

Policy Brief

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Land cover change and pasture quantity and quality: Implications for rangeland management

Land cover change is reshaping pasture quantity and quality in Karamoja's rangelands. This study shows how woody and grass-dominated rangelands differ in pasture biomass, species diversity and nutritional value across seasons, providing evidence to guide sustainable rangeland management.

Background

Rangelands comprise approximately 44% of Uganda's total land area (1). The Karamoja region alone harbours about 20% of the country's livestock herd (2), largely managed under open grazing systems. However, rapid land use and land cover changes - driven by population increase, cropland expansion, climate variability, government programs and development interventions – is transforming these rangelands (3, 4).

Land fragmentation, overgrazing, soil erosion, and encroachment of invasive woody species into rangelands reduce grazing areas and alter pasture quality (3, 4).

KEY MESSAGES

- Pasture biomass yield, species richness and diversity, nutritional quality, and organic matter digestibility are all higher in the wet than the dry season.
- Woody-dominated rangelands provide more diverse and nutritionally richer pastures, while grass-dominated areas produce more biomass but of lower quality.
- Vegetation structure (woody vs. grass-dominated cover) plays a stronger role in shaping pasture quality than soil nutrients alone.
- Maintaining a mosaic of woody and grass-dominated cover types at the landscape level can enhance both forage quantity and nutritional quality.

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Because livelihoods in Karamoja depend heavily on livestock production (5), sustaining both the quantity and quality of pasture resources is critical. This brief examines how land cover types and seasonality influence pasture quantity and quality to inform rangeland management and land use planning.

Methods

Systematic field surveys were conducted in two 100 km² sites (6) in Moroto and Napak districts in northeastern Uganda, covering 155 sampling plots across Karamoja's rangelands. At each plot, land cover was classified into grasslands, wooded grasslands, bushland, shrubland, woodland and fallow following FAO's modified land cover classification system.

Over two years, during both the wet and dry seasons, pasture species composition, biomass yields, and nutritional quality were assessed using standardized quadrat sampling. Chemical composition (crude protein, ash, fibre and invitro digestibility) and pasture nutrient content - nitrogen (N), sodium (Na), magnesium (Mg), potassium (K), zinc (Zn), iron (Fe), cobalt (Co), copper (Cu) and manganese (Mn) were analysed in the laboratory.

Soil samples were collected from the topsoil layer, and nutrients (N, K, Mg, Na, and Ca) and soil organic carbon content were predicted using Mid Infrared Spectroscopy (7).



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Measuring grass in Napak during the wet season

Findings

A. Seasonal variability strongly affects pasture quality and availability

Pasture species richness and diversity, biomass yield and nutritional quality (crude protein content and organic matter digestibility) were consistently higher in the wet season than in the dry season. Dry periods significantly reduce feed availability and quality.

B. Land cover type shapes the trade-off between pasture quantity and quality

In general, woody land cover types (bushlands and shrublands) supported higher species diversity than grassy land cover types (grasslands and wooded grasslands).



Recording pastures species in a 1m² quadrat in Moroto

In contrast, grass-dominated areas had a higher biomass yield but generally lower nutritional quality. This highlights an important trade-off between forage quantity and feed quality across land cover types.

C. Vegetation structure influences pasture quality more than soil nutrients

Soil nutrients explained only a small portion of the variation in pasture nutrient concentrations. Differences in vegetation structure and land cover type were stronger determinants of pasture quality than soil nutrient levels alone.

Conclusion

Sustaining livestock production in Karamoja requires managing rangelands at the landscape level. A mix of woody and grass-dominated land cover types balances forage quantity and quality, strengthens biodiversity, and enhances resilience to seasonal variability and climate stress.

ACTION POINTS

- **Strengthen participatory rangeland governance:** Local governments and pastoralist communities should collaborate to develop participatory rangeland management frameworks that promote sustainable rangeland management and restoration. This work needs to be integrated into district and regional development plans.

ACTION POINTS

- **Improve grazing management:** Adopt controlled or rotational grazing systems and strategically rest grazing areas during critical growth periods to reduce overgrazing and soil degradation, particularly in open grasslands.
- **Support livestock mobility:** Safeguard and promote pastoralists and livestock migration routes to reduce land degradation from increased grazing pressure on confined areas.
- **Promote dry season-feed conservation:** Integrate hay and silage production during the wet season into livestock feeding systems to reduce dry season feed shortages and improve livestock performance and resilience.
- **Restore and maintain rangeland landscape mosaics:** Restoration efforts should support natural regeneration, controlled bush management, over-sowing and reseedling with native grasses and legumes to maintain structural and floristic diversity and maintain a mosaic of woody and grass-dominated rangelands.



Wooded grassland in the wet season in Napak

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Identifying pasture species in grassland in Napak

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Identifying pasture species in grassland in Moroto during the wet season

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