SUSTAINABLE RURAL ENERGY USE IN PROMOTING BIODIVERSITY CONSERVATION AND COMMUNITY DEVELOPMENT IN KAJIADO SOUTH SUBCOUNTY.

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Key Messages

- There is a strong relationship between energy use and biodiversity conservation.
- There is a need for all levels of government to embrace sustainable rural energy use to support biodiversity conservation and environmental protection.
- There is potential for the adoption of affordable energy sources in rural areas of Kenya.
- Planning should incorporate energy use and source diversification to support socio-economic growth and development.

Context

Kajiado South Sub-County is located in the southeastern part of Kenya and forms part of the country's expansive arid and semi-arid lands (ASALs). Several group ranches lie within this sub-county, among them the Kuku Group Ranch. This community-owned ranch lies within a critical ecological wildlife corridor that links the Amboseli and Tsavo ecosystems, as shown in Figure 1.

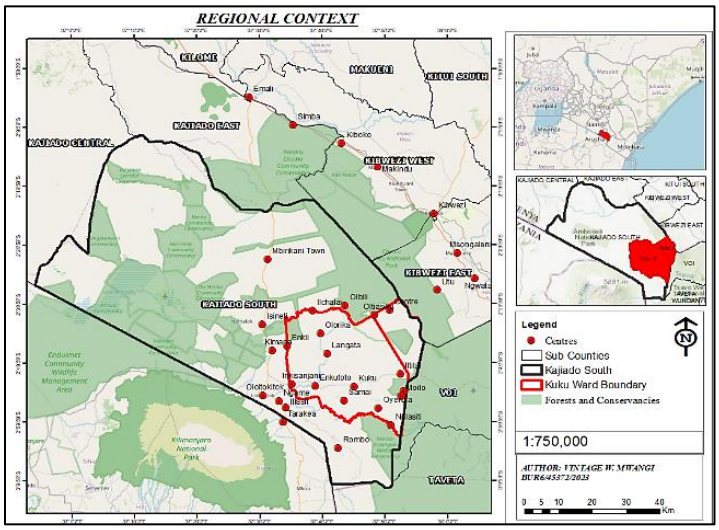

Figure 1: Location of Kuku Group Ranch within Kajiado South Sub-County
Source: Authors, 2025

Kuku faces an ongoing challenge in balancing energy needs with conservation goals. The heavy reliance on unsustainable biomass fuels has accelerated forest depletion, which is crucial for biodiversity conservation and carbon sequestration in the region (Namaswa et al., 2022).

Firewood remains the predominant source of household energy, as shown in Figure 2. The scarcity of alternative energy options, combined with weak policy enforcement, has contributed to widespread vegetation loss, declining water availability, and increased vulnerability to climate change. Women and children, who shoulder the burden of firewood collection, are disproportionately affected.

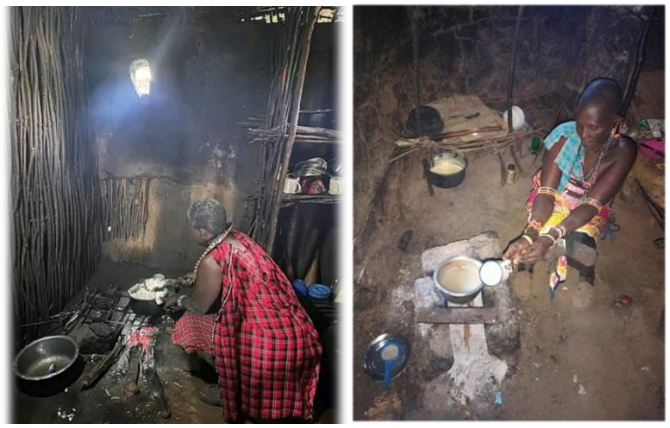

Figure 2: Firewood being used for cooking by the women in the ranch
Source: Field survey, 2025

Moreover, access to modern electricity services remains low, with only 30% of households connected to the national grid. There is also limited research on the relationship between access to clean energy and biodiversity conservation in this region. Existing policies and interventions have yet to adequately integrate sustainable energy solutions with conservation strategies or fully account for the socio-economic implications of energy transitions. Kajiado South, therefore, presents both a challenge and an opportunity through the chance to demonstrate how clean energy transitions can support environmental sustainability and local development simultaneously.

Approach and Results

This study was undertaken as part of a research project aimed at assessing the potential of sustainable energy in promoting biodiversity conservation and community development in Kuku Group Ranch. The study was guided by four specific objectives: i) to assess the current energy access and usage patterns in the ranch; ii) to analyze the impact of traditional biomass fuel use on land use and biodiversity; iii) to assess the socio-economic implications of adopting sustainable energy solutions; and iv) to develop recommendations for integrating clean energy into biodiversity conservation strategies.

A mixed-methods research design was adopted. Quantitative data were collected through 122 household surveys, while qualitative insights were drawn from three focus group discussions and seven key informant interviews. Figure 3 shows one of the focus group discussions done with the community.

Figure 3: During a focus group discussion with the community
Source: Field survey, 2025

The respondents included group ranch leaders, chiefs, sub-chiefs, as shown in Figure 4, representatives from the Maasai Wilderness Conservation Trust (MWCT), Kenya Wildlife Service (KWS), the Chyulu Hills REDD+ Project, and teachers. Field observations complemented these methods to enrich contextual understanding. Additionally, spatial analysis was conducted using satellite imagery from 2000 to 2022 to detect land cover change and model projections for the year 2030.

Figure 4: After a key informant interview with the chiefs and sub-chiefs
Source: Field survey, 2025

The findings revealed that over 80% of households rely on firewood as their primary cooking fuel. Women and girls spend an estimated 12 or more hours per week collecting fuelwood, a practice linked to both forest degradation and gendered labor burdens. Spatial analysis confirmed a decline in dense forest cover, sparse vegetation cover, and a doubling of bare ground coverage since 2000. The pie charts in Figure 5 illustrate the difference in vegetation cover in the years 2000 and 2022.

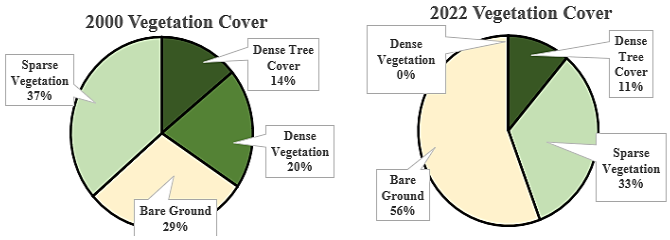

Figure 5: Vegetation Cover in 2000 Vs 2022
Source: Authors, 2025

On the other hand, the community awareness of clean energy is relatively high; however, adoption remains low, primarily due to upfront costs and technical limitations. This, therefore, necessitated the study to explore viable clean cooking alternatives suited for the local context via the Multi-Criteria Decision Analysis (MCDA). The MCDA evaluation ranked biomass briquettes with afforestation highest at 4.38, followed by biogas at 3.75, and solar at 3.63. The biomass briquettes and afforestation alternative were noted to offer scalability, affordability, and community benefits. Figure 6, therefore, shows an example of a cookstove and the briquettes.

Figure 6: Example of an improved cookstove and biomass briquettes
Source: eco-charcoal, limited

On lighting, only 30% of households are connected to the national grid. However, the region shows substantial promise for solar energy utilization, with direct normal irradiance ranging from 4.2 to 4.8 kWh/m²/day which is sufficient to meet all household and institutional energy needs through solar. This potential has already been partially realized as two ecotourism lodges in the area operate entirely on solar power. Solar-powered boreholes, as shown in Figure 7, support community water access, and solar lighting has been installed at livestock bomas to deter nocturnal wildlife raids.

Figure 7: A solar-powered borehole in Moilo Primary that serves the school and the neighbouring village.
Source: Field survey, 2025

The study thus concluded that conservation and sustainable energy are mutually reinforcing goals. A holistic, integrated approach, one that aligns clean energy initiatives with biodiversity conservation, can yield transformative outcomes in pastoralist and dryland settings in Kajiado South Sub-County, such as Kuku.

Policy Recommendations

The study has proposed policy and planning interventions for the accelerated development of the sub-county. These interventions support not only the long-term resilience of Kajiado South Sub-County but also contribute to Kenya's climate and development agenda.

Short-Term Policy Recommendations

- The County Government of Kajiado should prioritize mapping rural energy access and biomass demand patterns across the Sub-County. Participatory GIS and fuel-use surveys can help identify hotspots of deforestation and inform targeted clean energy interventions.
- A dedicated rural energy strategy should be formulated at the County level to link energy planning with land use management, climate change adaptation, health outcomes, and biodiversity conservation goals.
- The County Government and NGOs should introduce and demonstrate clean cooking technologies to the community. The improved cookstoves and briquette use among households should be complemented by community-level demonstrations comparing traditional and improved cooking systems. Institutional biogas digesters can be piloted in schools or group ranch centers to test feasibility.
- Promotion of off-grid solar solutions through a public-private partnership. Access to solar home systems, lanterns, and solar-powered water pumps should be scaled up. This should be done with a focus on affordability through community co-financing, subsidies, or energy cooperatives.
- Widespread awareness campaigns should be conducted by national agencies and the County government of Kajiado on the benefits of clean energy, leveraging existing women's and youth groups, school clubs, and barazas. These should include practical demonstrations of cookstove efficiency and solar usability.
- The County government of Kajiado should enforce land use regulations that protect sensitive forest areas and encourage designated woodlot zones. They should also integrate energy considerations into ongoing land adjudication and zoning plans for group ranches.

Medium to Long-term

- Agroforestry and reforestation should be integrated into rural planning by the county government of Kajiado and the National Ministry. Agroforestry and institutional woodlots, especially around schools, churches, and trading centers, should be incorporated into spatial and land use plans. Fast-growing, native tree species with fuelwood potential and carbon sequestration benefits should be encouraged.
- Local energy ambassadors and technicians should be trained through a public-private partnership on solar installation, stove maintenance, briquette production, and monitoring. This is expected to create green jobs and increase the retention of systems through community ownership.
- The County Government Department of Education, through the Ministry of Education, should develop energy literacy programs that include tree-planting clubs, solar kit demonstrations, and fuel-saving competitions. These will foster early environmental awareness and long-term behavioral change among students.
- A multistakeholder integrated energy-conservation action plan should be developed. The inter-agency action plan should align clean energy deployments with restoration zones, solar-powered water access points, and human-wildlife buffer zones.
- The County should align County programs with national commitments, e.g., Kenya's Clean Cooking Strategy, Forest Restoration Agenda, and global frameworks like REDD+ and the SDGs. This will help tap into carbon finance and climate adaptation funds to scale clean energy interventions.
- The community and the Maasai Wilderness Conservation Trust should establish monitoring and adaptive management mechanisms. The system will track clean energy adoption, forest cover changes, and socio-economic outcomes. This data can be used to adjust strategies annually in collaboration with local and external stakeholders.

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