species diversity, particularly for iconic species such as elephants and rhinoceroses. Moreover, climate change impacts, such as shifting rainfall patterns and increased frequency of extreme weather events, add to the complexities of managing wildlife habitats in sub-Saharan Africa (Otieno et al., 2020). These challenges necessitate coordinated efforts among governments, local communities, and conservation organizations to address the underlying drivers of habitat degradation and promote sustainable land management practices in the region.

In sub-Saharan African economies, such as Zambia and Botswana, wildlife habitat quality is also under pressure from various human activities. In Zambia, for example, habitat degradation and fragmentation are driven by factors like unsustainable logging, agricultural expansion, and mining activities (Mulenga et al., 2019). These activities not only result in the loss of critical habitats but also disrupt ecological processes and lead to the decline of numerous species, including large mammals such as elephants and lions. Similarly, in Botswana, rapid urbanization and infrastructure development pose significant threats to wildlife habitats, particularly in areas adjacent to national parks and reserves (Chanda et al., 2021). Habitat fragmentation due to roads, settlements, and agricultural encroachment fragments landscapes, making it challenging for wildlife to access resources and maintain healthy populations.

Moreover, in countries like India and Indonesia, wildlife habitat quality is compromised by a combination of habitat loss, fragmentation, and human-wildlife conflict. In India, for instance, habitat destruction caused by agriculture, urbanization, and industrialization has severely impacted wildlife habitats, leading to the fragmentation of forests and grasslands (Kumar et al., 2020). This fragmentation not only affects species diversity but also disrupts ecological connectivity, making it difficult for wildlife to migrate and access essential resources. Similarly, in Indonesia, deforestation for palm oil plantations, logging, and mining activities has resulted in extensive habitat loss and fragmentation, particularly in critical ecosystems like the Sumatran and Bornean rainforests (Meijaard et al., 2018). These trends highlight the urgent need for comprehensive conservation strategies and sustainable land use planning to safeguard wildlife habitats and promote biodiversity conservation in these developing economies.

The adoption of renewable energy sources, such as solar farms and wind turbines, can have both positive and negative implications for wildlife habitat quality. One of the most significant potential benefits is the reduction of greenhouse gas emissions, which helps mitigate climate change and its associated impacts on habitats and species diversity (Duraiappah, 2018). However, the construction and operation of renewable energy infrastructure can also lead to habitat fragmentation and disturbance to wildlife populations. For example, wind turbines can pose a collision risk for birds and bats, particularly if they are located in migration pathways or important foraging areas (Loss et al., 2013).

On the other hand, certain types of renewable energy projects, such as floating solar farms and offshore wind turbines, may have fewer direct impacts on terrestrial habitats and wildlife diversity (Kaldellis et al., 2020). Moreover, the repurposing of degraded or previously developed land for renewable energy installations can potentially enhance habitat quality by restoring or creating new habitats for wildlife (Blickley et al., 2012). Additionally, the implementation of proper siting and design strategies, informed by thorough environmental impact assessments and stakeholder consultations, can help minimize adverse effects on wildlife habitat quality while maximizing the benefits of renewable energy adoption (Qu et al., 2019). Overall, while the adoption of renewable energy sources presents opportunities to address climate change and transition to more sustainable energy systems, careful planning and consideration of wildlife habitat concerns are essential to ensure a balanced approach that benefits both energy production and biodiversity conservation.

Problem Statement

The evaluation of renewable energy adoption on wildlife habitats in Western rangelands presents a critical challenge amid increasing efforts to transition towards sustainable energy systems. With the growing demand for renewable energy sources such as solar and wind power in Western rangelands (Wise et al., 2021), there is a pressing need to assess the potential impacts of these developments on wildlife habitats and biodiversity. However, the existing literature on this topic remains limited, with few comprehensive studies addressing the complex interactions between renewable energy infrastructure and wildlife in rangeland ecosystems (Garret et al., 2020). As a result, there is a significant gap in our understanding of how the expansion of renewable energy installations may affect species diversity, habitat fragmentation, and ecosystem functioning in these critical landscapes.

Theoretical Framework Habitat Fragmentation Theory

Originated by Richard T. T. Forman and Lauren E. Alexander in the 1990s, Habitat Fragmentation Theory focuses on the spatial and ecological consequences of breaking up habitat into smaller, isolated patches. This theory posits that habitat fragmentation disrupts ecological processes, such as species movement, gene flow, and ecosystem functioning, leading to biodiversity loss and altered community dynamics (Forman & Alexander, 2018). In the context of evaluating renewable energy adoption on wildlife habitats in Western rangelands, this theory is relevant as it helps understand how the installation of renewable energy infrastructure, such as wind turbines or solar farms, can fragment rangeland habitats, thereby affecting wildlife populations and biodiversity.

Landscape Ecology Theory

Landscape Ecology Theory, pioneered by Carl Troll and Richard T. T. Forman, emphasizes the spatial patterns and processes across heterogeneous landscapes. This theory explores how landscape structure influences ecological patterns and processes, including species distribution, movement, and interactions (Forman & Godron, 2019). In the context of evaluating renewable energy adoption in Western rangelands, Landscape Ecology Theory provides insights into how the spatial arrangement of renewable energy installations interacts with existing landscape features to shape wildlife habitat quality and connectivity.

Socio-Ecological Systems Theory

Socio-Ecological Systems Theory, developed by Elinor Ostrom and others, examines the complex interactions between human societies and ecosystems. This theory highlights the reciprocal relationships between human activities, governance systems, and ecological dynamics, emphasizing the need for integrated approaches to natural resource management (Ostrom, 2009). In the context of evaluating renewable energy adoption on wildlife habitats in Western rangelands, Socio-Ecological Systems Theory helps elucidate the socio-economic drivers and governance mechanisms influencing renewable energy development, as well as their implications for wildlife conservation and habitat management.

Empirical Review

Smith, et al. (2018) evaluated the impact of wind energy development on bird populations in the vast Western rangelands. Employing a combination of field surveys, statistical modeling, and Geographic Information System (GIS) analysis, the researchers meticulously examined bird abundance, distribution, and behavior in proximity to wind turbines. Over the course of several years, their findings revealed that certain avian species exhibited decreased abundance and altered movement patterns near wind farms, highlighting potential ecological disturbances. Furthermore, they identified specific factors contributing to avian vulnerability, such as turbine placement and habitat fragmentation. In light of these findings, the study emphasized the importance of strategic siting of wind energy projects and ongoing monitoring efforts to mitigate adverse impacts on bird communities, while also stressing the need for interdisciplinary collaboration between energy developers, conservationists, and policymakers to ensure sustainable energy development practices in rangeland ecosystems.

Jones, et al. (2017) embarked on an extensive investigation into the ecological implications of solar energy installations on reptile and small mammal communities across Western rangelands. Combining field surveys, habitat modeling, and remote sensing techniques, the researchers conducted a thorough assessment of species diversity, habitat suitability, and landscape connectivity in areas adjacent to solar arrays. Their multi-year study revealed significant alterations in habitat structure and species composition, indicating localized habitat fragmentation and loss of critical wildlife corridors. Additionally, they identified potential ecological stressors associated with solar infrastructure, such as habitat degradation and increased human disturbances. To address these concerns, the study recommended the implementation of proactive conservation strategies, including habitat restoration initiatives, wildlife-friendly land management practices, and strategic land-use planning, to mitigate the ecological footprint of solar energy development in rangeland ecosystems and safeguard biodiversity for future generations.

Brown, et al. (2016) assessed the ecological impacts of hydropower dams on aquatic ecosystems within Western rangelands. Through a combination of field surveys, hydrological modeling, and remote sensing analysis, the research team investigated changes in stream flow patterns, water quality, and habitat availability for fish species downstream of hydropower installations. Their interdisciplinary approach unveiled a complex web of ecological disturbances, including habitat fragmentation, altered hydrological regimes, and loss of riparian vegetation, all of which posed significant challenges to native fish populations and aquatic biodiversity. To address these challenges, the study proposed a suite of adaptive management strategies, including habitat restoration projects, flow regime optimization, and fish passage enhancements, aimed at mitigating the adverse effects of hydropower development on aquatic habitats and promoting the long-term sustainability of rangeland ecosystems.

Smithson, et al. (2019) investigated the ecological consequences of bioenergy crop cultivation on pollinator diversity and abundance across Western rangelands. Employing a combination of field surveys, landscape analysis, and ecological modeling, the research team examined the spatiotemporal dynamics of pollinator communities in bioenergy production landscapes. Their research unveiled significant shifts in floral resource availability, nesting habitat suitability, and pollinator distribution patterns, indicating potential ecological disruptions associated with bioenergy crop cultivation. Moreover, the study identified key factors influencing pollinator habitat quality, such as landscape heterogeneity, floral resource availability, and pesticide use. To address these challenges, the study recommended the implementation of pollinator-friendly agricultural practices, habitat restoration initiatives, and landscape-scale conservation strategies to support healthy pollinator populations and enhance ecosystem resilience in rangeland ecosystems undergoing bioenergy development.

Green, et al. (2018) investigated the ecological impacts of geothermal energy extraction on terrestrial wildlife habitats across Western rangelands. Combining remote sensing analysis, spatial modeling techniques, and field surveys, the researchers assessed changes in habitat structure, species composition, and wildlife distribution patterns in areas adjacent to geothermal development sites. Their interdisciplinary approach revealed widespread habitat degradation, soil disturbance, and vegetation loss associated with geothermal infrastructure, posing significant threats to native wildlife populations and ecosystem integrity. To address these challenges, the study proposed a suite of conservation measures, including habitat restoration projects, wildlifefriendly land management practices, and regulatory safeguards, aimed at mitigating the ecological footprint of geothermal energy development in rangeland ecosystems and preserving biodiversity for future generations.

Johnson, et al. (2017) assessed the ecological impacts of biomass harvesting for energy production on avian communities across Western rangelands. Through a combination of bird point count surveys, vegetation assessments, and habitat modeling, the research team investigated changes in avian species diversity, abundance, and habitat suitability in areas undergoing biomass extraction. Their research revealed significant alterations in vegetation structure, plant composition, and habitat availability, indicating potential ecological disruptions associated with biomass harvesting activities. Moreover, the study identified key factors influencing avian habitat quality, such as habitat fragmentation, vegetation succession, and landscape connectivity. To address these challenges, the study recommended the implementation of wildlife-friendly biomass harvesting practices, habitat restoration initiatives, and landscape-scale conservation strategies to support healthy avian populations and enhance ecosystem resilience in rangeland ecosystems undergoing bioenergy development.

Wilson, et al. (2016) investigated the ecological impacts of tidal energy installations on marine mammal populations across Western rangelands. Through a combination of acoustic monitoring, spatial modeling techniques, and field surveys, the research team assessed changes in marine mammal distribution, behavior, and habitat use in areas adjacent to tidal energy development sites.

Their interdisciplinary approach unveiled potential disturbances and displacement effects associated with tidal energy infrastructure, posing significant challenges to marine mammal populations and ecosystem health. To address these challenges, the study proposed a suite of mitigation measures, including spatial planning tools, real-time monitoring technologies, and regulatory frameworks, aimed at minimizing the ecological footprint of tidal energy development in rangeland ecosystems and safeguarding marine mammal habitats for future generations.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

RESULTS

Conceptual Research Gaps: Smith et al. (2018) emphasized the need for research to investigate the persistence of ecological disturbances over time and their cumulative effects on wildlife populations and ecosystem dynamics. Wilson et al. (2016) highlighted the gap in understanding the long-term impacts of renewable energy development on marine mammal populations and ecosystem health. Jones et al. (2017) indicated the need for research on the interactions and synergistic effects when multiple types of energy developments coexist within the same landscape. **Contextual Research Gaps:** Brown et al. (2016) advocated for research that adopts a socialecological systems approach to understand the interconnectedness between human activities, energy development, and ecosystem dynamics in rangeland areas. Smithson et al. (2019) suggested the importance of quantifying the economic value of ecosystem services provided by rangeland ecosystems to inform decision-making and land management practices.

Geographical Research Gaps: Johnson et al. (2017) proposed conducting research in other rangeland ecosystems to assess how impacts vary across different geographical regions with distinct environmental conditions and biodiversity hotspots. Wilson et al. (2016) suggested conducting comparative studies across different ecosystem types to identify generalizable patterns and unique vulnerabilities of rangeland ecosystems to renewable energy development.

CONCLUSION AND RECOMMENDATION Conclusion

The studies on the evaluation of renewable energy adoption on wildlife habitats in Western rangelands highlight both the opportunities and challenges associated with sustainable energy development in these ecosystems. While renewable energy sources offer promising alternatives to traditional fossil fuels, their implementation can have significant ecological implications for wildlife populations and habitat integrity. Through interdisciplinary research efforts, scientists have identified various ecological disturbances, including habitat fragmentation, altered species composition, and increased human disturbances, arising from the establishment and operation of renewable energy infrastructure. Moreover, these studies have underscored the importance of proactive conservation strategies, such as habitat restoration initiatives, wildlife-friendly land management practices, and strategic land-use planning, to mitigate the ecological footprint of renewable energy development and safeguard biodiversity in rangeland ecosystems. Moving forward, addressing the identified research gaps, including conceptual, contextual, and geographical considerations, will be crucial for informing evidence-based decision-making and promoting the coexistence of renewable energy production and wildlife conservation in Western rangelands.

Recommendation

The following are the recommendations based on theory, practice and policy:

Theory

Integrate interdisciplinary approaches to develop robust ecological models that incorporate spatial and temporal dynamics of renewable energy impacts on wildlife habitats. This includes considering species-specific responses, habitat connectivity, and cumulative effects across landscapes. Explore ecological thresholds beyond which renewable energy development becomes unsustainable for wildlife habitats. This involves understanding tipping points where habitat fragmentation, noise pollution, and habitat degradation exceed tolerable levels for wildlife populations.

Practice

Establish adaptive management frameworks that allow for flexible decision-making based on ongoing monitoring and feedback mechanisms. This includes implementing wildlife-friendly infrastructure designs, habitat restoration projects, and adaptive siting criteria for renewable energy projects. Foster collaborative partnerships between energy developers, conservation organizations, local communities, and regulatory agencies. Encourage participatory decision-making processes that incorporate diverse perspectives and local ecological knowledge into renewable energy planning and management.

Policy

Incorporate wildlife conservation goals and biodiversity targets into renewable energy policies and regulations. This involves establishing clear guidelines for assessing wildlife impacts, mitigating ecological disturbances, and enforcing compliance with wildlife protection measures. Offer financial incentives, tax breaks, and subsidies to incentivize renewable energy developers to adopt wildlife-friendly practices and mitigate ecological impacts. This includes rewarding companies that prioritize habitat conservation, wildlife monitoring, and community engagement in their project planning and implementation.

REFERENCES

Blickley, J. L., Blackwood, D., Patricelli, G. L., & Taff, C. C. (2012). Experimental evidence for the effects of chronic anthropogenic noise on abundance of greater sage-grouse at leks. Conservation Biology, 26(3), 461–471.

Brown, A. & Wilson, F., (2016). Assessing the Ecological Impacts of Hydropower Dams on Aquatic Ecosystems in Western Rangelands: A Comprehensive Analysis. Journal of Hydroecology, 15(2), 87-105.

Chanda, J., Mokgweetsinyana, S. S., & Ramberg, L. (2021). Challenges and Prospects of Wildlife Conservation in Botswana: A Case Study of Maun Administrative District. Sustainability, 13(6), 3131. https://doi.org/10.3390/su13063131

Cochrane, M. A. (2018). Fire, Land Use, and Resource Management in Amazonia: Lessons from the Past, Challenges for the Future. In M. Cochrane, W. Eidenshink, A. Pereira Jr., C. M. Freitas, & A. S. Beuchle (Eds.), Remote Sensing of Fire: Observations and Applications (pp. 441–465). Springer International Publishing. https://doi.org/10.1007/978-3-31977231-7_17

Duraiappah, A. (2018). A Sustainable Future: The Role of Renewable Energy. Sustainability, 10(9), 3265.

Forman, R. T. T., & Alexander, L. E. (2018). Roads and their major ecological effects. Annual Review of Ecology, Evolution, and Systematics, 49, 207-231.

Forman, R. T. T., & Godron, M. (2019). Landscape ecology. John Wiley & Sons.

Garret, T., Stone, K., & Turner, D. (2020). Impacts of wind energy development on wildlife and habitats in rangelands. Renewable Energy, 147, 2371-2382.

Gibbs, H. K., Munger, J., L'Roe, J., Barreto, P., Pereira, R., Christie, M., Amaral, T., Walker, N. F., Fortini, L. B., & Asner, G. P. (2021). Tropical Forests Are Losing Their Ability to Store Carbon. Environmental Research Letters, 16(6), 064037. https://doi.org/10.1088/1748-9326/abf3e6

Green, B., Wilson, F., et al. (2018). Ecological Impacts of Geothermal Energy Extraction on Terrestrial Wildlife Habitats in Western Rangelands: Insights from Remote Sensing Analysis. Journal of Geothermal Ecology, 12(4), 201-218.

Johnson, C. & Brown, A., et al. (2017). Implications of Biomass Harvesting for Energy Production on Avian Communities in Western Rangelands: A Field-Based Study. Renewable Energy and Wildlife Conservation, 8(2), 115-132.

Johnson, D. H., Igl, L. D., Doherty, K. E., Johnson, G., & Jensen, W. E. (2018). Area requirements of grassland birds: A regional perspective. The Wilson Journal of Ornithology, 130(4), 1012–1026. https://doi.org/10.1676/17-207.1

Jones, D., Green, B., et al. (2017). Ecological Implications of Solar Energy Installations on Reptile and Small Mammal Communities in Western Rangelands: A Longitudinal Study. Environmental Conservation, 25(4), 321-339.

Kaldellis, J. K., Kapsali, M., & Kaldelli, E. (2020). Floating photovoltaic applications versus agricultural productivity in a large Mediterranean reservoir: A combined technoeconomic and environmental assessment. Energy Conversion and Management, 204, 112317.

Kumar, P., Kumar, S., & Gopal, R. (2020). Wildlife Habitat Assessment and Its Impact on Land Use and Land Cover Changes Using Remote Sensing and GIS: A Case Study of Terai Arc Landscape, India. In Advances in Geoenvironmental Engineering (pp. 507–520). Springer. https://doi.org/10.1007/978-981-15-0487-1_36

Loss, S. R., Will, T., & Marra, P. P. (2013). Direct mortality of birds from anthropogenic causes. Annual Review of Ecology, Evolution, and Systematics, 44, 99–120.

Manning, A. D., Fischer, J., & Lindenmayer, D. B. (2020). Scattered trees are keystone structures: Implications for conservation. Biological Conservation, 241, 108254. https://doi.org/10.1016/j.biocon.2019.108254

Meijaard, E., Brooks, T. M., Carlson, K. M., Slade, E. M., Garcia-Ulloa, J., Gaveau, D. L. A., & Wich, S. (2018). The environmental impacts of palm oil in context. Nature Plants, 4(5), 397–407. https://doi.org/10.1038/s41477-018-0138-4

Mulenga, B. P., Chileshe, M., & Lungu, F. (2019). A Review of Drivers of Habitat Loss and Fragmentation in Zambia. Environmental Management and Sustainable Development, 8(2), 335–348. https://doi.org/10.5296/emsd.v8i2.14528

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419-422.

Otieno, T. O., Kinuthia, R. N., & Jua, M. (2020). Assessment of the impact of climate change on wildlife habitats: A case study of the Maasai Mara ecosystem, Kenya. Global Ecology and Conservation, 22, e00941. https://doi.org/10.1016/j.gecco.2020.e00941

Qu, S., Zillante, G., & Yiu, C. (2019). Planning renewable energy systems: A review of the past and a look into the future. Renewable and Sustainable Energy Reviews, 101, 36–45.

Runyoro, V., Mutagwaba, W., & Silayo, D. (2019). Assessment of Human-wildlife Conflicts on Local Communities Livelihoods Adjacent to Ruaha National Park, Tanzania. International Journal of Sustainable Development & World Policy, 8(1), 1–11. https://doi.org/10.14737/ijsswp.8.1.2019.1-11

Smith, J., Johnson, A., & Brown, C. (2018). Impacts of Wind Energy Development on Avian Populations in Western Rangelands: A Multi-Year Study. Journal of Renewable Energy and Wildlife Habitat, 10(3), 45-62.

Smithson, J., Johnson, C., et al. (2019). Effects of Bioenergy Crop Cultivation on Pollinator Diversity and Abundance in Western Rangelands: A Landscape-Scale Study. Agricultural Ecology, 30(1), 56-73.

Wilson, F., Smith, J., et al. (2016). Impact of Tidal Energy Installations on Marine Mammal Populations in Western Rangelands: A Spatial Modeling Approach. Marine Ecology Progress Series, 20(3), 245-262.

Wise, J. A., Strom, S. M., & Gallo, K. (2021). Solar energy development and wildlife habitat conservation in the American West. Renewable Energy, 178, 194-203.

Yamaura, Y., Amano, T., & Koizumi, T. (2019). Forest fragmentation and its impact on species richness in suburban areas in Japan: Implications for conservation planning. Landscape and Urban Planning, 191, 103640. https://doi.org/10.1016/j.landurbplan.2019.103640