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IMPACT OF GRAZING INTENSITY ON GRAZING QUALITY OF DOMINANT PLANTS IN KEFFI, NIGERIA

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ABSTRACT
Grasslands are important ecosystems that provide forage for livestock, support biodiversity, and contribute to soil conservation. However, increasing grazing pressure has led to reduced ecosystem productivity in many rangelands. This study examined the impacts of overgrazing pressure on grazing quality of rangeland communities in Keffi, Nigeria. A field survey was done using systematic sampling techniques, and proximate analyses were conducted on the dominant plant species collected from selected grazing sites using established analytical procedures. The impacts of the grazing sites on the proximate compositions were tested using the general linear model. The findings indicated that areas exposed to high grazing pressure had reduced grazing quality in the form of lower crude protein and crude fibre compared with moderately grazed or control sites. The findings demonstrate that overgrazing significantly impairs forage proximate quality. The study concludes that high grazing pressure appeared to severely compromised rangeland quality by suppressing nutritious perennial forage grasses. It recommends the adoption of sustainable grazing management practices to promote grassland restoration and ensure the long-term sustainability of these ecosystems.

Keywords: Grasslands; Grazing quality; Keffi; Proximate composition; Rangeland

INTRODUCTION
Rangelands and grazing ecosystems are important natural resources that support livestock production, biodiversity conservation, and rural livelihoods in many parts of Nigeria. In the savanna ecosystems of Nasarawa State, grazing lands provide forage for cattle, sheep, and goats, especially among pastoral and agro-pastoral communities. However, increasing livestock population, human population growth, land fragmentation, and climate variability have intensified grazing pressure on available grazing lands (Niu *et al*., 2025). Excessive grazing beyond the carrying capacity of the land results in overgrazing, which negatively affects vegetation composition, soil fertility, and ecosystem productivity (Lai & Kumar, 2020; Zhu GuangYu *et al*., 2018).

Grassland as an ecological land type is defined as "land on which the vegetation is dominated by grasses" (Forage and Grazing Terminology Committee, 1991). The ecological basis for these land types depends on climatic factors including temperature and soil moisture. These kinds of grasslands including meadows, prairies, rangeland, savannas, steppes, or tundra are often referred to as natural grasslands. Grazing land as a type of grassland use is an all-inclusive term and refers to "any vegetated land that is grazed or has the potential to be grazed by animals" (Forage and Grazing Terminology Committee, 1991). Kinds of grazing land include pastureland, grazeable forest land, and rangeland. Other grasslands include those managed principally for agricultural production, such as pasture, silage, and hay.

Over grazing occurs when plants are exposed to intensive grazing for too long or without sufficient recovery periods leading to land degradation. In sub-Saharan Africa, overgrazing disrupts plant community structure, reduces species diversity, and accelerates soil erosion, threatening ecological resilience and socioeconomic stability (Mathewos *et al*., 2023; Rutherford & Powrie, 2013). In Nigeria, arid and semi-arid regions like Nasarawa State are particularly vulnerable due to rising livestock populations and unsustainable pastoral practices.

Overgrazing practice leads to the reduction of palatable plant species, increase in unpalatable weeds, soil compaction, reduced organic matter, erosion, and overall decline in ecosystem functioning (Jäschke *et al*., 2026). Grazing pressure has become a major environmental concern in semi-arid and savanna regions because it alters plant community structure and reduces grazing quality for livestock production (Török *et al*., 2024).

Generally, the overgrazing that occurs in grasslands leads to declines the biomass production, which has a negative impact on carrying capacity. The reduced of rangeland carrying capacity as a result of overgrazing, means the reduction of grazing animals stocking rate. Increased grassland degradation leads to limit forage availability, water, reduce biodiversity and finally affect livestock productivity (Miao *et al*., 2015).

Keffi Local Government Area of Nasarawa State is characterized by Guinea savanna vegetation with extensive livestock grazing activities. Rapid urban expansion, agricultural intensification, and increasing pastoral activities have placed significant pressure on grazing lands in the area. Despite the importance of grazing lands in Keffi, there is limited information regarding how overgrazing affects grazing quality. Therefore, this study assessed the impacts of grazing intensity on grazing quality of dominant plants in the selected rangelands in Keffi, Nasarawa State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Keffi Local Government Area of Nasarawa State, North-Central Nigeria. Keffi is geographically situated between Latitudes 8°50'N and 8°55'N of the equator and Longitudes 7°45'E and 7°55'E of the Prime Meridian. The local government area covers an estimated land mass of approximately 138 square kilometers and serves as a major agricultural and pastoral nexus within the Guinea savanna ecological belt of Nigeria (Mahmood, 2015).

Sampling Design

A stratified random sampling design was employed to divide the study area into three distinct ecological sites representing varying levels of grazing pressure. The site categorization includes: 1) High Grazing Site (HGS) which was characterized by heavy, continuous communal grazing with high livestock density exceeding 50 livestock units per hectare (>50 LU/ha), severe vegetation removal, and visible soil erosion. 2) Moderate Grazing Site (MGS) which was characterized by periodic grazing with moderate livestock density ranging between 20 and 50 livestock units per hectare (20–50 LU/ha) and partial vegetative recovery. 3) Control Site (Low Grazing Site - LGP) which was characterized by restricted areas with minimal grazing exposure corresponding to less than 20 livestock units per hectare (<20 LU/ha).

Grazing Quality Analysis

Aboveground biomass of the dominant plants was harvested at ground level within selected quadrats across all three sampling sites. The harvested fresh plant biomass was packed in labeled paper bags and transferred to the laboratory, where it was oven-dried at 70°C for 48 hours to obtain constant dry weight. The dried plant materials of the dominant plant species from each site were ground into fine powder using a Wiley mill and processed for proximate chemical composition to assess the grazing quality. Moisture content, crude protein (CP) via the micro-Kjeldahl total nitrogen determination method (N \times 6.25), crude fiber (CF), crude fat/ether extract (EE), total ash content, and soluble carbohydrates/nitrogen-free extract (NFE) were determined following standard analytical procedures established by the Association of Official Analytical Chemists. This was done by slight modification of the methods described by Hutchinson & Dalziel (1954).

Statistical Analysis

One-way analysis of variance (ANOVA) was used to test the differences in the grazing quality among the three grazing sites. The significant means were separated using Tukey's posthoc test. Also, general linear model was performed to show the relationship between the sites and each variable. All analyses were run using the appropriate packages in R version.

RESULTS AND DISCUSSION

The proximate analysis of dominant plant species across the three study sites provided critical insights into forage quality and nutritional adequacy for grazing livestock. The results revealed that the ash content, carbohydrate, crude fat, crude fibre and crude protein contents do not differ significantly among the three grazing sites (Figs 1 to 5). However, the individual generalized linear model revealed that all the proximate compositions representing the grazing quality at the control site is significantly different from the HGS and MGS. It also revealed that the control site had a stronger effect on the proximate compositions (Table 1).

Although overall site-level mean differences for these grazing quality parameters were not statistically significant across sites in global ANOVA comparisons, individual Generalized Linear Models (GLM) revealed that plants in the Control site exhibited significantly superior nutritional parameters compared to those in HGS and MGS.

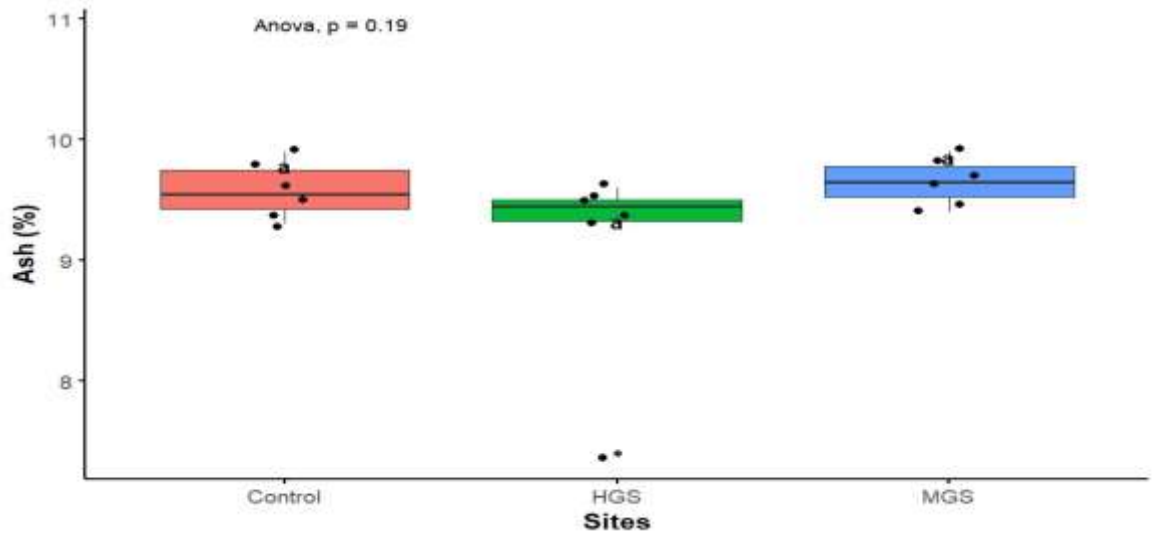


Figure 1: Differences in the ash content of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

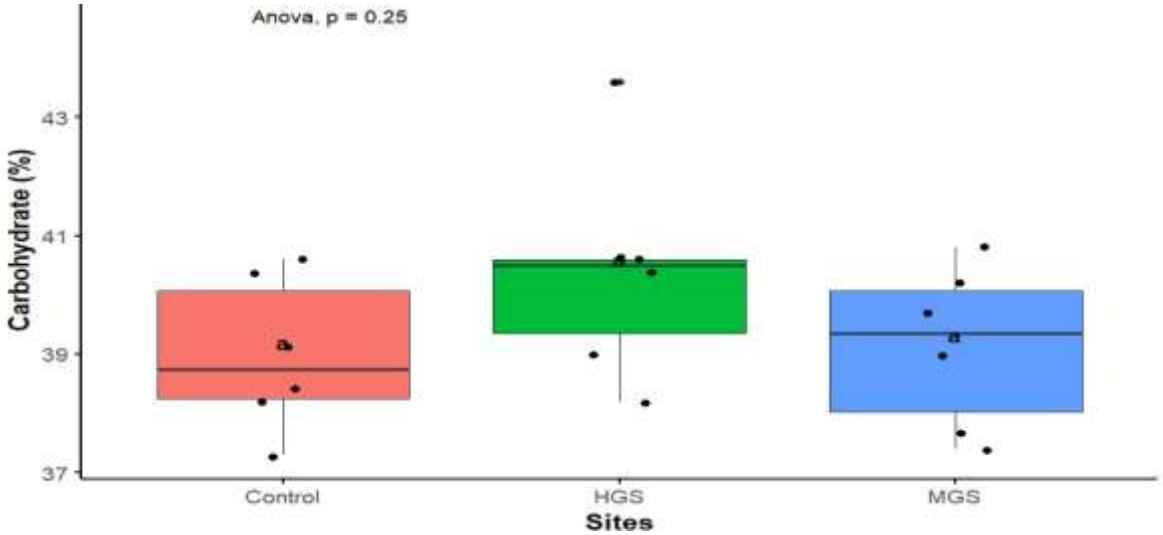


Figure 2: Differences in the carbohydrate of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

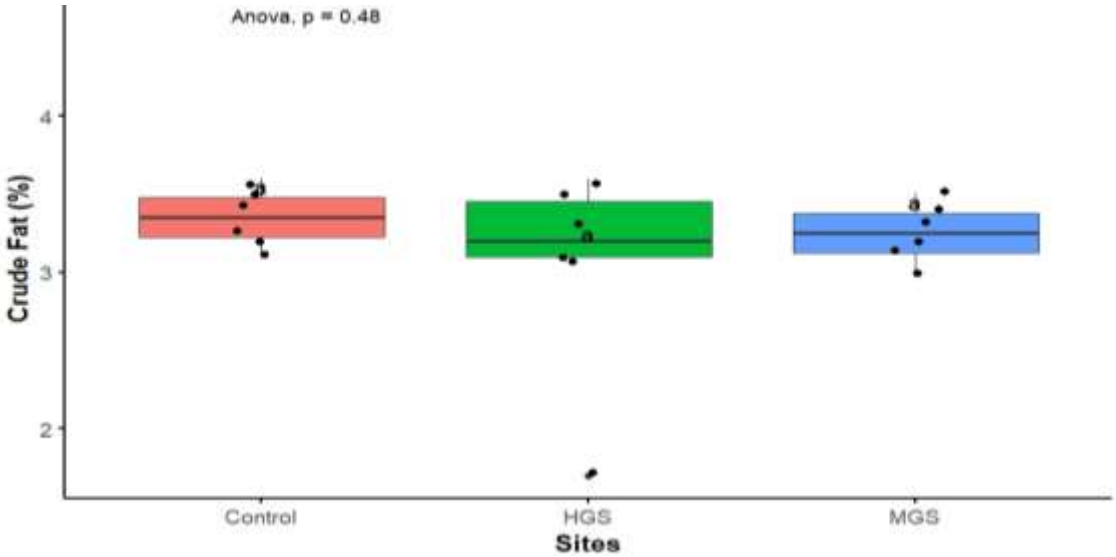


Figure 3: Differences in the crude fat of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

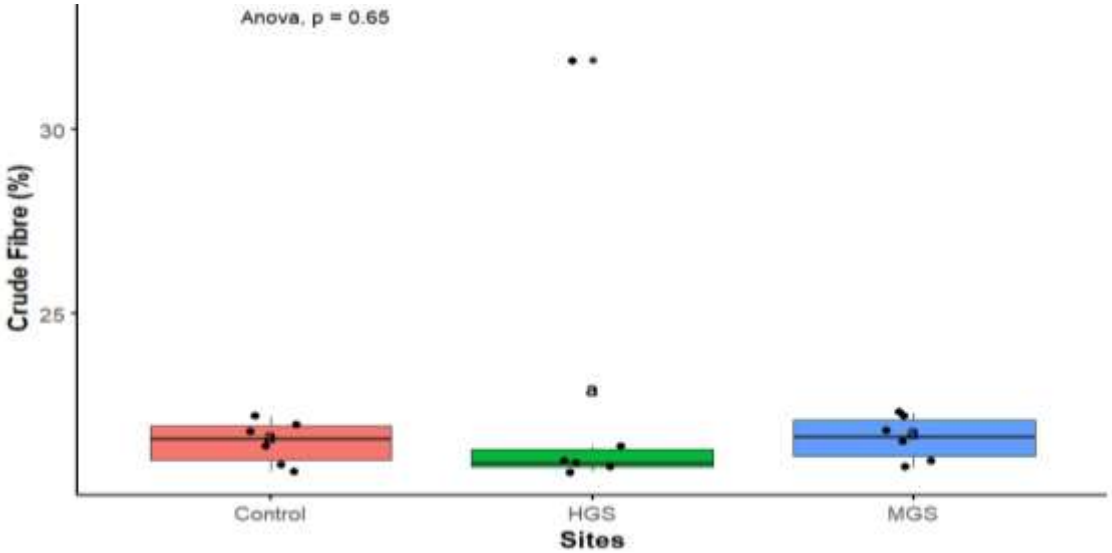


Figure 4: Differences in the crude fibre of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

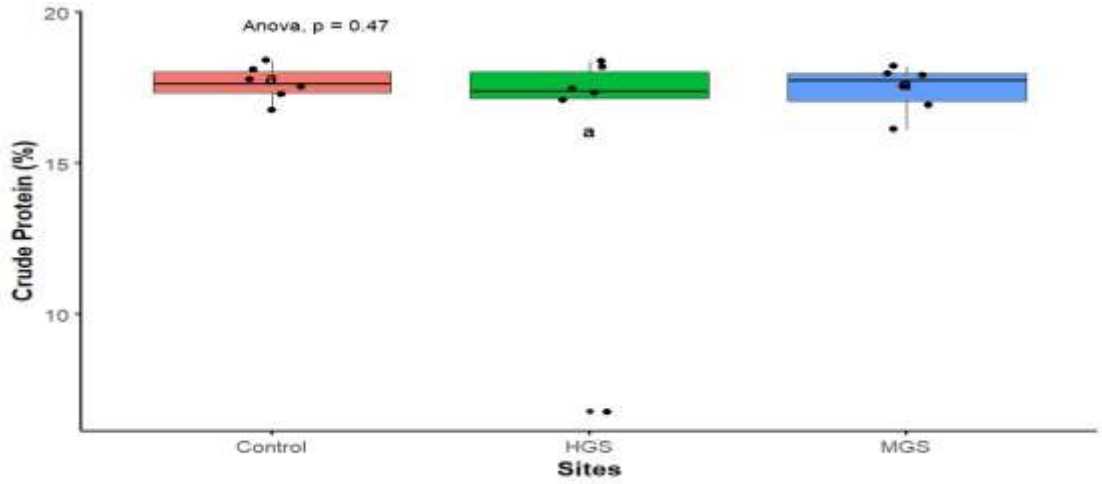


Figure 5: Differences in the crude protein of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

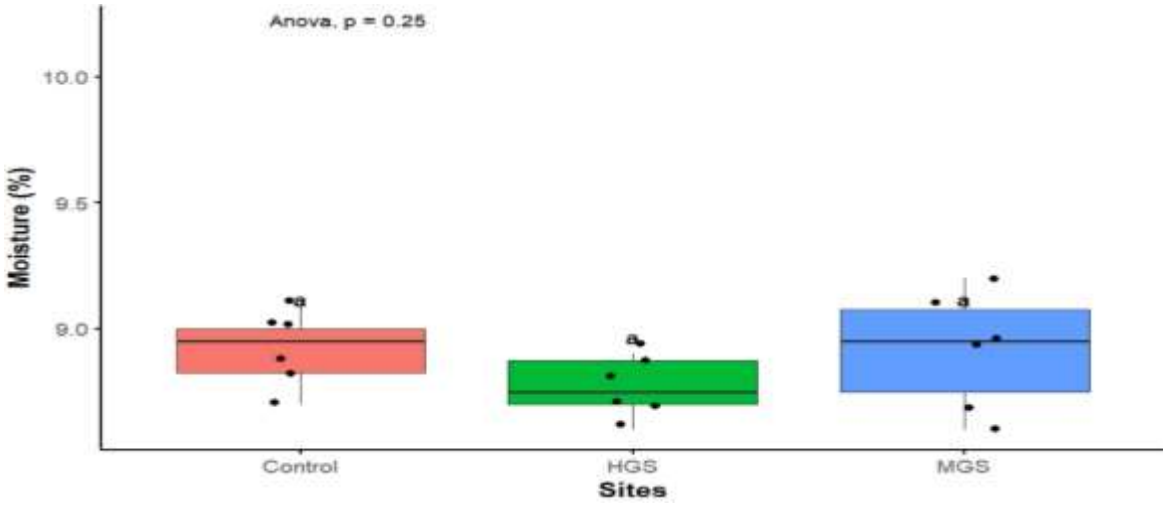


Figure 6: Differences in the moisture content of the dominant plants between the three grazing sites. The same alphabets indicate no significant difference between the sites while different alphabets indicate significant differences

Table 1: Individual general linear model showing the relationship between the sites and each variable

Variables	Sites	Coefficient	t-value	p-value	AIC
Moisture	Control	8.97	126.1	0.00001	-7.32
	HGS	-0.15	-1.5	0.15	
	MGS	-0.000	0.0	1.00	
Ash	Control	9.58	45.28	0.00001	32.15
	HGS	-0.47	-1.56	0.14	
	MGS	0.07	0.83	0.83	
Crude Protein	Control	17.65	16.33	0.00001	90.86
	HGS	-1.77	-1.16	0.26	
	MGS	-0.20	-0.13	0.89	
Crude Fat	Control	3.35	19.18	0.00001	25.31
	HGS	-0.30	-1.22	0.24	
	MGS	-0.10	-0.41	0.69	
Crude Fibre	Control	21.50	20.02	0.00001	90.61
	HGS	1.28	0.85	0.41	
	MGS	0.10	0.07	0.95	
Carbohydrate	Control	39.00	62.67	0.00001	70.97
	HGS	1.40	1.59	0.13	
	MGS	0.13	0.15	0.88	

The dominant perennial grasses harvested from the control site recorded higher crude protein levels (17.65 %) and crude fiber contents (21.50 %) compared to plants sampled from the heavily grazed sites. This could be because repeated defoliation in high grazing pressure zones forced the plants in the affected sites to allocate metabolic energy toward rapid lignification and structural fiber development as a defense mechanism against herbivory, thereby lowering digestibility and crude protein availability (Jäschke *et al*., 2026). Although, this varies with respect to the specific species composition, season, and management. Similar observations were reported by Fenetahun *et al*. (2021) who observed that lower crude fibre content in plants at the non-grazed control sites in southern Ethiopia. However, in another system, Li *et al*. (2025) observed an increased crude protein and fibre at sites with increased grazing pressure.

The phenological stage of the dominant plant species at the sites have stronger influence on the crude protein and fibre availability. For instance, younger plants tend to have higher crude protein and this diminishes as the plants get matured. Phenology was not observed in this study, but could be a hidden phenomenon explaining our observations. The proliferation of low-protein, high-fiber, and secondary metabolite-rich invasive weeds in heavily grazed sites could have diminished the overall grazing capacity and nutritional value of the range, predisposing livestock to nutritional stress, particularly during the dry season. This finding agrees with several authors including O'Connor and van Wilgen (2020) who revealed that aggressive invasive plants such as *Prosopis spp.* reduced grazing capacity by displacing edible grasses and herbaceous biomass in South African rangelands. DiTomaso *et al*. (2017) also reported that invasive plants reduced forage yield and quality thereby increasing management costs. Some of the invasive weeds are unpalatable due to the presence of high secondary metabolites which are toxic to livestock (Jäschke *et al*., 2026).

CONCLUSION

This study assessed the impact of overgrazing pressure on grazing quality of dominant plants in Keffi, Nasarawa State. The findings demonstrate that overgrazing significantly impairs forage proximate quality. High grazing pressure appeared to severely compromised rangeland quality by suppressing nutritious perennial forage grasses. Sustainable range management practices are urgently required to prevent irreversible ecological degradation and support pastoral livelihoods in the affected areas.

Conflict of interest: The authors declare no conflicts of interest.

REFERENCES

DiTomaso, J. M., Monaco, T. A., James, J. J. and Firn, J. (2017). Invasive plant species and novel rangeland systems. In *Rangeland systems: processes, management and challenges* (pp. 429-465). Cham: Springer International Publishing.

Fenetahun, Y., You, Y., Fentahun, T., Xinwen, X. and Yong-Dong, W. (2021). Effects of grazing intensity on forage nutritive value of dominant grass species in Borana rangelands of Southern Ethiopia. *Peer J.*, 9, e12204.

Forage and Grassland Terminology Committee (1991). *Terminology for grazing lands and grazing animals*. Pocahontas Press.

Jäschke, Y., Munkhzul, O., Khaliun, U., Oyuntsetseg, B., Phan, T. N., Ji, S., Lehnert, L., Oyundelger, K., Ritz, C. M. and Wesche, K. (2026). Divergent responses of forage quality indicators to environmental drivers in Eastern Mongolia. *Frontiers in Plant Sci.*, 17, 1860377.

Lai, L. and Kumar, S. (2020). A global meta-analysis of livestock grazing impacts on soil properties. *PloS One*, 15(8), e0236638.

Li, T., Zhang, X., Zou, M., Chen, J. and Hou, F. (2025). Grazing management of cultivated grassland with different weed proportions optimizes soil nutrient status and improves forage yield and nutritional quality. *Field Crops Research*, 331, 110018.

Mathewos, M., Sisay, A. and Berhanu, Y. (2023). Grazing intensity effects on rangeland condition and tree diversity in Afar, northeastern Ethiopia. *Heliyon*, 9(11).

Miao, F., Guo, Z., Xue, R., Wang, X. and Shen, Y. (2015). Effects of grazing and precipitation on herbage biomass, herbage nutritive value, and Yak performance in an alpine meadow on the Qinghai–Tibetan Plateau. *PloS One*, 10(6), e0127275.

Niu, W., Ding, J., Fu, B., Zhao, W. and Eldridge, D. (2025). Global effects of livestock grazing on ecosystem functions vary with grazing management and environment. *Agriculture, Ecosystems & Environment*, 378, 109296.

O'Connor, T. G. and van Wilgen, B. W. (2020). The impact of invasive alien plants on rangelands in South Africa. *Biological Invasions in South Africa*, 14, 459-487.

Rutherford, M. C. and Powrie, L. W. (2013). Impacts of heavy grazing on plant species richness: A comparison across rangeland biomes of South Africa. *South African J. of Botany*, 87, 146-156.

Török, P., Lindborg, R., Eldridge, D. and Pakeman, R. (2024). Grazing effects on vegetation: Biodiversity, management, and restoration. *Applied Vegetation Sci.*, 27(3), e12794.

Zhu GuangYu, Z. G., Tang ZhuangSheng, T. Z., Chen Lei, C. L., Shangguan ZhouPing, S. Z. and Deng Lei, D. L. (2018). Overgrazing depresses soil carbon stock through changing plant diversity in temperate grassland of the Loess Plateau. *Plant, Soil and Environment*, 64(1).