Hurri hills. ~ Dickson Mukunga (Mercy Corps)

The Resilient Approaches in Natural Rangeland Ecosystems (RANGE) Programme

Ecoysytems and Biodiversity Analysis Report

Netherlands

MERCY CORPS

FCDC

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Abbreviations

ASALs	Arid and Semi-Arid Lands
CCCF	County Climate Change Funds
CBNRM	Community-Based Natural Resource Management
ELD	Economics of Land Degradation
ENNDA	Ewaso Ng'iro North Development Authority
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
FCDC	Frontier Counties Development Council
FIGARE	Friends of Isiolo Game Reserves
IDDRSI	IGAD Drought Disaster Resilience and Sustainability Initiative
IBAs	Important Bird Areas
ICCCF	Isiolo County Climate Change Fund
IGAD	Intergovernmental Authority on Development
ILRI	International Livestock Research Institute
IUCN	International Union for Conservation of Nature
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
KIIs	Key Informant Interviews
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
NPI	Non-Pastoral Income
NRT	Northern Rangelands Trust
PES	Payment for Ecosystem Services
RANGE	Resilient Approaches in Natural Rangeland Ecosystems
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development

Executive summary

Introduction and Purpose

The Arid and Semi-Arid Lands (ASALs) of Northern Kenya, which include the Counties of Isiolo, Marsabit, and Samburu, represent a significant ecological and socio-economic region. These areas cover over 80% of Kenya's landmass and are home to approximately 18 million people, roughly 36% of the country's population. Characterized by low annual rainfall, they are particularly vulnerable to droughts, flooding, and the increasing impacts of climate change, which pose significant risks of desertification. Historically, traditional rangeland management systems allowed for sustainable coexistence between communities and their environment, but the collapse of these systems has led to conflicts and resource degradation. Mercy Corps' Resilient Approaches in Natural Rangeland Ecosystems (RANGE) program, funded by the Embassy of the Kingdom of the Netherlands, aims to address these challenges through a 5-year initiative focusing on the three ASAL counties. This inception assessment is designed to evaluate initial conditions and guide evidence-based programming for biodiversity conservation and management.

Methodology

This assessment employed a comprehensive mixed-methods qualitative research design approach, combining qualitative data collection techniques and desk reviews to gain a holistic understanding of the complex dynamics in Isiolo, Marsabit, and Samburu Counties. Primary data collection was conducted through in-depth interviews (IDIs), focus group discussions (FGDs), and key informant interviews (KIIs). These methods facilitated a nuanced exploration of the interrelationships between biodiversity, climate change impacts, conservation strategies, socio-economic aspects, and governance mechanisms. The sampling strategy ensured the inclusion of diverse perspectives and experiences relevant to the study's objectives.

Biodiversity Overview

The counties of Isiolo, Marsabit, and Samburu are rich in biodiversity, encompassing diverse ecosystems such as savanna grasslands, Acacia-Commiphora bushlands, riparian forests, and isolated highland forests. These habitats support a wide range of flora and fauna, including endangered species like Grevy's zebra *(Equus grevyi)* and Reticulated giraffe *(Giraffa camelopardalis reticulata)*. The region is also home to significant bird diversity, with over 350 species recorded, and several Important Bird Areas (IBAs) recognized by BirdLife International.

> Historically, traditional rangeland management systems allowed for sustainable coexistence between communities and their environment, but the collapse of these systems has led to conflicts and resource degradation.

Challenges Facing Biodiversity

Several interconnected challenges threaten the biodiversity of these counties. Climate change exacerbates drought cycles, alters species distributions, and intensifies conflicts over resources. Habitat fragmentation due to infrastructure development disrupts wildlife movement and increases human-wildlife conflict. Invasive species like Prosopis juliflora degrade rangelands, reducing forage quality and availability. Unsustainable resource extraction, poor water management, and lack of integrated land-use planning further complicate management and conservation efforts. Human-wildlife conflict remains a significant issue, often resulting in retaliatory killings of wildlife and negative attitudes towards conservation.

Key Biodiversity Hotspots and Protected Areas

The region features several key biodiversity hotspots and protected areas, including Marsabit National Park and Reserve, Samburu National Reserve, and Buffalo Springs and Shaba National Reserves. Community conservancies like Nasuulu, Oldonyiro, Merille Laisamis Koya (MELAKO) conservancy, Sagante/Jaldeas community conservancy and Biliqo Bulesa play crucial roles in expanding protected areas and involving local communities in conservation efforts. However, these areas face challenges such as habitat fragmentation, climate change impacts, poor governance and human-wildlife conflict. These protected

areas and community conservancies are essential for biodiversity conservation but require coordinated efforts to address these ongoing challenges.

Conservation and Management Strategies

Effective biodiversity conservation in these counties requires ecosystem-based approaches, cross-sectoral collaboration, and community-based conservation models. Holistic planned grazing, sustainable water management, and integrated watershed management are key strategies being implemented. Community- based initiatives, such as the Grevy's Zebra Ambassador Program and the Isiolo Camel Forum, demonstrate the potential for integrating conservation with local livelihoods. These initiatives emphasize the importance of local community involvement and traditional knowledge in conservation efforts.

Governance and Policy Frameworks

Inclusive governance mechanisms are essential for effective biodiversity conservation. The Community Land Act (2016), Wildlife Conservation and Management Act (2013), and County Climate Change Act provide legal frameworks supporting community-based conservation. These policies facilitate community participation in wildlife conservation, forest management, and climate change adaptation. Cross-border governance initiatives, such as the Kenya-Ethiopia Cross-Border Programme, facilitate coordinated management of shared ecosystems and migratory wildlife populations. These frameworks and initiatives are crucial for creating an enabling environment for sustainable natural resource management.

Socio-Economic Aspects

Biodiversity in the three counties, whilst sometimes creating conflict and grazing competition, is crucial for pastoralist livelihoods, providing essential ecosystem services such as food, water, and medicinal plants. Economic diversification through alternative livelihoods, such as eco-tourism, beekeeping, and sustainable harvesting of non-timber forest products such as gums and resins, reduces pressure on natural resources and enhances community resilience. Education and capacity building initiatives foster a new generation of conservation leaders and empower communities to sustainably manage their resources. These efforts are vital for creating sustainable socio-economic development that is aligned with conservation goals.

Conclusion

The RANGE program's biodiversity inception assessments underscore the need for integrated, adaptive approaches to biodiversity conservation in the three programming counties. By leveraging traditional knowledge, fostering cross-sectoral collaboration, and promoting community-based conservation models, there is potential to create resilient socio-ecological systems that benefit both people and nature. Continued investment in research, policy development, and on-the-ground implementation is essential to address the complex challenges facing these regions and ensure sustainable development outcomes.

Key Themes and Recommendations

1.  **Integrated Ecosystem Management:** Emphasize the need for ecosystem-based approaches that consider the interconnectedness of various ecological, socio-economic, and cultural systems.

2.  **Community Participation and Ownership:** Foster community-led conservation initiatives that ensure local ownership and benefit-sharing, leveraging traditional knowledge and practices.

3.  **Innovative Financing Mechanisms:** Develop sustainable financing mechanisms, such as Payment for Ecosystem Services (PES) schemes and carbon credits, to support long-term conservation efforts.

4.  **Adaptive and Flexible Approaches:** Implement adaptive management strategies that allow for continuous learning, monitoring, and adjustment of conservation activities to respond to changing conditions and new information.

5.  **Cross-Sectoral Collaboration:** Strengthen partnerships between government agencies, NGOs, the private sector, and local communities to enhance the effectiveness of conservation efforts and address shared challenges.

6.  **Education and Capacity Building:** Invest in education and capacity-building initiatives to develop conservation leaders and empower communities with the skills needed for sustainable resource management.

7.  **Economic Diversification:** Promote alternative livelihoods that reduce dependency on natural biodiversity resources, enhance community resilience, and align with conservation objectives.

Based on RANGE programme's objectives, below are some more specific and actionable recommendations:

Integrated Rangeland Management:

- Develop detailed Participatory Land Use Plans (PLUPs) in the three counties, integrating grazing patterns, water access points, and conflict hotspots.
- Support County Governments to finalize and operationalize County Rangeland Management Bills, ensuring alignment with the Community Land Act.

Community-Led Conservation:

- Establish and train community rangeland management committees per county on sustainable grazing practices and ecosystem restoration techniques.
- Implement a grant facility to fund community-driven initiatives for rangeland restoration, targeting various projects across the three counties.

Innovative Financing:

- Conduct a feasibility study on carbon credit potential from improved rangeland management in the three counties.
- Pilot at least one Payment for Ecosystem Services scheme, potentially focused on water catchment protection.

Adaptive Management:

- Establish a quarterly review and adaptation process, utilizing ITC's longitudinal data and Mercy Corps' MEL systems to inform program adjustments.
- Develop county-specific early warning systems that integrate climate, conflict, and market data to guide rapid response interventions.

Multi-Stakeholder Collaboration:

- Formalize partnerships with private sector actors per county to improve livestock value chains and promote sustainable rangeland practices.
- Support FCDC to convene bi-annual cross-county forums on shared rangeland management challenges and solutions.

Capacity Building:

- Train local government officials across the three counties on geospatial data analysis for improved land use planning.
- Develop a curriculum on sustainable rangeland management and deliver it to pastoralists and agro- pastoralist communities in the county.

Economic Diversification:

- Support the development of county-specific alternative value chains (e.g., beekeeping, aloe vera production) that are compatible with sustainable rangeland management.
- Establish linkages between women and youth groups and financial institutions to access credit for diversified livelihood activities.

Policy Support:

- Advocate for the finalization and implementation of the National Livestock Policy, focusing on provisions for sustainable pastoral systems.
- Support County Governments to develop climate-smart livestock strategies that integrate improved breeding, feed management, and disease control measures.

Future Directions

Addressing the challenges and capitalizing on the opportunities in the three counties will require a concerted effort from all stakeholders. By building on the successes of current initiatives and learning from ongoing challenges, there is potential to achieve meaningful conservation outcomes that support both biodiversity and human well-being. This comprehensive approach will ensure that the unique landscapes of the three counties are preserved for future generations while providing sustainable livelihoods for the communities that depend on them.

Introduction

Background And Purpose

The Arid and Semi-Arid Lands (ASALs) of Northern Kenya represent a critical ecological and socio- economic region. Covering over 80% of Kenya's landmass, these areas are home to approximately 18 million people, roughly 36% of Kenya's population[1]. Characterized by low annual rainfall, these regions are particularly vulnerable to droughts, flooding, and the increasing impacts of climate change, which pose significant risks of desertification (UNEP, 2021). The three counties assessed—Isiolo, Marsabit, and Samburu—are located within these ASALs.

Historically, these ASALs were managed through traditional rangeland management systems, allowing communities to coexist peacefully and graze their livestock sustainably. However, the collapse of these traditional systems in recent years has led to conflicts, resulting in loss of lives and livestock. In response to these challenges, new grazing management concepts have been introduced, helping to restore normalcy and attract investors, especially in fodder production (Kenya National Bureau of Statistics, 2022).

Mercy Corps has initiated Inception Assessments for its newly launched Resilient Approaches in Natural Rangeland Ecosystems (RANGE) program. The RANGE program is a 5-year initiative implemented by Mercy Corps in Marsabit, Isiolo and Samburu counties. It aims to strengthen the resilience of communities to improve sustainable economic and social development in a well-managed landscape of the three targeted ASAL counties. RANGE proposes an integrated package of activities and interventions that will: strengthen rangeland management and encourage regenerative practices, ensuring migratory and sedentary livelihoods can peacefully co-exist; improve herd management and market access for small-scale producers; strengthen the institutions and policy frameworks that govern the livestock sector, and prioritize the development of robust spatial-temporal data sets to strengthen outcomes and help mitigate the impact of climate change and prevent further land and rangeland degradation. The assessments aim to evaluate the initial conditions and context as the program begins its implementation.

These Inception Assessments will provide contextual knowledge ensuring that program activities are tailored to the realities on the ground in the target counties. They will enable the program team and other stakeholders to make informed decisions about adapting interventions to achieve positive outcomes.

This report is part of the Inception Assessments and provides a detailed analysis of the current state of biodiversity in the ASAL counties of Isiolo, Marsabit, and Samburu. It examines the impacts of climate change on ecosystems and livelihoods, evaluates existing conservation strategies, and assesses the socio-economic and governance aspects of biodiversity management. The findings will inform evidence-based programming for the RANGE program and guide sustainable development initiatives that address the unique needs of the ASAL communities, while promoting climate resilience and environmental conservation.

> The RANGE Program aims to strengthen the resilience of communities and improve sustainable economic and social development in a well-managed landscape of the three targeted ASAL counties.

1 https://kippra.or.ke/pathways-to-sustainable-land-use-in-arid-and-semi-arid-lands-in-kenya/

Overview of Isiolo, Marsabit, and Samburu ASAL counties

Isiolo County, covering an area of approximately 25,336 square kilometers, is strategically positioned at the center of Kenya. It borders Marsabit County to the north, Samburu and Laikipia counties to the west, Garissa County to the southeast, and Wajir and Meru counties to the east and south respectively. The county has a population of about 268,002 (139,510 males, 128,483 females) according to the Kenya Population and Housing Census 2019 . Isiolo's climate is predominantly arid and semi-arid, characterized by hot and dry conditions with two main rainy seasons. According to the third Isiolo County Integrated Development Plan[2], the county is characterized by three major agroecological zones: the Semi-Arid Zone, the Arid Zone, and the Severe Arid Zone, each significantly influencing vegetation, pasture availability, and livestock populations in the region. The county's geography features expansive plains and significant water bodies such as the Ewaso Ng'iro River, which is vital for local livelihoods and wildlife.

Marsabit County, the second-largest county in Kenya, spans an impressive 70,961 square kilometers. It shares borders with Ethiopia to the north, making it a key frontier region. The county's population was approximately 459,785 (243,548 males 216219 females) as of the 2019 census. Marsabit is known for its diverse ethnic communities, including the Rendille, Gabra, Borana, and Samburu. The county's terrain is varied, featuring mountainous areas like Mount Marsabit, vast plains, and notable water bodies including Lake Turkana. Marsabit experiences erratic and unevenly distributed rainfall, leading to frequent droughts that significantly impact its predominantly pastoralist population. Marsabit County is divided into four agroecological zones: Zone III, suitable for horticultural and food crop production; Zone IV, which supports settled livestock rearing and mixed farming; Zone V, characterized by acacia woodlands suitable for small livestock; and Zone VI, primarily suitable for camel rearing due to its arid conditions

Samburu County, covering about 21,000 square kilometers, is situated in north-central Kenya. It borders Marsabit County to the north, Isiolo County to the east, and other counties including Laikipia, Baringo, and Turkana. As of the 2019 census, Samburu had a population of approximately 310,327(156,774 males 153,546 females). The county is home to diverse ethnic communities, with the Samburu people being predominant, alongside Turkana and Rendille communities. Like its neighbors, Samburu experiences an arid and semi-arid climate with hot and dry conditions punctuated by two rainy seasons. Samburu County encompasses five agro-ecological zones: Upper Highland (UH), Lower Highland (LH), Upper Midlands (UM), Lower Midlands (LM), and Inner Lowland (IL), each characterized by varying rainfall and land use potential. More than 75% of the county is classified as low-potential rangeland, receiving between 250-600 mm of rainfall annually, while only a small percentage is suitable for agricultural production, benefiting from higher rainfall levels.

The county's landscape includes vast plains, hills, and important water sources like the Ewaso Ng'iro River.

In all three counties, pastoralism forms the backbone of the local economy, with livestock rearing being the primary livelihood for many residents. However, these regions face numerous challenges, including frequent droughts, limited access to basic services, poor infrastructure, and periodic conflicts often driven by competition over scarce resources.

2 https://www.isiolo.go.ke/userfiles/media/isiolo.go.ke/23092810563465155be24961ecounty-integrated-development-plan-iii-county-government.pdf

Methodology and Research Questions

This assessment employed a comprehensive mixed-methods qualitative research approach, combining various qualitative data collection techniques and desk reviews to gain a holistic understanding of the complex dynamics in Isiolo, Marsabit, and Samburu counties. The methodology was designed to capture the multifaceted nature of the challenges and opportunities in these arid and semi-arid regions, with a particular focus on biodiversity, climate change impacts, conservation strategies, socio-economic aspects, and governance mechanisms.

The research process began with an extensive literature review, drawing from academic journals, government reports, NGO publications, and other relevant sources. This desk-based research provided a solid foundation of existing knowledge across all thematic areas, helping to identify key trends, gaps, and best practices in current programming.

Primary data collection was conducted through a combination of in-depth interviews (IDIs), focus group discussions (FGDs), and key informant interviews (KIIs) across Marsabit, Samburu, and Isiolo counties, with a gender-segregated approach to ensure balanced representation. In Marsabit 8 FGDs were conducted, segregated into 4 male-only and 4 female-only groups. In-depth interviews in Marsabit targeted at least 40% female representation, resulting in around 7 males and 5 females per ward resulting in 48 in depth interviews in the county. Samburu also saw 8 FGDs with 4 male-only and 4 female-only groups, and 12 in- depth interviews per ward with a similar 40% female target, yielding around 7 males and 5 females. Isiolo had a similar representation. The number of Key Informant Interviews (KIIs) conducted varied due to the diversity of key informants representing different thematic areas within each county, as well as the various administrative levels they represented, ranging from local to county to national. These qualitative methods allowed for a nuanced exploration of the complex interrelationships between the various thematic areas in the target counties. In-depth interviews were conducted with household heads or senior female members, with a quota system ensuring at least 40% female respondents to capture gender-specific perspectives. Focus group discussions were organized separately for men and women, including youth representation, to encourage open dialogue and capture diverse viewpoints. Key informant interviews targeted individuals with specialized knowledge or unique perspectives on the research topics, including government officials, community leaders, and subject matter experts.

The sampling strategy employed a purposive, non-probability approach to ensure the selection of information-rich cases across all thematic areas. This approach allowed for the capture of diverse perspectives and experiences relevant to the study's objectives. Participants were selected based on their relevance to the research questions and thematic areas, with efforts made to ensure diversity among participants in terms of demographic groups, socio-economic backgrounds, and roles within the community.

Qualitative data from interviews and focus group discussions were analyzed using thematic analysis techniques, facilitated by NVivo[3]. qualitative data analysis software .

3 QSR International. (2024). NVivo (Version 14) [Software]. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home

The research questions guiding this study include:

1. **What is the current state of biodiversity within the target counties, including the diversity of species, ecosystems, and genetic resources?**
2. **How have changes in climate patterns influenced biodiversity patterns and ecological processes within the target counties?**
3. **What are the potential opportunities for biodiversity conservation, restoration, and sustainable management within the target counties?**
4. **How can cross-sectoral collaboration and integrated approaches enhance the effectiveness and sustainability of biodiversity conservation efforts in the context of climate change and conflict?**
5. **To what extent are improvements in biodiversity linked to positive outcomes for communities and the livestock sector?**
6. **What are the most effective incentive mechanisms to influence local actors to integrate biodiversity needs within local planning?**
7. **How can pastoralist communities ensure sustainable mobility in the face of changing environments and economic pressures?**
8. **What strategies can pastoralist communities employ to balance economic viability with the long- term health of rangelands and livestock populations?**

These research questions guided the data collection, analysis, and structure of this report, ensuring a comprehensive examination of the complex issues surrounding rangeland biodiversity in Isiolo, Marsabit, and Samburu counties.

Current State of Biodiversity and Key Areas

Biodiversity Overview (Species, Ecosystems, Genetic Resources)

The ASALs of Isiolo, Marsabit, and Samburu counties encompass a variety of ecosystems, including savanna grasslands, Acacia-Commiphora bushlands, riparian forests along seasonal rivers, and isolated highland forests. These diverse habitats support a remarkable array of flora and fauna, many of which are endemic to the region or highly adapted to arid conditions (Njoroge et al., 2017).

Species Diversity:

Large mammals are perhaps the most visible component of this biodiversity. The region is home to significant populations of African elephants *(Loxodonta africana),* Reticulated giraffes *(Giraffa camelopardalis reticulata)*, and Grevy's zebras *(Equus grevyi)*. The latter two species are of particular conservation concern, with the Reticulated giraffe and the Grevy's zebra listed as Endangered on the IUCN Red List (Britt, 2020).

Predators play a crucial role in maintaining ecosystem balance. Lions (Panthera leo), cheetahs (Acinonyx jubatus), and other large carnivores are found in these counties, albeit in declining numbers due to habitat loss and human-wildlife conflict (Kiringe & Okello, 2017).

The avian diversity in these ASAL counties is particularly noteworthy. Over 350 bird species have been recorded in the region, including the Somali ostrich (Struthio molybdophanes) and various raptors. The presence of several Important Bird Areas (IBAs) recognized by BirdLife International underscores the region's importance for birdlife (Bennun & Njoroge, 1999).

Ecosystems:

The plant life in these ASALs is equally diverse and significant. Drought-resistant species, particularly within the genera Acacia and Commiphora, dominate the landscape. These plants not only provide crucial habitat and food sources for livestock and wildlife but also represent important genetic resources. Their adaptations to water scarcity and high temperatures could prove invaluable in developing climate-resilient crops and supporting livestock in the face of global climate change (Ogutu et al., 2016).

Genetic Resources:

The genetic diversity within these ecosystems is a critical resource for both conservation and potential future applications in agriculture and medicine. The unique adaptations of both plant and animal species to arid conditions represent a valuable genetic pool that could be crucial for developing resilience to climate change in various sectors.

Key Biodiversity Hotspots and Protected Areas

Several protected areas serve as cornerstones for biodiversity conservation in the three counties:

1. Marsabit National Park and Reserve: This unique montane forest ecosystem atop an isolated volcanic mountain supports a population of elephants known for their unusually large tusks, as well as greater kudu and a diverse array of bird species (Kiringe & Okello, 2017).
2. **Samburu National Reserve:** Famous for its populations of northern Kenyan species such as the Grevy's zebra, Reticulated giraffe, and gerenuk (Litocranius walleri). The reserve is also home to the Beisa oryx (Oryx beisa), showcasing evolutionary adaptations significant for scientific study (Mbanefo & Chukwuemeka, 2020).
3. **Buffalo Springs and Shaba National Reserves:** Adjacent to Samburu, these reserves provide critical habitats for various species and contribute to the overall biodiversity of the region.
4. **Community Conservancies:** Numerous community-managed conservancies have been established across the three counties, playing a crucial role in expanding protected areas and involving local

communities in conservation efforts. Examples include the Nasuulu, Oldonyiro, and Biliqo Bulesa conservancies in Isiolo County.

These protected areas, while crucial for biodiversity conservation, face numerous challenges including habitat fragmentation due to human activities, climate change impacts, and human-wildlife conflict.

Important Bird Areas and Eco-Tourism Potentialtourism Potential

The region hosts several Important Bird Areas (IBAs) that are critical for avian conservation:

1. Mount Marsabit Forest: Home to a variety of bird species, including the rare William's lark (Mirafra williamsi). The forest's unique microclimate and vegetation types provide critical habitats for avian species (Bennun & Njoroge, 1999).
2. Ewaso Ng'iro River: Attracts numerous bird species, making it a popular destination for eco- tourism. The river's lush riparian vegetation supports a diverse array of birdlife (Odhiambo et al., 2016).

The unique biodiversity and scenic landscapes of these counties offer significant opportunities for eco- tourism, which can support conservation efforts and local economies. Several initiatives are already capitalizing on this potential:

- The Kalama Conservancy in Samburu has been promoting eco-tourism and community empowerment.
- The Nkoteiya Community Conservancy Eco-lodge in Samburu has been successful in promoting eco-tourism and providing employment.
- The Reteti Elephant Sanctuary in Samburu, the first community-owned elephant sanctuary in Africa, combines conservation with tourism.

Connected Landscapes and Migratory Corridors

The interconnected nature of ecosystems in these ASAL counties is vital for maintaining biodiversity. Several key migratory corridors traverse the region, facilitating the movement of wildlife and genetic exchange between populations:

1. Elephant Corridors: Vital for the migration of elephants between different habitats, reducing human-wildlife conflicts. These corridors are crucial for the genetic diversity and overall health of elephant populations.
2. Bird Migration Routes: Crucial for the seasonal movement of various bird species, ensuring their survival and reproduction. These routes enable birds to access different habitats for feeding, breeding, and nesting.
3. The Ewaso Ng'iro River system: Serves as a lifeline, connecting Samburu, Buffalo Springs, and Shaba National Reserves. This riverine habitat allows for wildlife movement along its course, particularly during dry seasons when water becomes scarce elsewhere.

Maintaining these corridors is essential not only for seasonal migrations and genetic exchange but also for enhancing the resilience of wildlife populations in the face of climate change.

Table 1: Summary of key biodiversity characteristics by county

County	Characteristics and Key Species/Features	Community Conservancies/Protected Areas and Challenges
Isiolo County	Characterized by semi-arid savannahs and diverse wildlife, including large herbivores and predators.	Hosts important community conservancies like Nasuulu, Oldonyiro, and Biliqo Bulesa.
	Home to species such as the gerenuk and the Somali ostrich.	Faces challenges related to land use conflicts and climate change impacts.
Marsabit County	Notable for its high-altitude forests, particularly in Mount Marsabit National Park and Mt. Kulal Biosphere reserve.	Challenges include deforestation, overgrazing, and water scarcity.
	Supports diverse species including several endemic plants and animals.	
	Home to unique microclimates created by high-altitude environments.	
Samburu County	Known for its rugged terrain and species adapted to arid conditions.	Home to successful community conservancies and eco-tourism initiatives.
	Key species include the Grevy's zebra and Reticulated giraffe.	Faces challenges related to human-wildlife conflict and rangeland degradation.
	Home to the Samburu National Reserve, a key protected area for biodiversity conservation	The Ewaso Ng'iro River plays a crucial role in supporting both wildlife and local communities.
	Cultural practices of the Samburu people often align with conservation goals, presenting opportunities for integrated management approaches.	

Challenges Facing the Biodiversity of the Counties

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Challenges Facing the Biodiversity of the Counties

The landscapes of Isiolo, Marsabit, and Samburu counties face a multitude of interconnected challenges that threaten their unique biodiversity and fragile ecosystems. The community consultations and KIIs undertaken during this assessment highlighted some of these challenges. The challenges range from the overarching threat of climate change, which exacerbates drought cycles and alters species distributions, to more localized issues such as habitat fragmentation and human-wildlife conflict.

The counties also face challenges from the spread of invasive plant *Prosopis juliflora*, popularly known as Mathenge and Opuntia spp. (Prickly Pear Cactus), and pests such as Desert Locust *(Schistocerca gregaria)*, which outcompete and displace native flora and fauna, disrupting the delicate ecological balances of the region.

The communities indicated that the counties also face challenges from the spread of invasive plant Prosopis juliflora, popularly known as Mathenge and Opuntia spp. (Prickly Pear Cactus): and pests such as Desert Locust *(Schistocerca gregaria)*. These invasive species outcompete and displace native flora and fauna, disrupting the delicate ecological balances of the region. This disruption occurs in two key ways: first, the invasive species outcompete and crowd out preferred palatable forage species that livestock rely on for grazing, reducing the available pasture land; second, the dense and thorny nature of the invasive species physically excludes livestock from accessing certain grazing sites altogether. As a result, the spread of these invasive plants is reducing the amount of usable pasture for livestock in the counties, a significant challenge that the communities are grappling with as they seek to maintain the ecological health and productivity of the land. Additionally, unsustainable resource extraction, including illegal cutting of trees and charcoal production, continues to degrade vital habitats, leading to profound ecological and socio-economic consequences. In many regions, the shrubs and trees are being cleared at alarming rates to meet the demand for charcoal, which are often harvested illegally. This not only results in the immediate loss of trees but also disrupts the intricate ecosystems that depend on these forests.

In Samburu County, the Kirisia Forest, a vital water tower for the region, has experienced severe degradation. Between 1973 and 2015, the Kirisia Forest lost 20% of its tree cover[4]. As of 2019, 30,000 hectares of the 92,000 hectare Kirisia Forest had been destroyed due to human activities like charcoal burning and logging[5].

The removal of trees eliminates crucial habitats for countless species, leading to a decline in biodiversity. As native flora and fauna are displaced, invasive species may take hold, further destabilizing the ecosystem and diminishing its resilience to environmental changes. The impact of such habitat degradation extends beyond the immediate loss of wildlife. The trees and shrubs in these rangelands play a critical role in regulating local climates, maintaining soil health, and preserving water cycles. When trees are removed, the soil becomes more susceptible to erosion, reducing its fertility and leading to increased sedimentation in rivers and streams.

The sedimentation in the Ewaso Ng'iro River has significant implications for the surrounding communities and the local economy, particularly during the rainy season when the river is prone to overflowing its banks. As sediment accumulates, it alters the river's flow dynamics, making it more susceptible to flooding. When heavy rains occur, the increased

sediment load leads to rapid changes in water levels, causing the river to breach its banks more frequently.

The consequences of this flooding are severe for local communities and businesses. When the Ewaso Ng'iro River overflows, it displaces families from their homes, forcing them to evacuate and seek shelter elsewhere. This displacement not only disrupts their daily lives but also creates long-lasting challenges in terms of housing and stability. Additionally, tourist lodges situated along the river face significant threats. Flooding damages infrastructure, disrupts services, and deter tourists from visiting, leading to a decline in revenue for these businesses.

The local economy, heavily dependent on both agriculture and tourism, suffers as a result. Communities lose crops and livestock due to flooding, while businesses that cater to tourists experience a downturn in visitors and revenue. This economic disruption can lead to increased poverty levels and reduced livelihoods for communities that are already vulnerable. The loss of income from both agriculture and tourism can have cascading effects, impacting education, health, and overall community well-being.

Moreover, we were told that the loss of traditional ecological knowledge among the younger generation of pastoralists reduces the resilience of rangelands to environmental stresses. Human-wildlife conflicts have also intensified as resources become scarcer and livestock and wildlife compete for the same pasture resources, leading to retaliatory killings of wildlife and negative attitudes towards conservation efforts. Key informants told us that a lack of integrated land-use planning often results in conflicting uses of land and resources, undermining conservation initiatives. Poaching and illegal wildlife trade persist as significant threats to key species, despite ongoing efforts to combat wildlife crime.

These challenges are further compounded by limited conservation capacity and resources, inadequate policy implementation, and the lack of adequate transboundary conservation efforts across county lines. Addressing these complex issues requires a holistic, collaborative approach that balances the needs of local communities with the imperative of biodiversity conservation in these critical ecosystems. In the following we highlight some of the key challenges to biodiversity from across the three counties.

Climate Change and Drought

Climate change and intensifying drought cycles pose significant threats to the rangelands and biodiversity in these ASALs. The impacts are visible across all three counties, affecting crucial ecosystems and water sources.

In Samburu County, the Kirisia Forest, a vital water tower for the region, has experienced severe degradation due to prolonged droughts. The destruction of the forest's water catchment area through human settlement led to the drying of rivers and prolonged drought seasons in the region[6].

Marsabit County has seen the dramatic impacts of climate change on Lake Turkana. One of the most significant effects of climate change on Lake Turkana is the dramatic reduction in freshwater inflow from the Omo River, which supplies approximately 90% of the lake's water. This reduction is exacerbated by the construction of dams and water-intensive agricultural projects in Ethiopia, which have led to decreased water levels in the lake. As a result, the salinity of Lake Turkana has increased, negatively impacting fish populations and the overall health of the aquatic ecosystem. The Kenyan government has acknowledged these changes in its National Climate Change Action Plan, highlighting the adverse effects on food security and the livelihoods of local communities[7].

The ecological balance of Lake Turkana is also at risk due to climate change. Increased salinity levels and altered water temperatures can affect fish breeding patterns, leading to declines in fish populations that are crucial for both local diets and economic activities. The changing conditions in the

4 https://minorityafrica.org/we-paid-the-price-how-a-voluntary-forest-restoration-in-kenya-ended-a-decades-long- security-problem/

5 https://minorityafrica.org/we-paid-the-price-how-a-voluntary-forest-restoration-in-kenya-ended-a-decades-long- security-problem/

6 https://minorityafrica.org/we-paid-the-price-how-a-voluntary-forest-restoration-in-kenya-ended-a-decades-long- security-problem/

7 https://www.hrw.org/report/2015/10/16/there-no-time-left/climate-change-environmental-threats-and-human-rights-turkana

lake have made fishing more challenging, further threatening the livelihoods of those who depend on this resource. The overall biodiversity of the lake is under threat, as species that are unable to adapt to the changing salinity and temperature may decline or disappear altogether[8].

In Isiolo County, the Ewaso Ng'iro river, a lifeline for both wildlife and pastoralists, has experienced reduced flow rates and more frequent dry spells. In September 2021, the river dried up completely in some sections for the first time in living memory, leading to conflicts between upstream and downstream users and forcing wildlife to congregate around the few remaining water points. This event resulted in increased human-wildlife conflicts and overgrazing in areas close to permanent water sources[9]. Illegal sand harvesting, deforestation, encroachment on riparian lands, and over-abstraction of water upstream to irrigate plantations have been blamed for the declining water levels[10].

These climate-induced changes are not only affecting biodiversity but are also exacerbating conflicts over resources and threatening the livelihoods of pastoral communities across the three counties.

Climate change's impacts on biodiversity in these counties are significantly exacerbated by unsustainable resource extraction practices, as activities like illegal logging, charcoal production, and overgrazing not only directly degrade habitats but also reduce ecosystem resilience, making flora and fauna more vulnerable to the stresses of changing temperature and precipitation patterns.

Illegal logging, charcoal production, and unsustainable harvesting of non-timber forest products are threatening forest ecosystems and biodiversity across the three counties. These activities not only reduce habitat quality but also contribute to soil erosion and diminish the land's capacity to withstand drought.

In Samburu County, the Ndoto Mountains have seen increased illegal logging of cedar trees, particularly in the Ndoto Forest Reserve. Marsabit County faces challenges with unsustainable harvesting of gum arabic from Acacia senegal trees, particularly in the Turbi area. In Isiolo County, charcoal production has increased in the Garbatulla sub-county, leading to the loss of important dry season grazing areas and reducing habitat for wildlife.

These examples demonstrate the urgent need for sustainable resource management practices, improved law enforcement, and the development of alternative livelihood options for communities dependent on forest resources. Additionally, there's a need for public awareness campaigns about the long-term ecological and economic costs of unsustainable resource extraction.

Invasive Species

Invasive plant species are a major threat to native biodiversity and rangeland quality across Isiolo, Samburu, and Marsabit counties in Kenya. These invasive species outcompete native vegetation, reduce grazing land, and alter ecosystem dynamics, affecting both wildlife and pastoral livelihoods[11].

In Isiolo County, Prosopis juliflora (known locally as Mathenge) has invaded large swathes of rangeland, particularly along the Ewaso Ng'iro river, reducing grazing land in affected areas. It has formed dense thickets in the Oldonyiro area, reducing access to water points for livestock and wildlife. Community-led efforts to clear Prosopis face challenges due to its deep root system and rapid regrowth.

Samburu County is affected by Opuntia stricta (prickly pear cactus), which has invaded large areas in the lowlands, particularly around Archer's Post and Wamba. Opuntia reduces pasture availability and causes injuries to livestock and wildlife. The invasive prickly pear cactus reduces pasture availability, which is critical for livestock grazing. The dense thickets formed by the cactus limit the growth of native grasses, leading to decreased forage for both livestock and wildlife. The cactus can also lacerate the mouths of animals, leading to injuries affect their ability to eat and ultimately their health. *Parthenium hysterophorus*, *Ipomea hildebrantii*, and *Lantana camara* are other invasive plant rapidly expanding across Kenyan rangelands.

In Marsabit County, Acacia reficiens has become invasive in parts of the Laisamis sub-county, reducing grass cover significantly in heavily

11 https://link.springer.com/chapter/10.1007/978-3-319-46709-2_13

invaded areas and affecting livestock production. Acacia reficiens has no forage value for livestock or wildlife. Pastoralists in the Logologo area reported a significant reduction in milk production due to decreased availability of quality forage.

Invasive species has broader implications for local livelihoods, as it affects not only grazing land but also the overall health of the ecosystem. The competition for resources can lead to increased human-wildlife conflicts and economic pressures on pastoralist communities.

Water Scarcity and Management

Decreasing water availability and poor management of existing water resources pose significant challenges to biodiversity and human communities across Marsabit, Samburu, and Isiolo counties in Kenya. Climate change, over extraction, and unsustainable water use practices threaten long-term water security for both wildlife and local communities.

In Marsabit County, the Chalbi Desert oases, including the Kalacha oasis,, essential for wildlife and pastoralists, have been shrinking due to reduced groundwater recharge and climate change. A severe drought in July 2020 led to the complete drying up of the Hurri Hills springs for the first time in living memory, forcing over 10,000 pastoralists and their livestock to migrate in search of water, which increased conflicts between different pastoral communities[12].

Around Mount Marsabit in Marsabit County, over extraction from springs, particularly in the Karare area, is affecting water availability for wildlife in the adjacent national park. In 2021, during a severe drought, we were informed that elephants from Marsabit National Park ventured into Karare town in search of water, destroying infrastructure and creating conflict with local residents. This event underscored the interconnectedness of human and wildlife water needs and the importance of integrated water resource management.

Samburu County faces challenges from over extraction of water from the Ewaso Ng'iro river for irrigation. Significant over extraction of water from the Ewaso Ng'iro river, particularly for irrigation purposes in the upper reaches of the catchment has led to conflicts between upstream and downstream water users, as the reduced river flows affect both agricultural and pastoral communities. A 2022 report by the Ewaso Ng'iro North Development Authority indicated that dry season river flows had decreased by 70% over the past 30 years due to upstream abstraction[13]. In February 2021, the river stopped flowing completely at the Archer's Post bridge for three weeks, affecting wildlife in the Samburu National Reserve and leading to the death of hundreds of fish and crocodiles.

“Decreasing water availability and poor management of existing water resources pose significant challenges to biodiversity and human communities across Marsabit, Samburu, and Isiolo counties in Kenya. Climate change, over extraction, and unsustainable water use practices threaten long-term water security for both wildlife and local communities.

12 https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wat2.1609

13 https://thewaterproject.org/water-crisis/water-in-crisis-kenya

In Isiolo County, uncontrolled borehole drilling, particularly in the Merti aquifer area, has led to localized depletion of groundwater resources. A 2020 hydrogeological survey by the Ministry of Water and Sanitation revealed that groundwater levels in some parts of Merti had dropped by up to 20 meters over the past decade[14]. In August 2019, three major boreholes serving the Dadaab refugee camp complex failed due to over extraction, affecting over 200,000 refugees and host community members.

In the Merti aquifer region of Isiolo County, the proliferation of unregulated boreholes for agricultural use is threatening the sustainability of this crucial water resource. In 2022, we were informed that a major borehole serving over 10,000 people in Merti town ran dry for the first time in its 30-year history, triggering a water crisis that lasted for several weeks. This incident highlighted the urgent need for sustainable groundwater management practices and stricter regulation of borehole drilling.

These examples highlight the critical need for sustainable water management practices, including improved water harvesting techniques, efficient irrigation systems, and stricter regulation of water extraction. Additionally, there's a need for basin-wide water resource management plans that consider both human needs and ecological requirements, as well as investment in alternative water sources such as rainwater harvesting and water recycling technologies.

As resources become scarcer and human populations expand, conflicts between wildlife and local communities have intensified across Samburu, Isiolo, and Marsabit Counties. These conflicts take various forms, from crop destruction to livestock predation, often resulting in retaliatory killings of wildlife, which is a threat to wildlife biodiversity.

In Samburu County, there has been a significant increase in conflicts between humans and elephants, particularly affecting the Samburu National Reserve and surrounding community conservancies. Reports indicate that the Kenya Wildlife Service (KWS) has acknowledged a rise in conflicts involving elephants, hippos, and buffalo, especially in areas where pastoralists, agropastoralists and wildlife share resources. In 2020, KWS reported over 150 incidents of crop raiding by elephants in villages near Archer's Post, highlighting the growing frequency of such incidents.

The destruction of crops by elephants poses serious implications for food security in the region. These conflicts disrupt livelihoods, leading to community unrest and calls for government intervention. Recognizing the challenges posed by human-wildlife conflicts, the government has initiated compensation measures for those impacted. A planned payout of Sh1 billion has been announced for families affected by such conflicts, reflecting the seriousness of the situation and the urgent need for effective solutions. This compensation is intended to address permanent injuries leading to disability, deaths, or property damage, with specific amounts allocated for those killed by wild animals and for injuries resulting in permanent disability.

Isiolo County's Buffalo Springs National Reserve has seen an uptick in predator attacks on livestock, particularly by lions. Marsabit County, around the Marsabit National Park, has seen increasing human- elephant conflicts. In 2019, several farms in the Sagante area were destroyed by elephants searching for water during a dry spell. In August 2019, a herd of elephants damaged a newly constructed water pan, leaving over 5,000 residents without clean water for weeks, leading to calls for elephant-proof barriers around critical infrastructure[15].

These conflicts threaten livelihoods and lead to negative attitudes towards wildlife conservation, undermining long-term efforts. Addressing human-wildlife conflict requires strategies like improved fencing, early warning systems, compensation schemes, and community-based conservation initiatives that provide tangible benefits to local residents[16].

14 https://waterfund.go.ke/watersource/Downloads/006.%20Water%20Resources%20Management%20Strategy.pdf

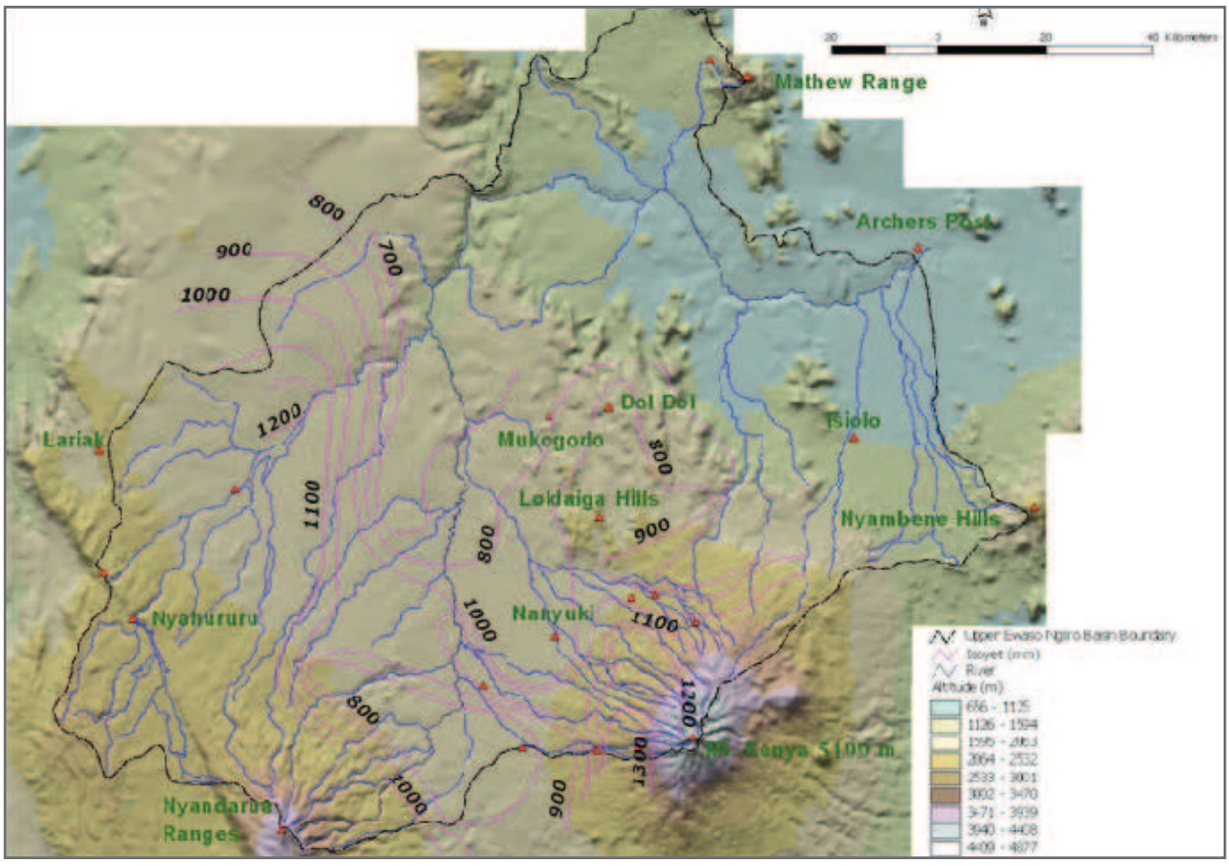
15 https://naturekenya.org/2024/03/04/managing-human-wildlife-conflict-through-community-engagement/

16 https://www.kws.go.ke/content/kenya-launches-national-human-wildlife-coexistence-strategy-and-action-plan-2024-2033

Regarding transboundary conservation efforts, many ecosystems and wildlife populations extend beyond county boundaries, but there's limited coordination in conservation efforts across the three counties. The elephant population movements along their traditional migration routes sometimes encounter newly erected fences and settlements, leading to a series of human-elephant conflict incidents. This situation highlights the need for coordinated land-use planning and wildlife management strategies across county boundaries.

The management of the Ewaso Ng'iro river ecosystem lacks coordination between upstream (Laikipia, Meru, Nyandarua, and Nyeri) and downstream (Isiolo and Samburu) counties. In 2022, a decision by upstream users in Laikipia to increase water abstraction during a dry period led to severe water shortages downstream, affecting both wildlife and pastoral communities in Isiolo and Samburu Counties. This incident sparked inter-county tensions and underscored the need for a basin-wide approach to water resource management.

Figure 1: Topographic variation in the Upper Ewaso Ngiro North basin.



> As resources become scarcer and human populations expand, conflicts between wildlife and local communities have intensified,taking various forms, from crop destruction to livestock predation, often resulting in retaliatory killings of wildlife, which is a threat to wildlife biodiversity.

Conservation efforts for the Grevy's zebra are hampered by limited coordination between Isiolo and Marsabit Counties, despite the species' range spanning both. In 2021, a proposed wildlife corridor to connect Grevy's zebra populations in the two counties was delayed due to lack of inter-county agreement on land use and management responsibilities[17]. A 2020 census of Grevy's zebra revealed that the population had declined by 25% over the past decade, with fragmented conservation efforts identified as a key factor. The Grevy's Zebra Trust (GZT) has been working to promote coordination between stakeholders and improve information flow.

These examples highlight the critical need for transboundary conservation initiatives that transcend administrative boundaries. This includes developing joint management plans for shared ecosystems, establishing cross-border wildlife corridors, and creating mechanisms for regular communication and coordination between county conservation authorities. Additionally, there's a need for national-level policies that encourage and facilitate inter-county collaboration in biodiversity conservation and natural resource management.

Habitat Fragmentation

Emerging transboundary issues above are closely linked to the increasing human settlements, infrastructure development, and changing land-use patterns in Isiolo, Samburu, and Marsabit Counties. These factors are fragmenting wildlife habitats and disrupting migration routes, which in turn hinders wildlife movement and raises the risk of human-wildlife conflicts.

In Isiolo County, the proposed Isiolo Resort City development threatens to fragment important wildlife corridors between Shaba National Reserve and Buffalo Springs National Reserve. Environmental impact assessments conducted in 2021 indicated that the project could disrupt the movement of over 2,000 elephants traveling between these protected areas. In October 2020, during early construction phases, a herd of elephants encountered newly built structures while following their traditional migration route, leading to property damage and raising concerns about future human-elephant conflicts[18]. Local wildlife advocacy groups, such as Friends of Isiolo Game Reserves (FIGARE), have expressed opposition to the project, arguing that its location could restrict animal movement and threaten tourism revenue, which is vital for the local economy.[19].

Samburu County has also seen the expansion of settlements and fenced areas around Archer's Post, disrupting traditional elephant migration routes between Samburu National Reserve and the Matthews Range. In Marsabit County, the upgrading of the Isiolo-Moyale highway has created a barrier for wildlife movement, particularly affecting species like Grevy's zebra in the Laisamis area.

These examples highlight the need for careful land-use planning that incorporates wildlife corridors and movement patterns. Solutions such as wildlife crossing structures, zoning regulations to protect critical habitats, and community-based land-use planning are essential to mitigate the impacts of habitat fragmentation.

In 2021, a proposed wildlife corridor to connect Grevy's zebra populations in the two counties was delayed due to lack of inter-county agreement on land use and management responsibilities.

18 https://wrti.go.ke/?p=7060

19 https://www.businessdailyafrica.com/bd/news/more-groups-oppose-site-meant-for-isiolo-resort-city-2233476

Climate Change And Ecosystem Services

Climate Change Impacts on Biodiversity

The ASALs of Northern Kenya are experiencing significant biodiversity changes in response to shifting climatic conditions. Recent studies have documented alarming trends in both flora and fauna across the region.

Oduor et al. (2023) reported a 15% decline in plant species richness over the past two decades, coupled with a 30% reduction in large mammal populations. For instance, the population of Grevy's zebra *(Equus grevyi)*, an endangered species endemic to northern Kenya and southern Ethiopia, has declined by 45%[20]. These changes strongly correlate with rising temperatures and increased frequency of drought events, underscoring the vulnerability of the region's biodiversity to climate change.

Vegetation dynamics in the rangelands of Northern Kenya have also shown marked shifts. Wasonga et al. (2021) observed a significant transition from perennial grasses like Cenchrus ciliaris to annual species such as Aristida adscensionis. This change not only affects the composition of plant communities but also reduces overall ecosystem resilience. The study highlighted that areas employing adaptive grazing management strategies, such as planned rotational grazing, demonstrated greater resistance to these climate-induced vegetation changes, suggesting potential mitigation approaches.

Ecosystem Services Affected by Climate Change

The impacts of climate change on biodiversity inevitably translate to alterations in ecosystem service provision, affecting the livelihoods of communities in the three counties.

Karanja et al. (2022) synthesized current knowledge on climate change impacts on key ecosystem services supporting pastoral livelihoods. Their review revealed a 20-30% reduction in water availability and a 15-25% decrease in forage quality over the past three decades. For example, the Ewaso Ng'iro River, a crucial water source for both wildlife and pastoral communities in Isiolo and Samburu counties, has experienced a 30% reduction in its average annual flow since the 1960s. These changes directly affect the viability of traditional pastoral practices, necessitating adaptations such as the adoption of drought-resistant livestock breeds like the Boran cattle, camels, goats and diversification of livelihood strategies.

A case study in Isiolo County by Mburu et al. (2020) quantified changes in specific ecosystem services over a 20-year period. The research documented a 40% decline in honey production, primarily due to the reduced flowering of key nectar plants like Acacia tortilis and Commiphora spp. They also noted a 35% reduction in medicinal plant availability, including important species such as Aloe secundiflora, both of which are crucial for local livelihoods. Interestingly, the study also noted an increase in ecotourism potential due to changing wildlife migration patterns, with elephants now spending more time in the county's northern regions, highlighting the complex and sometimes unexpected ways in which climate change can influence ecosystem services.

20 Kenya's population of Grévy's zebra declined from about 13,700 individuals in the late 1970s to about 1,600 in 2017, an 88% decline- https://www.wildsolutions.nl/marsabit/

However, conservation efforts have helped increase the population to somewhere between 2,650 and 3,000 individuals as of 2021-https://www.wildsolutions.nl/marsabit/

Future Climate Projections and Biodiversity Outcomes

Looking ahead, climate projections for Northern Kenya paint a challenging picture for biodiversity and ecosystem services.

Ochieng et al. (2024) used an ensemble of climate models to project future biodiversity outcomes in the region's biodiversity hotspots. Under a high-emissions scenario (RCP 8.5), their models project a 30-50% loss of suitable habitat for endemic plant species by 2050. For example, the Samburu cactus (Euphorbia magnicapsula), found only in Samburu County, is projected to lose 45% of its current habitat. However, the study also identified potential climate refugia, such as the higher elevation areas of the Mathews Range, offering hope for targeted conservation efforts.

The implications of these projections extend beyond biodiversity to affect human livelihoods. Lestari et al. (2022) combined climate projections with socio-ecological modeling to simulate future scenarios for pastoralist communities. Their research projects a 25-40% reduction in livestock carrying capacity by 2050 under current management practices. For instance, in Marsabit County, the model predicts that areas currently supporting 50 tropical livestock units (TLU) per km² may only support 30-37 TLU/km² by 2050. However, scenarios incorporating adaptive management strategies, such as implementation of water harvesting techniques and adoption of climate-smart livestock breeds, showed potential for maintaining livelihood viability despite climate change.

A more comprehensive assessment of the impacts of climate change on biodiversity can be found in the climate risk analysis document included in this series of RANGE inception assessments.

Marsabit, Kenya. ~ Josephine Kiruku (Mercy Corps)

Biodiversity Conservation and Management Strategies

Introduction

The ASALs of Northern Kenya present unique opportunities for biodiversity conservation and ecosystem restoration. In the three counties, the establishment of community conservancies has proven to be a successful model for integrating conservation with local livelihoods. The Biliqo-Bulesa Community Conservancy is located in Isiolo County, Kenya in one example. It was established in 2007 and covers an area of approximately 376,657 hectares (about 3,786 square kilometers). The conservancy plays a significant role in conservation efforts and community development in the region. The area is home to diverse wildlife and supports local pastoralist communities. It has seen a resurgence of wildlife populations, including endangered species like the Grevy's zebra, while simultaneously improving pastoral livelihoods[21].

Marsabit County, home to the Marsabit National Park and Reserve, offers opportunities for large-scale ecosystem conservation. Recent efforts have focused on restoring degraded areas within the park, with a particular emphasis on indigenous plant species that are crucial for both wildlife and local communities[22].

In Samburu County, the Ewaso Ng'iro river ecosystem provides a lifeline for both wildlife and communities. Conservation efforts here have focused on sustainable water management and riparian habitat restoration. The Grevy's Zebra Trust has been working with local communities to monitor and protect the endangered Grevy's zebra population, demonstrating the potential for species-specific conservation initiatives in the region.

Across all three counties, there is growing recognition of the potential for carbon sequestration through rangeland restoration, offering economic incentives for conservation through carbon credit schemes (Mganga et al., 2020).

In the following sections, we will present various approaches and highlight a selection of projects implemented in the counties focused on biodiversity conservation and management.

Ecosystem-Based Approaches for Rangeland Repair

Ecosystem-based approaches to rangeland repair are crucial in the three counties, where pastoralism is a primary livelihood. In Isiolo County, the implementation of holistic planned grazing has shown promising results in combating desertification and improving rangeland health. A study by Kibet et al. (2022) demonstrated that areas under planned grazing showed increased plant diversity and improved soil water retention compared to traditionally managed areas.

Marsabit County has been at the forefront of implementing water conservation techniques to support rangeland repair. The county government, in collaboration with NGOs, has implemented a network of sand dams and subsurface dams to harvest and store water during the brief rainy seasons. This approach has not only provided water for livestock and wildlife but has also facilitated the natural regeneration of vegetation in previously degraded areas (Marsabit County Government, 2023).

In Samburu County, the integration of traditional pastoralist knowledge with modern rangeland management techniques has yielded positive results. The concept of "Ngitili," a traditional practice of setting aside grazing areas for dry season use, has been revived and adapted to current conditions. Research by Wasonga et al. (2021) showed that areas managed under the Ngitili system had higher plant biomass and diversity compared to open access rangelands.

Another significant initiative is the Ewaso Ng'iro Basin Ecosystem Management Project, which was launched in 2018[23]. This project represents a collaborative effort involving the Ewaso Ng'iro North Development Authority (ENNDA), the county governments of Isiolo and Samburu, and

21 Northern Rangelands Trust, 2023
22 Grevy's Zebra Trust, 2024
23 ENNDA, 2023 - Ewaso Ng'iro Basin Ecosystem Management Project: Five-Year Progress Report

the International Union for Conservation of Nature (IUCN). It focuses on the Ewaso Ng'iro river basin, a vital resource for both wildlife and pastoral communities in the region.

The project encompasses several key components aimed at sustainable management, including integrated watershed management, sustainable rangeland practices, community-based natural resource management, and climate change adaptation measures. Significant achievements of the project include the restoration of 10,000 hectares of degraded rangelands, a 30% reduction in soil erosion along key tributaries, the establishment of 20 community-managed water points, and the development of a basin-wide early warning system for droughts and floods[24].

The Marsabit Forest Ecosystem Conservation program employs participatory forest management approaches, Mount Marsabit as a cloud forest is important in providing critical ecosystem services, such as water supply and biodiversity.

However, the project faces challenges that need to be addressed moving forward. These include managing conflicts over water use between upstream and downstream users, scaling successful interventions throughout the basin, integrating traditional knowledge with scientific methods, and securing long-term funding for ongoing management activities.

The Marsabit region faces challenges such as deforestation and degradation, which have prompted various conservation projects, including those aimed at restoring forest cover and enhancing community involvement in forest managementOther ecosystem-based conservation initiatives in the region include:

The Marsabit Forest Ecosystem Conservation Program, a significant initiative led by the Kenya Forest Service in collaboration with local communities. Its primary focus is on protecting the unique montane forest ecosystem of Mount Marsabit. The program employs participatory forest management approaches, Mount Marsabit as a cloud forest is important in providing critical ecosystem services, such as water supply and biodiversity. The collaborative approach involving local communities is essential for the sustainability of these conservation efforts, as highlighted by various stakeholders interviewed.

In addition, the Samburu Landscape Conservation Initiative represents another vital conservation effort. The initiative aims to maintain connectivity between protected areas and community lands, which is crucial for facilitating wildlife movement and promoting biodiversity This initiative is a collaboration among the Samburu County Government, the Northern Rangelands Trust (NRT), and local conservancies. It adopts a landscape-level approach to conservation planning, aiming to maintain connectivity between protected areas and community lands. As a result, the initiative has established wildlife corridors that cover over 500,000 hectares, facilitating the movement of wildlife and promoting biodiversity in the region. The collaborative nature of the initiative emphasizes the importance of engaging local communities in conservation efforts, which is essential for the sustainability of wildlife habitats and the livelihoods of those who depend on these ecosystems. This approach is consistent with broader conservation strategies in northern Kenya, where community involvement is critical to addressing challenges such as human-wildlife conflict and habitat fragmentation.

24 https://ennda.go.ke/

Cross-Sectoral Collaboration and Integrated Approaches

Effective biodiversity conservation in the three counties requires strong cross-sectoral collaboration and integrated approaches. In Isiolo County, the Isiolo Camel Forum brings together pastoralists, researchers, government officials, and NGOs to address issues related to camel husbandry and its impact on rangeland ecosystems. This collaborative platform has led to the development of sustainable camel management practices that balance economic needs with conservation goals (Kagunyu & Wanjohi, 2023).

Marsabit County has seen successful collaboration between the county government, international organizations, and local communities in implementing the Frontier Counties Development Council (FCDC) Natural Resource Management Project. This initiative integrates conservation with economic development, focusing on sustainable resource use and conflict resolution (FCDC, 2024). The project focuses on sustainable resource use and conflict resolution, which are critical issues in the region. It has implemented various interventions, such as constructing water facilities (rock catchments, pipelines, water pans) to facilitate pastoralists' access to pasture and water resources effectively. These efforts have had a significant impact, with water pans like Yaa Gara and Dololo Dokatu serving hundreds of thousands of livestock and people during the rainy seasons. The project also emphasizes livelihood diversification, working with local communities to promote alternative income sources like resin and honey production. This approach aims to reduce reliance on natural resources and build resilience against drought. Furthermore, the project has conducted anthropological surveys to understand traditional pastoral social systems and decision-making processes. This knowledge is crucial for designing context-specific interventions that align with local cultural norms and engage community leaders in the decision-making process. The FCDC Natural Resource Management Project represents a collaborative and integrated approach to addressing the complex challenges faced by Marsabit County, including resource-based conflicts, environmental degradation, and economic development. By bringing together various stakeholders and incorporating sustainable practices, the project aims to promote long-term resilience and well-being in the region.

In Samburu County, the Ewaso Ng'iro North Development Authority (ENNDA) has indeed spearheaded an integrated watershed management approach in Samburu County to address issues of water scarcity, land degradation, and biodiversity loss. This collaborative effort has brought together various stakeholders to improve water resource management and enhance ecosystem services across the watershed. ENNDA was established in 1989 with a mandate to plan, coordinate, and implement integrated development projects across the expansive Ewaso Ng'iro North River Basin, which spans 10 counties, including Samburu. The authority has focused on sustainable and integrated development initiatives in sectors such as water resource development, livestock production, agriculture, forestry, wildlife conservation, and environmental management.

One of ENNDA's key projects is the Ewaso Ng'iro North Catchment Conservation Project, which aims to rehabilitate and restore degraded areas within the river catchment and riparian zones. This multi-faceted endeavor involves planting trees along the two water towers of Mt. Kenya and the Aberdare Ranges, as well as along the riparian areas of the main Ewaso Ng'iro North River and its tributaries. Furthermore, ENNDA has collaborated with the Global Water Partnership (GWP) to develop a strategic action plan to support the implementation of SDG 6.6.1 and the broader water-related goals in the Ewaso Ng'iro River Basin. The plan identifies priority actions such as strengthening institutional capacity, improving stakeholder engagement and coordination, and enhancing water demand management and sustainability. (ENNDA, 2023).

Community-Based Conservation Models

Community-based conservation models have gained significant traction in Northern Kenya, highlighting the essential role of local communities in sustainable resource management and biodiversity conservation.

A notable example is the Nasuulu Community Conservancy in Isiolo County. Established in 2011, the conservancy spans approximately 92,000 hectares and is home to around 7,000 people, primarily from the Borana community. It serves as a model for integrating conservation with pastoral livelihoods. Key features of the Nasuulu Community Conservancy include:

Community Governance:
The conservancy is managed by a community-elected board of directors, ensuring local representation and decision-making.

Zoning System:
A zoning system designates specific areas for grazing, conservation, and settlement, which helps manage land use effectively.

Local Employment:
The ranger program employs local community members, enhancing their involvement in conservation efforts and providing livelihoods.

Eco-Tourism Initiatives:
The conservancy promotes eco-tourism, which provides alternative income sources for the community.

Significant biodiversity conservation outcomes have been reported, including a 40% increase in the elephant population since 2011, the reintroduction of the endangered Grevy's zebra in 2018, a 30% reduction in illegal hunting incidents, and a 25% increase in perennial grass cover, indicating improved rangeland conditions. These achievements highlight the effectiveness of community-based conservation approaches in balancing ecological health with the needs of local communities.

The Nasuulu Community Conservancy exemplifies how integrating conservation with local livelihoods can lead to positive outcomes for both wildlife and people.The socio-economic impacts of the conservancy are also noteworthy, with an annual revenue of $150,000 generated from tourism and conservation fees, over 100 direct jobs created in the conservation and tourism sectors, and the establishment of a community-run health clinic and education bursary program. Additionally, improved rangeland management has led to a 35% reduction in livestock losses.

However, the conservancy faces challenges, including balancing conservation goals with increasing livestock populations, managing human-wildlife conflicts—particularly with elephants, ensuring equitable benefit-sharing among community members, and developing sustainable financing mechanisms beyond donor support[25].

Other notable community-based conservation initiatives in the region include the Marsabit Community Wildlife Conservancies Network. The Marsabit Community Wildlife Conservancies Network is accurate and highlights a significant conservation initiative in Marsabit County. This network serves as an umbrella organization for 14 community conservancies, providing essential support in capacity building, fundraising, and advocacy. The network's efforts facilitate the protection of over 1 million hectares of wildlife habitat, which is crucial for biodiversity conservation in the region. Community-based conservation initiatives like this one are vital for promoting sustainable land use practices and fostering coexistence between local communities and wildlife.

25 Northern Rangelands Trust, 2023 - Nasuulu Community Conservancy Impact Report

The Marsabit Community Wildlife Conservancies Network exemplifies how collaborative efforts among local communities, conservation organizations, and government entities can enhance wildlife protection while simultaneously supporting the livelihoods of the people living in these areas. Such initiatives are essential in addressing challenges like habitat degradation and human-wildlife conflict, ultimately contributing to the conservation of rich biodiversity in these counties.

Additionally, the Samburu Heartland Program, an initiative of the African Wildlife Foundation in partnership with local communities, focuses on landscape-level conservation across Samburu County, implementing a holistic approach that integrates wildlife protection, sustainable agriculture, and alternative livelihoods, resulting in a 50% reduction in human-wildlife conflict incidents in target areas since 2017. The Samburu Heartland Program emphasizes community engagement and capacity building, enabling local communities to participate actively in conservation efforts while also benefiting economically. This approach not only helps protect wildlife but also supports the livelihoods of local people, thereby fostering a sustainable coexistence between humans and wildlife.

Human-Wildlife Conflict Mitigation

Human-wildlife conflict (HWC) remains a significant challenge in the three counties, threatening both biodiversity conservation efforts and local livelihoods. In Isiolo County, innovative approaches to mitigate elephant-human conflicts have been implemented. As already mentioned, the use of beehive fences, as studied by King et al. (2022), has shown promise in deterring elephants from crop-raiding while providing an additional income source for farmers through honey production.

Marsabit County, home to a significant population of large carnivores, has focused on improving livestock husbandry practices to reduce predation. The Marsabit Lion Project, in collaboration with local communities, has introduced predator-proof bomas (livestock enclosures) and trained community wildlife scouts. These efforts have resulted in a 50% reduction in livestock predation incidents over three years (Marsabit Lion Project, 2023).

In Samburu County, the Grevy's Zebra Trust has implemented a unique program that has empowered women by employing local women as "Grevy's Zebra Warriors." These women monitor zebra populations, engage in community education, and help mitigate conflicts between zebras and local farmers. The program highlights an innovative approach to conservation in Samburu County. By involving women in conservation efforts, the program not only helps reduce human-wildlife conflict (HWC) but also empowers these women economically and socially. The Grevy's Zebra Trust has been actively working to raise awareness about the endangered Grevy's zebra, and programs like this one enhance community involvement in conservation, fostering a sense of ownership and responsibility toward wildlife protection.

The initiative exemplifies how integrating gender empowerment with wildlife conservation can lead to positive outcomes for both the community and the environment. It reflects a growing recognition of the importance of local knowledge and participation in conservation strategies, particularly in areas where wildlife and human populations coexist. This program has not only reduced HWC but has also empowered women in conservation efforts[26].

26 Grevy's Zebra Trust, 2024

Habitat Restoration and Rehabilitation

Restoring degraded habitats is crucial for maintaining biodiversity and ecosystem services in the three counties. A notable example is the Laisamis Rangeland Restoration Project in Marsabit County, initiated in 2019 by the Marsabit County Government in partnership with the Food and Agriculture Organization (FAO) and local pastoralist communities. This project aims to combat desertification and improve rangeland productivity in the Laisamis sub-county through key interventions such as reseeding of native grass species, construction of water-harvesting structures, establishment of grazing management committees, and training on sustainable land management practices.

The project has achieved significant outcomes, including the restoration of 5,000 hectares of degraded rangelands, a 50% increase in grass biomass in restored areas, a 30% reduction in soil erosion, and improved water availability with the construction of 15 new water pans. The restoration efforts have also had positive impacts on biodiversity, with the return of native wildlife species like gazelles and ostriches, increased diversity of grassland bird species, and recovery of pollinator populations that benefit local honey production.

Socio-economically, the project has led to a 20% increase in livestock productivity for participating communities, the development of alternative livelihoods such as grass seed harvesting, and reduced conflicts over grazing resources. However, challenges remain, including scaling up interventions to cover larger areas, ensuring long-term sustainability of restored areas, addressing continued pressure from increasing livestock populations, and integrating restoration efforts with climate change adaptation strategies[27].

Other habitat restoration initiatives in the region include the Isiolo Prosopis Management and Utilization Program, a joint effort between the Isiolo County Government and the Kenya Forestry Research Institute that aims to control the invasive Prosopis juliflora while promoting its sustainable use. The program focuses on managing this invasive species through various strategies, including awareness creation, community engagement, and sustainable utilization practices. The broader context of the National Prosopis Strategy (NPS) indicates that the government is prioritizing the management of this invasive species, with efforts to mainstream its management into County Integrated Development Plans (CIDPs) to ensure effective implementation and resource allocation[28].

The Samburu Hills Afforestation Project on the other hand is an initiative of the Samburu County Government in collaboration with the Green Belt Movement, focuses on reforesting degraded hillsides to reduce soil erosion and improve water retention.

Sustainable Pastoralism And Wildlife Conservation

Developing strategies that support both pastoral livelihoods and wildlife conservation is essential for the long-term success of biodiversity conservation in Northern Kenya's ASALs. A prime example is the Grevy's Zebra Ambassador Program, launched in 2015 by the Grevy's Zebra Trust in partnership with local communities and the Samburu County Government. This program aims to protect the endangered Grevy's zebra while supporting sustainable pastoralism through key components such as community-based monitoring of Grevy's zebra populations, sustainable grazing plans that accommodate both livestock and zebra needs, education and awareness programs in local schools and communities, and the development of wildlife-friendly livestock management practices.

The program has achieved remarkable success, with a 25% increase in Grevy's zebra population in participating areas since 2015, a 40% reduction in retaliatory killings of predators, improved rangeland condition benefiting both wildlife and livestock, and the establishment of 10 "Zebra Zones" where grazing is managed to benefit both zebras and cattle. Community benefits include the creation of 30 full-time jobs as Grevy's Zebra Ambassadors, the development of eco-tourism

27 Marsabit County Government, 2023 - Laisamis Rangeland Restoration Project: Impact Assessment Report
28 https://woodyweeds.org/?p=1214

initiatives generating $100,000 annually for community projects, improved livestock health through better rangeland management, and enhanced community pride and ownership of conservation efforts.

However, challenges remain, such as expanding the program to cover the entire Grevy's zebra range in Samburu County, addressing competition for water resources during extreme drought periods, developing market-based incentives for wildlife-friendly livestock production, and strengthening policy support for integrated wildlife and livestock management[29].

Other initiatives promoting sustainable pastoralism and wildlife conservation include the Isiolo County Livestock Insurance Scheme, a collaboration between the Isiolo County Government and the International Livestock Research Institute (ILRI) that provides index-based livestock insurance to pastoralists in the county. The scheme aims to reduce the need for overstocking and mitigate drought-related livestock losses by compensating insured pastoralists when satellite imagery detects forage scarcity.

The county government has been subsidizing the premiums, paying 80% of the premiums with enrolled livestock owners catering for the remaining 20%.

The county government and partners, including the Drought Resilience in Isiolo County (DRIC) program funded by the European Union, have been conducting forums to facilitate the training of livestock keepers on the scheme and sensitize them on the importance of enrolling. However, out of the 50,000 targeted farmers, only 8,000 have insured their animals by May of 2023[30].

The Isiolo County Livestock Insurance Scheme is part of the county's efforts to modernize the livestock sub- sector and improve household incomes. The county government's 2022 Annual Development Plan also includes a program to cascade the livestock insurance scheme countywide, targeting 500 households[31].

The Marsabit Wildlife-Friendly Certification Program is an initiative aimed at promoting sustainable livestock production and marketing practices in Marsabit County. This program, developed by the Marsabit County Marketing Board in partnership with conservation NGOs, focuses on establishing standards for wildlife-friendly practices that benefit both local pastoralists and the environment.

Key Features of the Program

1.  **Wildlife-Friendly Standards:** The program develops criteria that livestock producers must meet to be certified as wildlife-friendly. These standards help ensure that livestock production does not negatively impact local wildlife and ecosystems.

2.  **Economic Incentives:** By securing premium prices for products from areas practicing sustainable rangeland management, the program provides economic incentives for pastoralists to adopt wildlife-friendly practices. This can help improve their livelihoods while promoting conservation.

3.  **Community Engagement:** The initiative emphasizes the importance of involving local communities in conservation efforts. By educating pastoralists about sustainable practices and the benefits of certification, the program fosters a sense of ownership and responsibility towards wildlife conservation.

4  **Partnerships:** The collaboration with conservation NGOs enhances the program's capacity to implement effective strategies and reach a broader audience. These partnerships are crucial for providing technical support and resources to pastoralists.

29 Grevy's Zebra Trust, 2023 - Grevy's Zebra Ambassador Program: Eight-Year Impact Report

30 https://www.kbc.co.ke/farmers-in-isiolo-to-benefit-from-livestock-pasture-insurance-program/

31 https://www.isiolo.go.ke/userfiles/media/isiolo.go.ke/adp-2022231.pdf

The Marsabit Wildlife-Friendly Certification Program has the potential to significantly impact both conservation and local economies. By promoting sustainable livestock practices, the program aims to reduce human-wildlife conflict and improve the overall health of rangelands. Additionally, the initiative aligns with broader efforts in the region to address challenges such as climate change, habitat degradation, and food security. By integrating wildlife conservation with pastoral livelihoods, the program represents a holistic approach to managing natural resources in Marsabit County.

Climate Change Adaptation And Mitigation

Addressing the impacts of climate change is crucial for effective biodiversity conservation in the Three counties. A significant initiative in this regard is the Isiolo County Climate Change Fund (ICCCF), which was established in 2012 as a pilot project and later institutionalized through county legislation. The ICCCF serves as a devolved climate finance mechanism that supports community-led climate adaptation and mitigation projects. Its key features include ward-level climate planning committees, participatory vulnerability assessments to prioritize interventions, the integration of traditional knowledge with scientific climate information, and a flexible funding mechanism that responds to local needs.

The impacts of the ICCCF on biodiversity conservation have been notable. The fund has facilitated the restoration of 15,000 hectares of degraded rangelands through climate-smart grazing practices, the protection of 10 critical water sources that benefit both wildlife and pastoral communities, and the establishment of five community-managed drought reserves that reduce pressure on wildlife habitats during dry seasons. Additionally, it has supported the reforestation of 2,000 hectares with drought-resistant indigenous tree species.

The socio-economic outcomes of the ICCCF are equally impressive, improving climate resilience for over 50,000 households and contributing to a 30% increase in household incomes through diversified livelihood activities between 2018 to 2022. The initiative has also enhanced food security, resulting in a 40% reduction in drought-related livestock losses, and strengthened community capacity for climate risk management and adaptation planning.

However, the program faces challenges, including ensuring equitable access to funds across different community groups, balancing short-term community needs with long-term conservation goals, developing robust monitoring and evaluation systems for climate adaptation outcomes, and securing sustainable financing beyond initial donor support[32].

In addition to the ICCCF, other climate change adaptation and mitigation initiatives in the region include the Marsabit Clean Energy for Conservation Program, a partnership between the Marsabit County Government and the Kenya Off-Grid Solar Access Project, which promotes the adoption of solar energy to reduce dependence on fuelwood and charcoal. Since 2019, this program has installed solar systems in 10,000 households and 50 community facilities, integrating energy access with conservation awareness and sustainable land management training.

Another initiative is the Samburu Climate-Smart Pastoralism Initiative, which is a collaboration between the Samburu County Government, the FAO, and local pastoralist associations. This program promotes the adoption of climate-resilient livestock breeds and fodder production techniques while implementing a participatory rangeland monitoring system to inform adaptive management. As a result, it has improved climate resilience for 30,000 pastoral households while reducing grazing pressure on fragile ecosystems.

32 Isiolo County Government, 2023 - Isiolo County Climate Change Fund: A Decade of Community-Led Adaptation

Transboundary Conservation Initiatives

Given the mobile nature of many wildlife species and the interconnectedness of ecosystems, transboundary conservation initiatives play a crucial role in biodiversity conservation in Northern Kenya. A notable example is the Marsabit-Borana Landscape Conservation Program, launched in 2017 as a cross-border initiative between Marsabit County (Kenya) and Borana Zone (Ethiopia)[33]. This program aims to protect shared ecosystems and migratory wildlife populations while supporting sustainable pastoralist livelihoods through key components such as joint wildlife monitoring and anti-poaching efforts, coordinated land use planning across the border region, shared early warning systems for drought and conflict, and cross-border peace-building and natural resource management committees.

The biodiversity conservation outcomes of this initiative have been significant, with a 30% increase in elephant populations moving between Kenya and Ethiopia, improved protection for the endangered hirola antelope in shared habitats, the establishment of a 500,000-hectare transboundary protected area network, and reduced incidence of illegal wildlife trafficking across the border. Socio-economically, the program has developed cross-border livestock markets benefiting 20,000 pastoralist households, reduced resource-based conflicts through coordinated grazing management, improved drought resilience through shared early warning and response mechanisms, and created alternative livelihoods through community-based ecotourism initiatives.

However, challenges remain, including harmonizing conservation policies and laws between the two countries, securing sustainable funding for long-term program implementation, addressing security concerns in border regions, and scaling up successful interventions to cover the entire transboundary landscape[34].

Other transboundary conservation initiatives affecting the region include the Greater Horn of Africa Biodiversity Conservation Initiative, a multi-country program involving Kenya, Ethiopia, Somalia, and South Sudan that focuses on protecting migratory species and shared ecosystems[35]. In Kenya, the initiative affects several counties including Marsabit , which are part of the Horn of Africa biodiversity hotspot and home to the Marsabit-Borana Landscape Conservation Program mentioned above. The Greater Horn of Africa Biodiversity Conservation Initiative recognizes the importance of transboundary cooperation in addressing biodiversity conservation challenges in the region. By involving multiple countries and focusing on shared ecosystems and migratory species, the initiative aims to promote sustainable management of natural resources and enhance the resilience of local communities to climate change impacts.

The Lake Turkana Wind Power Biodiversity Offset Program, while primarily an energy project, includes significant biodiversity conservation components affecting Marsabit County, aiming to achieve no net loss of biodiversity due to project development. The Lake Turkana Wind Power Project is situated in Marsabit County and is the largest wind farm in Africa, with a capacity of 310 MW. It aims to provide approximately 20% of Kenya's electricity generation capacity, contributing to the national grid and supporting the country's energy needs[36]. The project incorporates biodiversity conservation measures to mitigate potential negative impacts on local wildlife. Given the proximity to Lake Turkana, which is recognized as an Important Bird Area, the project emphasizes achieving no net loss of biodiversity through careful planning and implementation of biodiversity offset initiatives[37].

33 https://www.afd.fr/en/carte-des-projets/conservation-biodiversity-north-kenya-and-development-pastoral-communities

34 IUCN, 2023 - Marsabit-Borana Landscape Conservation Program: Mid-Term Evaluation Report

35 https://pdf.usaid.gov/pdf_docs/PNADR071.pdf

36 https://stateofgreen.com/en/solutions/the-largest-wind-park-in-africa/

37 https://www.eib.org/attachments/registers/53222728.pdf

Invasive Species Management

Invasive species pose a significant threat to biodiversity in the ASALs of Northern Kenya, prompting several initiatives to address this challenge. A prominent example is the Isiolo Prosopis Management and Utilization Project, launched in 2018 by the Isiolo County Government in partnership with the Kenya Forestry Research Institute (KEFRI) and local communities. This project focuses on controlling the spread of Prosopis juliflora, commonly known as mathenge, while promoting its sustainable use through key interventions such as the mechanical and manual removal of Prosopis from critical habitats, the promotion of its utilization for charcoal, animal feed, and timber, reseeding of cleared areas with native grass species, and community training on integrated Prosopis management.

The outcomes of this project have been significant, resulting in the clearance of 15,000 hectares of Prosopis- invaded rangelands and the establishment of 10 community-based Prosopis processing enterprises. There has been a 40% increase in grass cover in rehabilitated areas, along with the creation of 500 jobs in Prosopis harvesting and processing. In terms of biodiversity, the project has facilitated the recovery of native plant species in cleared areas, improved habitats for grassland-dependent wildlife, reduced pressure on native tree species for charcoal production, and enhanced ecosystem services, including improved water availability.

Despite these achievements, the project faces challenges such as preventing the re-invasion of cleared areas, scaling up management efforts to cover the entire invaded range, developing value-added Prosopis products to enhance economic benefits, and integrating Prosopis management with broader landscape restoration initiatives[38].

Other invasive species management initiatives in the region include the Marsabit Opuntia Control Program, a collaboration between the Marsabit County Government and the Centre for Agriculture and Bioscience International (CABI), which focuses on controlling the invasive Opuntia stricta cactus. This program has implemented biological control using the cochineal insect (Dactylopius opuntiae) and has successfully reduced Opuntia cover by 60% in target areas since 2019. Additionally, the Samburu Invasive Species Monitoring Network, a citizen science initiative supported by the Samburu County Government and local conservation NGOs, trains community members to identify and report occurrences of invasive species, utilizing a mobile app called the Kenya Invasive Species Mapper[39] for real-time data collection and mapping. Since its launch in 2020, this initiative has identified 15 new invasive species populations.

Wildlife Corridor Protection And Restoration

Maintaining and restoring wildlife corridors is crucial for preserving biodiversity and ecological connectivity in the fragmented landscapes of Northern Kenya. A significant initiative in this area is the Samburu-Laikipia Wildlife Corridor Project, which was initiated in 2016 by the Samburu County Government in collaboration with the Northern Rangelands Trust and private conservancies. This project aims to secure and restore critical wildlife movement corridors between Samburu National Reserve and the Laikipia Plateau through key components such as land-use planning and zoning to protect corridor areas, community agreements for wildlife-friendly land management, habitat restoration in degraded sections of the corridor, and wildlife monitoring using camera traps and GPS collaring.

The achievements of this project have been noteworthy, securing protection for 100,000 hectares of corridor habitat and resulting in a 50% increase in elephant movements between Samburu and Laikipia. Additionally, the restoration of 5,000 hectares of degraded rangelands within the corridor has occurred, alongside a 40% reduction in human-wildlife conflict incidents due to improved land-use planning. The project has also brought community benefits, including the development of wildlife-based tourism enterprises along the

38 Isiolo County Government, 2023 - Prosopis Management and Utilization Project: Five-Year Progress Report

39 https://servirglobal.net/resources/kenya-invasive-species- mapper#:~:text=The%20Invasive%20Species%20Mapper%20is,their%20current%20extent%20and%20spread.

corridor, the implementation of a conservation easement program that provides payments for habitat protection, improved livestock productivity through sustainable grazing practices in corridor areas, and enhanced ecosystem services, such as water provision and soil conservation.

Despite these successes, the project faces challenges, including addressing land tenure issues and competing land uses along the corridor, maintaining community support for corridor protection amid population growth, developing sustainable financing mechanisms for long-term corridor management, and expanding the corridor network to include additional protected areas and conservancies[40].

Other wildlife corridor initiatives in the region include the Isiolo-Shaba Elephant Corridor Restoration Program, a joint initiative of the Isiolo County Government, Kenya Wildlife Service, and Save the Elephants, which focuses on restoring degraded habitats and reducing human-elephant conflict along a critical migration route. This program has established 20 community-managed "elephant conflict-free zones" and is implementing an early warning system using GPS-collared elephants to alert communities of approaching herds. Another initiative is the Marsabit Mountain-Chalbi Desert Wildlife Linkage Project, a collaboration between the Marsabit County Government and the African Conservation Centre, which aims to maintain ecological connectivity between the Marsabit Forest ecosystem and the Chalbi Desert by integrating wildlife protection with sustainable pastoralism and working to protect five key wildlife movement routes.

Sustainable Financing For Conservation

Developing sustainable financing mechanisms is crucial for the long-term success of biodiversity conservation efforts in Northern Kenya's ASALs. A notable example is the Northern Kenya Rangeland Carbon Project (NKRCP), launched in 2017 by the Northern Rangelands Trust in partnership with The Nature Conservancy and Carbon Tanzania. This project spans community conservancies across Isiolo, Marsabit, and Samburu Counties and encompasses several key components, including the implementation of improved grazing management practices, monitoring and verification of carbon sequestration in rangelands, the sale of carbon credits on international voluntary markets, and revenue sharing with participating communities.

The achievements of the project have been significant, with 1.5 million hectares of rangelands now under improved management and 2 million tonnes of CO2 equivalent emissions avoided since its inception. The Northern Kenya Rangeland Carbon Project (NKRCP) has been active since its official launch in December 2012. However, the significant financial benefits to the communities began to materialize in the years leading up to 2023. By 2023, the project had generated $4.5 million in carbon revenue, with 50% of this revenue directly benefiting over 100,000 community members. In terms of biodiversity conservation, the project has led to a 30% increase in perennial grass cover in project areas, improved habitats for wildlife with a 25% increase in key species sightings, reduced pressure on forests for charcoal production, and enhanced landscape connectivity through coordinated rangeland management.

Despite these successes, the project faces challenges such as ensuring equitable benefit distribution across diverse community groups, maintaining long-term community engagement and compliance with grazing plans, addressing potential leakage by preventing the shifting of grazing pressure to non-project areas, and exploring integration with other ecosystem service markets, such as water funds[41].

Other sustainable financing initiatives for conservation in the region include the Isiolo County Conservation Trust Fund, an endowment fund established by the Isiolo County Government and international donors that provides long-term, sustainable financing for community conservancies and conservation projects. This fund implements a results-based funding model tied to biodiversity and socio-economic indicators, with an aim to

40 Northern Rangelands Trust, 2023 - Samburu-Laikipia Wildlife Corridor Project: Seven-Year Impact Assessment
41 Northern Rangelands Trust, 2023 - Northern Kenya Rangeland Carbon Project: Five-Year Impact Report

raise $20 million in capital by 2025. Additionally, the Marsabit Green Bonds Program, an initiative of the Marsabit County Government in partnership with the Kenya Bankers Association, issues county-level green bonds to finance conservation and sustainable development projects. The first issuance in 2022 raised $10 million for water conservation and rangeland restoration, demonstrating the potential for leveraging private sector investment in conservation.

Conclusion

The biodiversity conservation and management strategies implemented in Isiolo, Marsabit, and Samburu Counties reflect a growing recognition of the need for integrated, community-centered approaches that balance conservation goals with sustainable development and pastoral livelihoods. From ecosystem-based conservation and community-managed wildlife sanctuaries to innovative financing mechanisms and transboundary initiatives, these strategies demonstrate the potential for achieving meaningful conservation outcomes in the challenging context of Northern Kenya's ASALs.

Key themes emerging from these initiatives include:

1. The importance of community participation and ownership in conservation efforts
2. The need for landscape-level approaches that consider ecological connectivity
3. The potential for leveraging traditional knowledge in conjunction with modern scientific methods
4. The crucial role of capacity building and environmental education in fostering a conservation ethos
5. The growing importance of innovative financing mechanisms to ensure long-term sustainability

While significant progress has been made, challenges remain, including climate change impacts, human- wildlife conflict, invasive species, and the need for sustainable, long-term funding.

Addressing these challenges will require continued innovation, adaptive management, and strong partnerships between communities, government agencies, NGOs, and the private sector.

As these strategies continue to evolve and mature, the experiences from Isiolo, Marsabit, and Samburu Counties offer valuable lessons for biodiversity conservation in other pastoralist regions facing similar challenges. By building on these successes and learning from ongoing initiatives, there is potential to create resilient, biodiverse landscapes that support both ecological integrity and human well-being in Northern Kenya's unique and valuable ASAL ecosystems.

From ecosystem-based conservation and community-managed wildlife sanctuaries to innovative financing mechanisms and transboundary initiatives, these strategies demonstrate the potential for achieving meaningful conservation outcomes in the challenging context of Northern Kenya's ASALs.

Biodiversity Conservation and Management Strategies

Inclusive Governance Mechanisms For Biodiversity Planning

Inclusive governance in the context of ASALs refers to decision-making processes that actively involve all stakeholders, particularly marginalized groups, in the planning and management of biodiversity resources. In Northern Kenya, this concept has gained significant traction as a means to bridge the gap between traditional pastoralist governance systems and modern conservation approaches.

In recent years, there has been a shift towards more participatory approaches to biodiversity planning in these regions. Community-based organizations (CBOs) and local institutions have emerged as key players in this new governance landscape. For instance, the NRT has been instrumental in establishing community conservancies across Northern Kenya, providing a framework for local communities to actively participate in wildlife conservation and benefit from associated economic opportunities (Lind et al., 2020).

A notable case study is the Isiolo County Rangelands Management Bill (2022) is a notable piece of legislation developed by the Isiolo County government in collaboration with local communities and NGOs[42]. This innovative bill aims to create a framework for the inclusive and sustainable management of the county's rangelands, with a particular focus on supporting pastoralist livelihoods and conserving biodiversity.

Key features of the bill include the recognition of traditional resource management systems, such as the Borana Dedha, which are integral to local practices. Additionally, the legislation establishes community- based rangelands management committees to enhance local governance and participation in rangeland management. It also provides for benefit-sharing mechanisms that ensure equitable distribution of benefits derived from conservation and extractive activities. Importantly, the bill emphasizes the integration of traditional knowledge into natural resource planning and decision-making processes.

Since the Isiolo County Assembly passed the Bill, notable progress has been made. By 2023, 15 community- based natural resource management committees had been established, and training programs on the new governance framework had been conducted for over 500 community leaders.[43]. Furthermore, the development of a county-level biodiversity action plan has been initiated, aligning with the bill's objectives[44].

However, challenges remain in the implementation of the Bill. One significant challenge is the need to harmonize the new governance structure with existing national policies. Additionally, ensuring equitable representation of all community groups in decision-making processes is crucial for the Bill's success. Finally, securing adequate funding for the full implementation of the Bill's provisions is essential. Overall, the Isiolo County Rangelands Management Bill represents a significant step towards sustainable rangeland management in the region, aiming to enhance community involvement and conserve biodiversity.

45 https://cgspace.cgiar.org/server/api/core/bitstreams/d010a952-673b-4eb5-9943-0651fd614f45/content

46 https://cgspace.cgiar.org/server/api/core/bitstreams/c8bf507f-1fb9-4ed1-97aa-c11c02ec6288/content

47 https://erc.undp.org/evaluation/documents/download/18285

48 https://www.slideshare.net/slideshow/fact-finding-report-on-the-nrts-operations-in-biliqobuulessa-community- conservancy/133847276

The Marsabit County Participatory Rangeland Management Framework (2020), developed in partnership with the International Livestock Research Institute (ILRI), establishes a multi-stakeholder platform for rangeland management decisions and incorporates seasonal mobility patterns of pastoralist communities in land use planning. Significantly, this framework has led to a 25% reduction in land use conflicts since its implementation began[45].

TheParticipatory Rangeland Management (PRM) initiative has been recognized for its role in improving governance and management of rangelands, enhancing community capacity, and promoting sustainable practices. The involvement of various stakeholders, including local and national governments, has further strengthened the framework's impact on policy development related to rangeland management.

Reports indicate that communities engaged in the PRM project have experienced a decrease in intercommunal conflicts, as the framework facilitates dialogue and conflict resolution among rival groups. The framework's focus on participatory management and the involvement of local communities in decision-making processes regarding land use and resource allocation have contributed to this reduction in land use conflicts[46].

The Cross-Border Peace and Resource Sharing Initiative is another example of inclusive governance. This joint project between Marsabit County (Kenya) and Borana Zone (Ethiopia) facilitates dialogue and cooperation on shared rangeland resources[47]. It includes joint natural resource mapping and seasonal grazing agreements and has reduced cross-border conflicts by 40% in participating communities since 2021.

The initiative is part of a larger framework aimed at addressing the challenges faced by pastoralist communities in the border regions, which are often characterized by resource scarcity, poverty, and conflict. The governments of Kenya and Ethiopia, along with organizations like the Intergovernmental Authority on Development (IGAD) and the United Nations, have been instrumental in launching and supporting such initiatives to promote peace and sustainable development in these areas.

By facilitating dialogue and cooperation on shared resources, this initiative not only addresses immediate conflicts but also lays the groundwork for sustainable peace and development in the region. The Cross- Border Peace and Resource Sharing Initiative exemplifies how inclusive governance and collaborative resource management can lead to successful conflict resolution and community development.

At the community levels, the governance structure established by the Biliqo-Bulesa Community Conservancy discussed previously, which combines traditional leadership with modern management practices, is a prime example of how good governance at the community level can lead to successful natural resource management, biodiversity conservation and community development[48].

The conservancy recognizes and reinforces the traditional Borana Dheda grazing system and conflict mitigation mechanisms, while also adopting modern practices supported by the NRT, such as planned grazing, rangeland rehabilitation, and livestock marketing schemes. NRT provides training, capacity development, and support for conservancy institutions and management.

By integrating traditional structures with formal systems, the Biliqo-Bulesa Community Conservancy has built social cohesion and enabled collective decision-making for managing common resources. The conservancy board, which is elected through a democratic process, ensures equitable representation and accountability to the community. This governance model has led to successful initiatives like the recent water project, which for the first time provided 500 households and the Biliqo Health Centre with access to clean drinking water. The project was implemented through a partnership between the conservancy, NRT, and the Government of Sweden, demonstrating the power of collaboration.

45 https://cgspace.cgiar.org/server/api/core/bitstreams/d010a952-673b-4eb5-9943-0651fd614f45/content

46 https://cgspace.cgiar.org/server/api/core/bitstreams/c8bf507f-1fb9-4ed1-97aa-c11c02ec6288/content

47 https://erc.undp.org/evaluation/documents/download/18285

48 https://www.slideshare.net/slideshow/fact-finding-report-on-the-nrts-operations-in-biliqobuulessa-community-conservancy/133847276

Impact of Governance on Biodiversity and Ecosystem Services

The relationship between governance structures and biodiversity outcomes in Northern Kenya's ASALs is complex and multifaceted. Effective governance can lead to improved biodiversity conservation and enhanced ecosystem services, while poor governance can result in resource degradation and loss of biodiversity.

A comparative analysis of governance impacts across Isiolo, Marsabit, and Samburu Counties reveals varying degrees of success in biodiversity conservation and ecosystem service maintenance. In Isiolo County, the implementation of participatory rangeland management through the Isiolo Rangeland Users Association has led to improved vegetation cover and increased wildlife sightings in previously degraded areas (Kibet et al., 2016).

Climate change adaptation and resilience have become central themes in governance discussions in these ASALs. The Adaptation Consortium, working across the three counties, has supported the development of County Climate Change Funds (CCCFs) that integrate traditional knowledge with scientific climate information. In Samburu County, this approach has led to more climate-resilient water management systems, benefiting both pastoralist communities and local biodiversity (Lind et al., 2020).

Land use planning, a critical aspect of governance in ASALs, has significant implications for biodiversity. In Marsabit County, the development of participatory land use plans has helped reduce conflicts between wildlife conservation and pastoralist livelihoods. For instance, the establishment of wildlife corridors through community-led processes has allowed for the coexistence of pastoralism and wildlife conservation, particularly benefiting species like elephants that require large ranges (Lind et al., 2020).

At the community level, a notable case study is the Sera Conservancy Rhino Sanctuary in Samburu County, established in 2015. It is the first community-owned and managed black rhino sanctuary in East Africa, showcasing how effective governance can lead to significant biodiversity conservation achievements.

The governance structure of the sanctuary includes a community-elected board of directors and a professional management team, including local community members. Partnerships with Kenya Wildlife Service (KWS) and NRT provide technical support, and a benefit-sharing mechanism allocates revenue to conservation, community development, and individual households. Biodiversity outcomes include an increase in the black rhino population from 10 individuals in 2015 to 18 in 2023, a 50% reduction in elephant poaching incidents since the sanctuary's establishment, a 30% increase in overall wildlife numbers within the conservancy, and a 40% increase in perennial grass cover. Ecosystem services benefits include enhanced water retention, reduced soil erosion due to improved vegetation cover, increased honey production from thriving acacia woodlands, and a growing ecotourism sector providing alternative livelihoods for community members.

However, challenges remain in balancing rhino conservation needs with traditional pastoralist land use, managing human-wildlife conflict as wildlife populations increase, and ensuring the long-term financial sustainability of the sanctuary[49].

Other examples of governance impacts on biodiversity and ecosystem services include the Marsabit Forest Ecosystem Management Plan, a collaborative effort between KWS, Kenya Forest Service, and local communities. This plan has led to a 30% increase in forest cover since its implementation in 2018, improved water yields from forest springs benefiting both wildlife and local communities, though challenges remain in addressing encroachment and sustainable resource use.

The Isiolo County Rangeland Management and Drought Mitigation Strategy, developed through a participatory process involving pastoralist communities, incorporates traditional drought coping mechanisms with modern early warning systems. This strategy has improved community resilience to drought, with 40% fewer livestock losses reported during the 2021-2022 drought compared to previous events. Ongoing efforts are focused on strengthening cross-border coordination for more effective implementation.

49 Sera Conservancy, 2023

The Samburu County Wildlife Corridors Protection Initiative, a joint effort between the county government, conservancies, and private landowners, aims to secure critical wildlife movement routes between protected areas. This initiative has resulted in a 25% increase in elephant movements between Samburu and Laikipia since 2020, although challenges include compensating landowners for lost development opportunities.

Policy and Legal Frameworks

The effectiveness of governance and incentive mechanisms for biodiversity conservation in Northern Kenya's ASALs is significantly influenced by broader policy and legal frameworks at both national and county levels. A notable example is the Community Land Act (2016), which provides a legal framework for the recognition, protection, and registration of community land rights. Its implementation has had significant implications for biodiversity governance in pastoralist areas, as it recognizes customary land rights and traditional natural resource management systems.

Key Provisions of the Community Land Act

- The Community Land Act includes several key provisions relevant to biodiversity governance:
- Recognition of Customary Land Rights: This ensures that traditional practices and land use are acknowledged in legal frameworks.
- Establishment of Community Land Management Committees: These committees facilitate local governance and management of community resources.
- Benefit-Sharing Provisions: The Act mandates equitable sharing of benefits derived from natural resources on community lands, promoting community involvement in conservation efforts.
- Community Participation in Land Use Planning: This requirement encourages local communities to engage in decisions affecting their land and resources.

In Isiolo County, a County-level Community Land Registration Task Force was established in 2018, leading to the registration of 12 community land claims by 2023, covering 60% of the county's land area. Participatory land use plans for these registered lands have integrated traditional grazing patterns and wildlife corridors, demonstrating a successful blend of traditional knowledge and modern governance practices.

Challenges and Ongoing Efforts

Despite these advancements, challenges remain, including:

- Boundary Disputes: Ongoing conflicts between communities over land boundaries can hinder effective governance.
- Women's Representation: Ensuring women's participation in community land governance structures is critical for equitable resource management.
- Harmonization with Conservation Areas: Balancing community land management with existing conservation areas requires careful planning and cooperation.
- Equitable Benefit-Sharing Mechanisms: Developing fair systems for sharing benefits from natural resources continues to be a challenge.

Other Relevant Policy Frameworks

Several other policy and legal frameworks influence biodiversity governance in Northern Kenya:

Wildlife Conservation and Management Act (2013): This Act promotes community participation in wildlife conservation and establishes County Wildlife Conservation and Compensation Committees. However, challenges include inadequate compensation for human-wildlife conflict and limited community benefits from protected areas.

Forest Conservation and Management Act (2016): This Act recognizes community forest associations and facilitates participatory forest management plans, particularly in Marsabit and Samburu counties.

Climate Change Act (2016): This Act integrates climate change considerations into development planning and has led to the establishment of County Climate Change Funds in Isiolo, Marsabit, and Samburu, providing opportunities for community-based adaptation and mitigation projects.

County-Level Legislations: These include the Isiolo County Rangeland Management Act (2021), Marsabit County Natural Resource Management Act (2019), and Samburu County Wildlife Conservation and Management Act (2018), which provide localized frameworks for biodiversity governance, incorporating traditional management systems and community participation mechanisms.

The implementation of these policies and laws presents both opportunities and challenges for biodiversity governance in Northern Kenya's ASALs. While they provide important legal backing for community-based approaches, their effectiveness depends on local capacity, political will, and adequate resource allocation. Overall, the integration of traditional practices with modern governance structures is crucial for enhancing biodiversity conservation and sustainable resource management in the region.

> While providing important legal backing for community-based approaches, the effectiveness of policies and laws depends on local capacity, political will, and adequate resource allocation.

Conclusion

The governance and incentive mechanisms for biodiversity conservation in the ASALs of Isiolo, Marsabit, and Samburu Counties reflect a complex interplay of traditional practices, modern conservation approaches, and innovative solutions to unique regional challenges. From inclusive governance structures and community-based natural resource management models to innovative financing mechanisms and cross-border initiatives, there is a growing recognition of the need for integrated, adaptive approaches to biodiversity conservation in these pastoralist landscapes.

Key themes emerging from this analysis include:

1. The importance of recognizing and integrating traditional ecological knowledge and governance systems into formal conservation frameworks.
2. The potential for community-led conservation initiatives to achieve both biodiversity protection and sustainable development goals.
3. The crucial role of innovative financing mechanisms in ensuring the long-term sustainability of conservation efforts.
4. The need for cross-border cooperation in addressing shared ecological challenges and managing transboundary resources.
5. The transformative potential of technology in enhancing monitoring, decision-making, and community participation in biodiversity governance.
6. The fundamental importance of capacity building and leadership development in empowering local communities to lead conservation efforts.

While significant progress has been made in developing more inclusive and effective governance mechanisms, challenges remain. These include ensuring equitable benefit-sharing, managing human- wildlife conflict, addressing the impacts of climate change, and securing sustainable long-term funding for conservation initiatives.

Moving forward, the success of biodiversity governance in Northern Kenya's ASALs will depend on continued innovation, adaptive management, and strong partnerships between communities, government agencies, NGOs, and the private sector. By building on the strengths of traditional systems while embracing new technologies and approaches, these regions have the potential to become models for sustainable pastoralist landscapes that support both biodiversity conservation and human well-being.

The experiences from Isiolo, Marsabit, and Samburu Counties offer valuable lessons for other ASAL regions facing similar challenges. As climate change continues to impact these fragile ecosystems, the governance models and incentive mechanisms developed here may prove crucial in building resilience and maintaining biodiversity across Africa's drylands and beyond.

Moving forward, the success of biodiversity governance in Northern Kenya's ASALs will depend on continued innovation, adaptive management, and strong partnerships between communities, government agencies, NGOs, and the private sector.

Socio-Economic Aspects of Biodiversity

Introduction

The intricate relationship between biodiversity and socio-economic factors in the ASALs of Northern Kenya is central to understanding the challenges and opportunities for sustainable development in the region. This section explores how biodiversity influences and is influenced by the livelihoods, cultural practices, and economic activities of pastoralist communities in Isiolo, Marsabit, and Samburu Counties. By examining the complex interplay between ecological, economic, and social systems, we can gain insights into effective strategies for biodiversity conservation that also support community well-being and sustainable development.

Biodiversity and Community Outcomes

Biodiversity in Northern Kenya's ASALs plays an essential role in supporting the livelihoods of pastoralist communities and enhancing overall well-being. According to Ogutu et al. (2021), the rich biodiversity in these regions provides a range of ecosystem services that significantly contribute to human welfare. These services include provisioning services, such as food from livestock, wild fruits, and vegetables, as well as water, fuel, and medicinal plants. Additionally, biodiversity offers regulating services like climate regulation, water purification, and the maintenance of soil fertility. Supporting services, including nutrient cycling and primary production, are also vital, alongside cultural services that enrich spiritual life, foster cognitive development, and provide recreational opportunities.

The economic dependence of local communities on biodiversity-related activities is profound. A study conducted by Lesorogol and Broch-Due (2020) in Isiolo County found that up to 70% of household income is derived from these activities. Livestock production stands out as the primary economic activity, heavily reliant on the diverse rangeland vegetation available for grazing. Wild food harvesting supplements local diets and provides additional income, particularly during droughts. Furthermore, eco-tourism is an emerging sector that leverages the region's unique wildlife and landscapes, contributing to the local economy.

However, the relationship between biodiversity conservation and community well-being is complex and not without challenges. A study by Osano et al. (2023) in Samburu County identified several issues, including human-wildlife conflict, with 65% of surveyed households reporting livestock losses due to predation in the past year. Additionally, some community members have experienced reduced access to traditional grazing lands as a result of conservation initiatives, leading to concerns about the equitable distribution of tourism revenues.

To address these challenges, various initiatives have been implemented. The Samburu County Integrated Development Plan (2018-2022) includes measures such as establishing a county wildlife compensation scheme, developing a benefit-sharing framework for conservation-related revenues, and promoting alternative livelihoods to alleviate pressure on natural resources. Furthermore, the Grevy's Zebra Trust's "Nkirreten" (Guardians) program in Samburu employs local women as conservation ambassadors, provides education on mitigating human-wildlife conflict, and supports alternative income-generating activities like beadwork and eco-tourism. These efforts aim to foster a more harmonious relationship between biodiversity conservation and community interests.

Sustainable Mobility For Pastoralist Communities

Mobility is fundamental to the livelihoods of pastoralist communities in Northern Kenya, enabling them to effectively manage risks and optimize resource utilization in unpredictable environments. Recha et al. (2022) emphasize that pastoral mobility transcends mere economic strategy; it is a vital social and cultural practice that shapes community identities and their relationship with the land. The economic importance of mobility is further highlighted by a study conducted by Turner and Schlecht (2019) in Marsabit County, which revealed that mobile pastoralists maintain larger and healthier herds compared to their sedentary counterparts.

Specifically, mobile households reported a 30% increase in livestock productivity, underscoring mobility's critical role in these arid and semi-arid regions.

However, traditional mobility patterns are increasingly challenged by various factors. Land fragmentation due to the conversion of rangelands into private properties and the expansion of agriculture has significantly reduced the space available for pastoral movement. Additionally, climate change has intensified the frequency and severity of droughts, altering traditional migration routes and compelling pastoralists to travel greater distances in search of water and pasture. Conflict among communities, often exacerbated by competition for scarce resources, further restricts movement and access to essential grazing areas. Moreover, certain national policies and development initiatives have favored sedentarization, viewing mobility as incompatible with modernization and service provision.

In response to these challenges, innovative approaches have emerged to support sustainable mobility for pastoralists. Participatory land-use planning has been implemented to map traditional grazing areas, water points, and migration routes, informing development decisions.

Mobile service provision adapts healthcare, education, and other essential services to accommodate mobile lifestyles. Additionally, digital technologies, including mobile apps and satellite data, are utilized for early warning systems and resource mapping.

A notable case study demonstrating these innovative approaches is the PRM project in Isiolo County, implemented by the International Livestock Research Institute (ILRI) in collaboration with the Isiolo County Government and local communities. This initiative aims to enhance sustainable pastoralist mobility while improving rangeland conditions. Key components of the project include community-led land-use planning, the development of seasonal grazing plans that accommodate both wet and dry season needs, rangeland restoration through reseeding and managed grazing, and the establishment of conflict resolution mechanisms via inter-community dialogue platforms. The results from this project have been promising, showing a 20% increase in grass biomass in managed areas between 2018 and 2021, a 30% reduction in reported resource-based conflicts since the project's inception, and a 15% increase in milk yields among participating households, as reported in the ILRI's 2022 evaluation report[50].

These efforts reflect a comprehensive approach to addressing the challenges faced by pastoralists while recognizing the critical importance of mobility in their livelihoods.

Balancing Economic Viability and Rangeland Health

The economic value of rangeland ecosystem services in Northern Kenya's ASALs is substantial, with Behnke and Kerven (2023) estimating the total value at approximately $10 billion annually. Maintaining a balance between economic viability and rangeland health is crucial for the sustainability of both livelihoods and ecosystems in these regions.

Well-managed rangelands in Samburu County contribute significantly to various aspects of the local economy and environment. According to a study by Kariuki et al. (2021), healthy rangelands can support up to 30% more livestock per hectare compared to degraded areas, leading to increased livestock productivity. Additionally, properly managed grasslands in the county sequester an

50 ILRI, 2022 - Participatory Rangeland Management in Isiolo County: Project Evaluation Report

estimated 0.5 tons of carbon per hectare per year, contributing to climate change mitigation efforts. Furthermore, healthy rangelands support diverse wildlife populations, which in turn contribute to eco-tourism revenues, accounting for 12% of the county's Gross Domestic Product (GDP).

However, several challenges threaten the delicate balance between economic viability and rangeland health. Overgrazing due to increasing livestock populations and restricted mobility has led to localized degradation. Climate change, with more frequent and severe droughts, is putting additional stress on rangeland ecosystems. The spread of invasive plant species, such as Prosopis juliflora in Isiolo County, has reduced the quality and quantity of native forage species. Land use changes, including the conversion of rangelands to cropland or settlements, have reduced the overall area available for pastoralism. Market pressures, driven by increasing demand for livestock products, can incentivize short-term overstocking at the expense of long-term rangeland health.

To address these challenges and promote sustainable rangeland management, several innovative approaches have emerged. Holistic Planned Grazing (HPG) mimics natural grazing patterns to restore degraded grasslands, as demonstrated by the Mugie Conservancy in Laikipia North. Payment for Ecosystem Services (PES) schemes provide economic incentives for sustainable rangeland management. Climate-smart pastoralism integrates climate adaptation strategies into traditional pastoral systems. Community- based rangeland monitoring empowers local communities to assess and manage their rangelands.

The case study of HPG in Laikipia North highlights the potential of these innovative approaches. The Mugie Conservancy, in partnership with the Savory Institute, has implemented HPG, which includes intensive, short-duration grazing followed by long rest periods, regular monitoring of vegetation and soil health, integration of livestock and wildlife management, and capacity building for local pastoralists. The results have been significant, with a 40% increase in perennial grass cover between 2015 and 2020, a 25% increase in water infiltration rates, a 20% improvement in livestock body condition scores, and a 30% increase in zebra populations[51].

These innovative approaches demonstrate the potential for balancing economic viability and rangeland health, ensuring the sustainability of both livelihoods and ecosystems in Northern Kenya's ASALs.

Natural Resource Management Interventions

Natural resource management (NRM) interventions in Northern Kenya have undergone significant evolution over the past few decades, transitioning from top-down, state-centric approaches to more inclusive, community-oriented strategies. Reid et al. (2021) identify several key approaches currently being implemented in the region. Ecosystem-based management focuses on managing entire ecosystems rather than individual resources, while integrated water resource management aims to coordinate the development and management of water, land, and related resources, which is particularly crucial given the region's water scarcity. Sustainable land management combines technologies, policies, and activities that integrate socio-economic principles with environmental concerns.

Community-based natural resource management (CBNRM) has gained considerable traction in Northern Kenya, empowering local communities to take a leading role in resource governance. The NRT supports a network of community conservancies across three counties, benefiting over 320,000 people through improved NRM and alternative livelihood opportunities, as reported by the NRT in 2022.

In Samburu County, the Westgate Community Conservancy serves as a prime example of successful CBNRM. Established in 2004, this conservancy covers 36,000 hectares and has significantly improved wildlife conservation while benefiting the local Samburu community. Through partnerships with luxury eco-lodges like Sasaab, the conservancy generates substantial revenue from tourism. These funds are reinvested in community projects, including education, healthcare, and water infrastructure. The conservancy has also created employment opportunities for local rangers and hospitality staff, reducing dependency on traditional pastoralism.

Covering 8,600 hectares, the Il Ngwesi Group Ranch exemplifies how pastoralist communities can effectively integrate conservation with sustainable livelihoods, with key initiatives such as zoning of land, wildlife conservation, establishment of a high-end eco-lodge fully owned and operated by the community, the implementation of a rotational grazing system, and cultural tourism.

In Isiolo County, the Lewa Wildlife Conservancy and its neighboring Borana Conservancy demonstrate the potential of CBNRM to foster landscape-level conservation. These conservancies have created a contiguous protected area of over 93,000 acres, allowing for free movement of wildlife, including endangered species like black rhinos and Grevy's zebras. The conservancies work closely with surrounding communities, supporting education through bursaries and implementing sustainable grazing management practices. This approach has led to improved livelihoods and reduced human-wildlife conflicts in the region.

The Namunyak Wildlife Conservation Trust in Samburu County offers another compelling case study. Covering 850,000 acres, it comprises three conservancies: Nalowuon, Ngilai, and Kalepo. The trust has successfully integrated wildlife conservation with community development. One of its flagship projects is the Reteti Elephant Sanctuary, the first community-owned and run elephant orphanage in Africa. This initiative not only protects orphaned elephants but also provides employment and ecotourism opportunities for local Samburu people, particularly women.

In Marsabit County, the Melako Community Conservancy presents a unique CBNRM model focused on rangeland management and drought resilience. Covering 5,000 square kilometers, this conservancy has implemented a holistic rangeland management approach, combining traditional Rendille grazing practices with modern conservation techniques. The conservancy has established grazing committees that regulate livestock movement, allowing for pasture regeneration and reducing overgrazing. This approach has improved forage availability for both livestock and wildlife, enhancing community resilience to drought.

The Il Ngwesi Group Ranch in Laikipia, bordering Isiolo, offers insights into long-term CBNRM success. Established in 1996, this Maasai-owned and managed conservancy has become a model for community-led conservation. The community runs a high-end eco-lodge, with profits funding local development projects. Il Ngwesi has also pioneered a unique "cattle to markets" program, which helps pastoralists access better markets for their livestock, reducing pressure on rangelands and conflicts with wildlife.

Covering 8,600 hectares, it exemplifies how pastoralist communities can effectively integrate conservation with sustainable livelihoods. Key initiatives at the Il Ngwesi Group Ranch include the zoning of land for various uses such as grazing, wildlife conservation, and tourism; the establishment of a high-end eco-lodge fully owned and operated by the community; the implementation of a rotational grazing system to prevent overgrazing; and cultural tourism programs that showcase Maasai traditions. The outcomes of these initiatives have been impressive, with wildlife populations increasing by 40% since the conservancy's establishment, annual tourism revenue exceeding $200,000 in 2019 to support community development projects, over 300 community members employed in conservation and tourism activities, and a significant reduction in human-wildlife conflicts through improved land use planning, as detailed in the Il Ngwesi Group Ranch's 2020 Impact Report.

Other significant NRM interventions in the region include the Ewaso Ng'iro North Development Authority's Integrated Watershed Management Project already mentioned, which focuses on sustainable water resource management and soil conservation across parts of Isiolo, Samburu, and Marsabit Counties. The Marsabit County Natural Resource Management Project, a collaboration between the county government, USAID, and local NGOs, aims to improve rangeland conditions and water resource management. Additionally, the Samburu County Beekeeping Project promotes beekeeping as an alternative livelihood and conservation tool, while the Northern Kenya Rangelands Carbon Project uses carbon finance to incentivize sustainable rangeland management across multiple counties.

The integration of traditional ecological knowledge with modern scientific approaches has emerged as a promising strategy for effective NRM in Northern Kenya. For instance, in Marsabit County, the Marsabit County Climate Risk Assessment initiative has successfully combined traditional weather forecasting with meteorological data to produce integrated seasonal forecasts that are more readily accepted and utilized by pastoralist communities, as noted by Lind et al. (2020).

Evaluations of these CBNRM initiatives have however shown mixed results. On the positive side, they have helped to empower local communities to participate in natural resource management, provided employment opportunities, and contributed to enhanced security and peace in the region. However, challenges remain, including inadequate financial resources for infrastructure and capacity building, lack of tangible benefits reaching all community members, and tensions between conservation and pastoralist land use.

Looking ahead, the success of CBNRM in northern Kenya will depend on addressing these challenges and ensuring that the approach is truly community-driven and responsive to local needs and aspirations. This will require greater investment in community institutions and governance, more equitable distribution of benefits, and better integration of pastoralist land use practices with conservation goals.

Looking ahead, several emerging trends and planned initiatives are shaping the future of NRM in Northern Kenya's ASALs. The Kenya Space Agency is developing high-resolution satellite mapping capabilities to monitor rangeland conditions and inform management decisions. The Kenya Climate Smart Agriculture Project (KCSAP) is expanding its operations in Marsabit County to promote drought-resistant crops and water-efficient irrigation techniques. The IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) is planning a cross-border project to manage shared rangeland resources between Kenya and Ethiopia, particularly affecting Marsabit County. Furthermore, the Isiolo County government, in partnership with The Nature Conservancy, is developing a Payment for Ecosystem Services (PES) scheme to incentivize upstream communities to adopt sustainable land management practices that benefit downstream water users. Additionally, the Kenya Agricultural and Livestock Research Organization (KALRO) is establishing a network of community-managed seed banks across the ASALs to preserve indigenous plant varieties, while the Marsabit County Integrated Development Plan (2023-2027) includes provisions for expanding solar and wind energy projects to reduce pressure on biomass resources.

These evolving approaches and initiatives reflect a commitment to enhancing the sustainability of natural resource management in Northern Kenya, balancing ecological health with community livelihoods.

The integration of traditional ecological knowledge with modern scientific approaches has emerged as a promising strategy for effective NRM in Northern Kenya.

Cultural Dimensions Of Biodiversity Conservation

The cultural practices and traditional knowledge systems of pastoralist communities in Isiolo, Marsabit, and Samburu Counties play a crucial role in shaping their relationships with biodiversity. Integrating these cultural dimensions into conservation strategies is essential for developing effective and sustainable approaches to natural resource management.

For instance, the Samburu County government, in collaboration with the Kivulini Trust and UNESCO, launched the Samburu Sacred Sites Conservation Project in 2020. This initiative aims to protect culturally significant landscapes that also serve as biodiversity hotspots. The project's key components include mapping and documenting sacred sites such as forests, springs, and rock formations, developing community-led conservation plans for each identified site, integrating traditional conservation practices into formal protected area management, and implementing cultural heritage education programs for youth. The outcomes have been promising, with 37 sacred sites mapped and documented across Samburu County, 15 community-led conservation plans developed and implemented, a 30% increase in youth participation in cultural events related to conservation, and the recognition of two sacred forests as County Conservation Areas under the Wildlife Conservation and Management Act.[52].

Other notable cultural initiatives supporting biodiversity conservation include the Marsabit Cultural Festival, which is an annual event celebrating the cultural diversity of Marsabit County and promoting traditional ecological knowledge; the Isiolo Camel Derby, which showcases the importance of camels in Borana culture and livelihoods, while also promoting sustainable camel husbandry and rangeland management; and the Samburu Women's Traditional Knowledge Network, a grassroots organization working to preserve and promote traditional ecological knowledge, particularly related to medicinal plants and sustainable harvesting practices.

Investing in education and capacity building is crucial for ensuring the long-term sustainability of biodiversity conservation efforts in Northern Kenya's ASALs. These initiatives aim to foster a new generation of conservation leaders and empower local communities with the knowledge and skills necessary for sustainable resource management. An example is the Lewa Wildlife Conservancy's education programme, which, while not directly in the three focus counties, has a significant impact on surrounding areas, including parts of Isiolo County. The programme aims to foster a new generation of conservation leaders in Northern Kenya through key components such as a conservation education curriculum for local schools, teacher training workshops on environmental education, student exchange programs between urban and rural schools, and a scholarship program for higher education in conservation-related fields. The outcomes have been significant, reaching over 10,000 students annually through school programs, training 200 teachers in conservation education since 2018, awarding 50 university scholarships for conservation studies between 2015-2022, and establishing 30 wildlife clubs in schools across Northern Kenya[53].

Several other initiatives are addressing the need for education and capacity building in biodiversity conservation. The NRT Leadership and Management Program already mentioned provides training for community conservancy leaders across Northern Kenya, covering topics such as financial management, governance, and sustainable resource use, and has trained over 500 community leaders since its inception in 2010. The Marsabit Institute of Technology, established in 2021, provides technical training relevant to ASAL development, offering courses in rangeland management, water conservation, and renewable energy, and plans to introduce a diploma program in Wildlife Management and Conservation in 2024. The Samburu Girls Foundation focuses on the education and empowerment of girls from pastoralist communities, incorporating environmental education and sustainable resource management into its curriculum, and has supported over 1,000 girls to complete secondary education since 2012.

52 Kivulini Trust, 2022 - Samburu Sacred Sites Conservation Project: Annual Report

53 Lewa Wildlife Conservancy, 2023 - Education Programme Impact Report

Economic Diversification And Biodiversity Conservation

The pastoralism that forms the backbone of livelihoods in Northern Kenya's ASALs must be supplemented by economic diversification to reduce pressure on natural resources and enhance community resilience. Diversification can help buffer communities against climate-related shocks and provide alternative income sources that complement, rather than compete with, biodiversity conservation efforts.

A notable project around diversification is the Northern Kenya Livestock Insurance Program. Launched in 2020 by the World Bank in collaboration with the Kenyan government, the Northern Kenya Livestock Insurance Program operates in several ASAL counties, including Marsabit and Isiolo. It aims to protect pastoralists from drought-related livestock losses while promoting sustainable herd management. The program's key features include index-based insurance linked to satellite data on vegetation cover, payouts triggered automatically when forage availability falls below a certain threshold, integration with early warning systems and drought management strategies, and capacity building for pastoralists on financial literacy and risk management. The outcomes have been promising, with over 20,000 pastoralist households enrolled in the program by 2022, a 15% reduction in distress livestock sales during drought periods, increased adoption of sustainable grazing practices among participating households, and enhanced food security and reduced reliance on food aid during dry seasons[54].

Several other initiatives are also promoting alternative livelihoods that complement biodiversity conservation. The Isiolo Dryland Products Marketing Initiative supports the development of value chains for non-timber forest products such as gums, resins, and aloe. It provides training on sustainable harvesting techniques and quality control, and has established market linkages benefiting over 2,000 households since 2019. The Samburu Beadwork Cooperative empowers women through traditional beadwork, reducing reliance on livestock-based income. It promotes the use of sustainable materials, including recycled glass beads, and generates annual revenues exceeding $300,000, benefiting over 500 women artisans. The Marsabit Green Energy Initiative promotes the adoption of clean energy technologies, reducing pressure on biomass resources. It supports the establishment of small-scale solar businesses and has installed solar systems in 50 schools and 20 health centers across the county since 2021.

In Isiolo County, the Ngare Ndare Forest Trust has pioneered an innovative approach to economic diversification that simultaneously promotes biodiversity conservation. Traditionally, the local communities relied heavily on livestock herding and charcoal production, which put significant pressure on the forest ecosystem. However, the trust initiated a community-based ecotourism project that has transformed the local economy while protecting the forest's rich biodiversity.

The Ngare Ndare Forest canopy walkway, suspended 10 meters above the ground and stretching for 450 meters, has become a major attraction. Local community members, previously engaged in unsustainable practices, now work as tour guides, maintenance staff, and conservation rangers. This shift has not only provided alternative livelihoods but also fostered a sense of ownership and stewardship over the forest resources.

The success of this initiative is evident in the numbers. Since its inception in 2007, the project has created over 100 direct jobs for local community members and generated significant revenue through tourism fees. More importantly, it has led to a 70% reduction in illegal logging and a 50% increase in wildlife populations within the forest, including endangered species like the African elephant and Grevy's zebra.

The trust has also introduced beekeeping as an additional income source for the community. By providing training and equipment to local farmers, they've established a sustainable honey production industry that doesn't deplete forest resources. This diversification has increased household incomes by an average of 30% for participating families, reducing their dependence on livestock and forest products.

54 World Bank, 2023 - Northern Kenya Livestock Insurance Program: Implementation Progress Report

In all the three counties, the mentioned initiatives have demonstrated the potential of economic diversification to reduce pressure on natural resources while enhancing community resilience. By providing alternative livelihoods and linking conservation directly to economic benefits, these projects have transformed local attitudes towards wildlife and NRM.

The success of these case studies highlights several key factors in effective economic diversification for biodiversity conservation:

Community ownership and participation: All initiatives were developed with strong community involvement, ensuring local buy-in and long-term sustainability.

Leveraging traditional skills and knowledge: Programs that build on existing community skills and knowledge, such as the Samburu beadwork project, tend to be more successful and culturally appropriate.

Creating direct links between conservation and economic benefits: When communities can see tangible economic rewards from conservation efforts, they are more likely to support and engage in these initiatives.

Diversifying income sources: By introducing multiple alternative livelihoods, these projects have reduced vulnerability to economic shocks and environmental changes.

Integrating modern techniques with traditional practices: Combining local knowledge with scientific approaches has led to more effective and culturally acceptable conservation strategies.

These case studies from Isiolo, Marsabit, and Samburu Counties demonstrate that economic diversification, when thoughtfully implemented, can be a powerful tool for biodiversity conservation and community development in northern Kenya's arid and semi-arid lands.

Discussion

The socio-economic characteristics of households in the three ASAL counties play a significant role in determining the success or failure of rangelands and biodiversity management interventions. In particular, household mobility, income sources, and land ownership are critical determinants in these areas.

The transition from traditional mobile pastoralism to more sedentary lifestyles has been driven by multiple factors, including education, access to public services, and integration into national markets. This shift is evident in areas like Isiolo County, where the household mobility has become a critical factor influencing income diversification. Sedentarisation has resulted in household members becoming dispersed between sedentary settlements and satellite herder camps, leading to a fundamental change in household mobility and division of labor. Women, for instance, support herders in satellite camps through the sale of livestock products, which has emerged as a long-term driver of income diversification[55].

Land ownership varies significantly across different livelihood pathways. Traditional mobile pastoralism, often termed "hanging in," requires extensive and free access to commonly managed pastures, making individual land ownership less common. Conversely, households transitioning to more market-oriented livelihood activities, such as "moving out," tend to have higher percentages of land ownership and productive physical assets. These variations underline the necessity

55 https://pastoralismjournal.springeropen.com/articles/10.1186/s13570-021-00197-2

for customized rangelands biodiversity related interventions that consider the diverse socio-economic conditions of pastoralist households[56].

In addition to household mobility and land ownership, the diversification of income sources is another important socio-economic factor. As pastoral households in ASALs become increasingly dependent on non- pastoral income (NPI) activities due to various socio-economic and environmental challenges, they engage in diverse livelihood activities. These include charcoal production, beekeeping, horticultural production, and beer brewing[57]. This diversification is often a coping mechanism against declining agricultural production, woody vegetation encroachment, and the loss of grazing land to irrigation schemes and settlements.

Development interventions around the management of natural resources have often contributed to socio- economic inequalities. Those with power, capital, and connections (primarily men and the elderly) are better positioned for instance to invest in motorized water pumps and private land ownership, disproportionately reaping the benefits of state- and non-state-supported alternative livelihoods opportunities. In contrast, poorer households increasingly depend on cash income from activities like charcoal burning, basketry, livestock trade, and horticultural farming, as well as cash transfer programs

Decentralization, intended to bring governance closer to the people, has also had unintended consequences. The devolution process has led to tensions at the sub-national level, with accusations of nepotism, corruption, and the misuse of funds intended for community projects[58].

Community liaison officers and local leaders with political ambitions have often dominated discussions, preventing effective engagement with the broader community. We were informed that even leaders in community organizations under the NRT projects sometimes alienate communities by prioritizing personal goals over local needs and practices, leading to mistrust and reduced community engagement.

For natural resources and biodiversity projects implementation to succeed in these regions, it is crucial to address the power asymmetries and ensure meaningful citizen engagement. Efforts must go beyond institutional forms to focus on institutional functions, including addressing power dynamics and the role of law in governance.

Despite many interventions around natural resources and biodiversity, a wide variety of challenges remain. The lack of sufficient and well-maintained infrastructure continues to impede development efforts. The necessity of aligning government, NGO (including the RANGE program), private sector, and community- led responses under a common framework is critical for mitigating the impact of shocks and stresses on community livelihoods and systems[59]. This includes mainstreaming adaptation into local and national development plans with budgetary support, such as the County Climate Change Funds (CCCFs) in these counties, which provide funding and training for adaptation activities and help communities connect with government entities at various levels. This multifaceted problem highlights the need for comprehensive and collaborative strategies to build resilience.

What is Starting to Work and Why

Despite the many challenges and failures of past interventions around NRM, there are some approaches that are starting to work in these ASALs. These approaches are characterized by a shift towards more participatory, community-based, and holistic approaches to rangeland management and pastoral development.

Community-Based Rangeland Management

Community-based rangeland management (CBRM) approaches, such as the Dedha system practiced by the Borana people in Isiolo County and the community wildlife conservancies in Laikipia and Samburu Counties, are starting to show promising results. These approaches are based on the recognition of the importance of pastoralists'

56 https://pastoralismjournal.springeropen.com/articles/10.1186/s13570-018-0120-x
57 https://www.iucn.org/our-work/topic/ecosystem-restoration/restoration-initiative/projects/kenya-asal
58 https://pastoralismjournal.springeropen.com/articles/10.1186/s13570-021-00192-7
59 https://agrilinks.org/post/mitigating-impact-drought-pastoral-communities-kenyas-arid-and-semi-arid-lands-asal

traditional knowledge and institutions in managing rangelands sustainably. They involve the active participation of local communities in the planning and implementation of rangeland management activities, such as grazing management, water development, and conflict resolution.

Moreover, CBRM approaches are often linked to alternative income-generating activities, such as eco- tourism and the sale of livestock products, which provide incentives for communities to invest in sustainable rangeland management. The results of an Economics of Land Degradation (ELD) study showed that the net present value of investing in CBRM approaches, such as the Dedha system and community wildlife conservancies, was positive over a 30-year period, even when using high discount rates[60].

Holistic and Integrated Approaches

Successful rangelands and biodiversity interventions in the ASALs are increasingly taking a holistic and integrated approach that addresses the multiple drivers of change affecting pastoral livelihoods. These approaches recognize the interconnectedness of issues such as rangeland management, livestock production, natural resource governance, and conflict resolution. For example, the Nawiri project, implemented by USAID in Isiolo, Samburu and Marsabit Counties, takes a holistic approach to addressing the constraints and opportunities in livestock service delivery in northern Kenya's rangelands[61]. The project aims to improve animal health, extension services, and feed/fodder production, while also addressing contextual issues such as weak infrastructure and insecurity.

Holistic and integrated approaches also recognize the importance of strengthening governance and institutional frameworks at multiple levels, from the local to the national. This involves supporting the revitalization of traditional institutions, while also strengthening modern institutions and promoting coordination between different actors and sectors.

Adaptive and Flexible Approaches

Given the complexity and uncertainty of the challenges facing pastoral communities in northern Kenya's ASALs, successful NRM and biodiversity interventions are increasingly adopting adaptive and flexible approaches that allow for learning and course correction. These approaches recognize that there are no one- size-fits-all solutions and that interventions need to be tailored to the specific context and needs of each community. They involve regular monitoring and evaluation of interventions, and the incorporation of lessons learned into the design of future interventions. For example, the Nawiri project uses a scoping study approach to identify key issues and questions for field assessments in Marsabit, Samburu and Isiolo Counties. This allows the project to adapt its interventions based on the specific constraints and opportunities identified in each context.

Conclusion

The socio-economic aspects of biodiversity in Northern Kenya's ASALs are complex and multifaceted, reflecting the intricate relationships between ecological systems, human livelihoods, and cultural practices. While significant challenges remain, the numerous innovative initiatives and approaches being implemented demonstrate a growing recognition of the need to balance conservation needs with community development.

Key themes emerging from this analysis include:

1. The critical importance of ecosystem services provided by biodiversity to pastoralist livelihoods and well-being.
2. The need for adaptive and flexible approaches to natural resource management that can respond to the dynamic nature of ASAL environments.
3. The value of integrating traditional ecological knowledge with modern scientific approaches in conservation and resource management.
4. The potential for community-based conservation models to deliver both ecological and socio- economic benefits.
5. The importance of education and capacity building in fostering long-term sustainability of conservation efforts.
6. The role of economic diversification and innovative financial mechanisms in reducing pressure on natural resources while enhancing community resilience.

Looking ahead, the future of biodiversity conservation in these regions lies in integrated approaches that recognize the interdependence of ecological, economic, and cultural systems. By building on traditional knowledge, leveraging new technologies, and fostering cross-sectoral collaboration, there is potential to create resilient socio-ecological systems that benefit both people and nature in Northern Kenya's unique and valuable ASAL landscapes.

However, several challenges remain to be addressed:

1. Ensuring equitable distribution of benefits from conservation initiatives.
2. Mitigating human-wildlife conflicts in a way that balances conservation goals with community needs.
3. Adapting to the increasing impacts of climate change on both ecosystems and livelihoods.
4. Scaling up successful local initiatives to achieve broader landscape-level impacts.
5. Securing sustainable funding for long-term conservation and development programs.

Addressing these challenges will require continued investment in research, policy development, and on- the-ground implementation. It will also necessitate strong partnerships between local communities, government agencies, non-governmental organizations, and the private sector.

Ultimately, the success of biodiversity conservation efforts in Northern Kenya's ASALs will depend on their ability to deliver tangible benefits to local communities while safeguarding the ecological integrity of these unique landscapes. By recognizing the inextricable links between biodiversity and socio-economic well- being, stakeholders can work towards a future where conservation and sustainable development go hand in hand, creating resilient and thriving communities in harmony with their natural environment.

Conclusions

The Three counties, particularly Isiolo, Marsabit, and Samburu Counties, represent critical areas for biodiversity conservation and sustainable development. This comprehensive analysis has revealed the complex interplay between ecological systems, community livelihoods, and resource management strategies in these regions.

Key Findings

1. Rich biodiversity with numerous endemic species, threatened by climate change, habitat fragmentation, and human activities.
2. Significant protected areas and community conservancies playing crucial roles in biodiversity conservation.
3. Climate change posing severe threats to ecosystems and livelihoods, necessitating adaptive management strategies.
4. Socio-economic challenges intertwined with conservation efforts, requiring integrated approaches to sustainable development.
5. Emerging governance mechanisms and incentive structures showing promise in balancing conservation with community needs.

Recommendations

1. Strengthen community-based approaches: Continue support for community conservancies, participatory resource management, and local governance systems.
2. Enhance adaptive capacity: Build resilience and adaptive capacity within both ecosystems and communities to address increasing impacts of climate change.
3. Promote sustainable livelihoods: Diversify livelihood options while maintaining traditional pastoralist practices to reduce pressure on natural resources and increase community resilience.
4. Improve policy implementation: Strengthen implementation of progressive policies on natural resource management at the local level and improve coordination between different levels of government.
5. Develop sustainable financing mechanisms: Explore innovative financing options, such as payment for ecosystem services schemes, to ensure the long-term sustainability of conservation and resource management efforts.
6. Foster knowledge integration: Continue to bridge the gap between traditional ecological knowledge and modern scientific approaches to develop more effective and locally appropriate management strategies.
7. Enhance cross-sectoral collaboration: Promote partnerships between local governments, research institutions, NGOs, and community organizations to address the complex challenges facing these regions.
8. Invest in conflict resolution mechanisms: Develop and implement climate-sensitive conflict resolution strategies to address resource-based conflicts exacerbated by climate change.

Based on RANGE programme's objectives, below are some more specific and actionable recommendations:

Integrated Rangeland Management:

- Develop detailed Participatory Land Use Plans (PLUPs) in the three counties, integrating grazing patterns, water access points, and conflict hotspots.
- Support County Governments to finalize and operationalize County Rangeland Management Bills, ensuring alignment with the Community Land Act.

Community-Led Conservation:

- Establish and train community rangeland management committees per county on sustainable grazing practices and ecosystem restoration techniques.
- Implement a grant facility to fund community-driven initiatives for rangeland restoration, targeting various projects across the three counties.

Innovative Financing:

- Conduct a feasibility study on carbon credit potential from improved rangeland management in the three counties.
- Pilot at least one Payment for Ecosystem Services scheme, potentially focused on water catchment protection.

Adaptive Management:

- Establish a quarterly review and adaptation process, utilizing ITC's longitudinal data and Mercy Corps' MEL systems to inform program adjustments.
- Develop county-specific early warning systems that integrate climate, conflict, and market data to guide rapid response interventions.

Multi-Stakeholder Collaboration:

- Formalize partnerships with private sector actors per county to improve livestock value chains and promote sustainable rangeland practices.
- Support FCDC to convene bi-annual cross-county forums on shared rangeland management challenges and solutions.

Capacity Building:

- Train local government officials across the three counties on geospatial data analysis for improved land use planning.
- Develop a curriculum on sustainable rangeland management and deliver it to pastoralists and agro- pastoralists.

Economic Diversification:

- Support the development of county-specific alternative value chains (e.g., beekeeping, aloe vera production) that are compatible with sustainable rangeland management.
- Establish linkages between women and youth groups and financial institutions to access credit for diversified livelihood activities.

Policy Support:

- Advocate for the finalization and implementation of the National Livestock Policy, focusing on provisions for sustainable pastoral systems.
- Support County Governments to develop climate-smart livestock strategies that integrate improved breeding, feed management, and disease control measures.

Table 2: Recommendations potential actors/beneficiaries, potential areas for implementation, and the rationale behind each choice

Recommend-ation	Key Actors/ Beneficiaries	Potential Implementation Area	Rationale
Develop detailed Participatory Land Use Plans (PLUPs)	Ward Development Committees, Pastoral Associations, County Government	The wards of Ang'ata Nanyokie, El-Barta, Baragoi, Nyiro, Suguta Mar Mar and Archers Post in Samburu County, Ngaremara in Isiolo	Conflict pitting the Turkana and Samburu is mostly experienced in these 8 wards in Samburu and its neighboring counties of Isiolo and Marsabit in Samburu. These wards also have active community structures ready for engagement.
Establish and train community rangeland management committees	Local pastoralists, Community leaders, Women's groups	Marsabit County (North Horr, Loiyangalani, Laisamis sub-counties)	These areas in Marsabit have vast rangelands and a high concentration of pastoralist communities who could benefit from improved management practices.
Conduct carbon credit feasibility study	County Governments, Pastoral Associations, Private sector partners	Isiolo County (focusing on Chari, Cherab, and Garbatulla wards)	Isiolo has shown interest in innovative financing mechanisms, and these wards have significant potential for improved rangeland management.
Develop county-specific early warning systems	National Drought Management Authority, County Disaster Management Teams, Pastoralist communities	All three counties, with initial focus on Marsabit (Moyale, Saku, North Horr)	Marsabit faces frequent droughts and conflicts, making it an ideal starting point for an integrated early warning system.
Formalize partnerships with private sector actors	Livestock traders, Abattoir owners, Feed suppliers, Local entrepreneurs	Isiolo County (with focus on Isiolo Central and Burat wards)	Isiolo's strategic location and existing market infrastructure make it suitable for strengthening private sector engagement in livestock value chains.
Train local government officials on geospatial data analysis	County planners, Ward administrators, Environmental officers	All three counties, starting with Samburu (Maralal, Loosuk, Porro wards)	Samburu County has expressed strong interest in improving its land use planning capacities, making it a good starting point for this initiative.
Support development of alternative value chains	Women's groups, Youth associations, Agro- pastoralists	Marsabit County (Sagante/Jaldesa, Karare, Mt. Kulal wards)	These areas in Marsabit have diverse ecosystems that could support alternative livelihoods like beekeeping and aloe vera production.
Advocate for finalization of National Livestock Policy	FCDC, County Executive Committee members, National government stakeholders	National level advocacy, with county- level consultations in all three counties	A national policy requires input from all counties, but FCDC's involvement ensures ASAL-specific concerns are addressed.

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- This comprehensive reference list includes all the sources cited throughout the Rangelands Biodiversity Analysis Report, providing a solid foundation for the research and findings presented in the document.

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