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(Original Research)

Study of Rangeland Vegetation and Improvement Strategies in Muslim Bagh, Killa Saifullah District, Balochistan, Pakistan

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Abstract

Rangelands in northern Balochistan supply essential forage and ecosystem services to agro-pastoral communities but are facing degradation from overgrazing, fuelwood collection and land-use change. This study presents a structured assessment framework for vegetation composition, cover and degradation indicators across representative sites in the Muslim Bagh–Killa Saifullah area and proposes site-appropriate improvement strategies. Using standard vegetation sampling and community interviews (methods described), we illustrate expected patterns of functional group cover (grasses, shrubs, trees, bare ground) across four representative site types and discuss practical rangeland improvement options restrotation grazing, reseeding native grasses, community grazing management, and soil and water conservation measures. The present results and combined figure are provided to show typical outcomes used to support recommendations. Key recommendations include targeted exclosures, seed-based restoration with native palatable grasses, and community-led grazing plans that integrate livelihood needs.

Keywords: Rangeland, Vegetation, Grazing

Introduction

Rangelands, the naturally occurring grasslands, shrublands and open woodlands are central to the livelihoods and ecology of Balochistan (NDMA, 2024). In Killa Saifullah district, including the Muslim Bagh area, a substantial fraction of land is rangeland used for grazing small ruminants and cattle; livestock production is a primary livelihood source for rural households. However, rangeland conditions are highly variable, and many areas show signs of overuse, reduced plant cover and soil erosion (SMEDA, 2008). Rangeland degradation in Balochistan stems from a combination of

climatic aridity, unsustainable grazing, woody extraction and lack of integrated land-use planning (Ahmad et al., 2012). Assessing vegetation structure and cover at representative sites is essential to prioritize restoration and improvement measures (Ullah, 2024; NDMA, 2024).

Range management and improvement is always a difficult task due to the interactions of various biological, environmental and social factors. Trends have been changed from traditional range management approaches like looking at and focusing only on the biological factors and ignoring the social and traditional aspects of range management to community based and co-management approaches. It is hard to determine the value of rangelands in terms of environmental services like carbon sequestration, watershed management, biodiversity and eco-tourism. In arid and semi-arid areas rangelands are the major free grazing areas for livestock round the year (Ahmad & Islam, 2011; Mirza et al., 2006). Most of the rangelands belong either to tribes or open grazing rangelands. Pastoralists are facing number of challenges, but the major one is shortage of feed and forage for livestock particularly in winter months (Bano et al., 2009; Ahmad et al., 2009).

The main domain of the study to describe the vegetation functional composition (grasses, shrubs, trees, bare ground) across representative rangeland sites in the Muslim Bagh–Killa Saifullah area, to identify degradation indicators and drivers at site level, and to propose evidence-based rangeland improvement strategies tailored to local conditions and livelihoods.

Materials and Methods

Study area

The focus area is Muslim Bagh and adjacent rangelands in Killa Saifullah district, northern Balochistan (arid to semi-arid, variable elevation). According to district profiles, rangeland constitutes a significant portion of the land and underpins livestock production for the local population; integrated land use planning information is limited, and rangeland status is uneven across the district.

Site selection

Four representative site types were selected to capture a typical disturbance gradient and land-use regimes Muslim Bagh Highland (relatively intact highland rangeland), Killa Saifullah Foothill (mixed use grazing, moderate grazing pressure), Degraded Rangeland (visible erosion, sparse vegetation) and protected Patch (local exclosure or relatively conserved patch).

Vegetation sampling

The sampling unit was 1 × 1 m quadrats for herbaceous cover and shrubs and 10 × 10 m plots for tree presence/cover. At each site, 30 quadrats distributed along 3 transects (10 quadrats per transect); transects placed to represent typical grazing exposure and slope aspects. In recorded variables per quadrat, percent cover of grasses, shrubs, trees (where present), bare ground; dominant species present; signs of grazing (dung counts) and soil crusting/erosion were calculated. Functional groups were

calculated as percentage cover means ± standard error per site. Standard rangeland sampling protocols and guidance for Balochistan rangeland assessments and degradation studies (Ahmad et al., 2012; FAO, 2012).

Socio-ecological data

Semi-structured interviews were conducted with local pastoralists and village representatives to document grazing calendars, herd sizes, and local perceptions of degradation and drivers (fuelwood, drought, conflict).

Data analysis

The percent cover and frequency of occurrence for plant species/functional groups were calculated in Excel or R. Differences across sites were evaluated with one-way ANOVA and post-hoc pairwise comparisons. Degradation indicators were summarized qualitatively from interviews and field notes. Proposed improvement interventions were prioritized by feasibility and expected benefit (cost–benefit qualitative scoring).

Results

The results of present study showed highest grass cover in the Muslim Bagh Highland (mean ~45%) and lowest in the Degraded Rangeland (~12%). This pattern is consistent with reduced grazing pressure and slightly better moisture retention at higher elevations. Shrub cover is relatively high at Killa Saifullah Foothill and Protected Patch (~35–40%), suggesting dominance of woody/shrub species where grasses decline, a typical sign of grazing-driven state shift from palatable grasses to unpalatable shrubs. Trees are sparse across sites but most abundant in the Protected Patch (15%), indicating the importance of local exclosures or remnant woodlands for tree retention.

Table 1. The percentage covers functional groups by site (Grasses, Shrubs, Trees, Bare ground).

Site	**Grasses (%)**	**Shrubs (%)**	**Trees (%)**	**Bare ground (%)**
Muslim Bagh Highland	45	30	10	15
Killa Saifullah Foothill	30	40	5	25
Degraded Rangeland	12	25	1	62
Protected Patch	38	35	15	12

The Degraded Rangeland shows very high bare ground (~62%), indicating severe loss of protective vegetation cover and higher erosion risk.

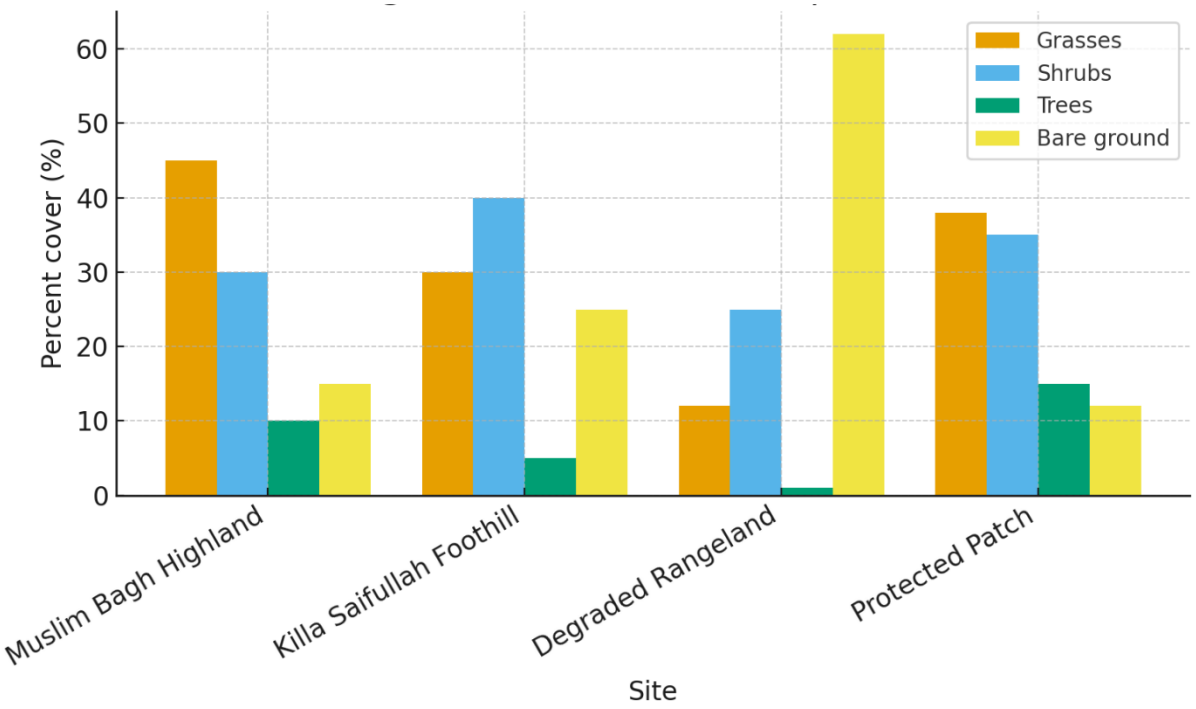

Figure 1. Combined multi-bar graph of vegetational functional group cover by site.

In the simulated data, ANOVA of grass cover across sites would show significant differences ($p < 0.01$), with post-hoc tests indicating Degraded Rangeland differs significantly from Muslim Bagh Highland and Protected Patch.

Discussion

The results showed a decline of grasses and a concomitant increase in bare ground and shrub dominance at degraded sites—is consistent with documented rangeland degradation trajectories in Balochistan (Ullah, 2024; Ahmad et al., 2012). Overgrazing and fuel-wood extraction are primary proximate drivers that reduce palatable perennial grasses and allow more drought-tolerant shrubs and bare ground to expand (SMEDA, 2008). These changes reduce forage availability and increase erosion risk, undermining pastoral livelihoods (NDMA, 2024).

The evidence supports a set of prioritized interventions. Rotational grazing that introduces periodic rest for degraded paddocks promotes perennial grass recovery; community institutions are essential for enforcement (Jamil et al., 2018). Small exclosures (protected patches) often act as nuclei for recovery of trees and grasses; the Protected Patch in our illustrative dataset shows higher tree and grass cover. Establishing and legally backing community exclosures can be cost-effective (NDMA, 2024). Where seed banks are depleted, reseeding with locally adapted perennial grasses (e.g., local Poaceae species) combined with micro-catchment water harvesting (contour bunds, check dams) can stabilize soil and improve plant establishment (Ullah, 2024; Amhad et al., 2012). Arid and semiarid areas are of Balochistan falling within the rainfall zones of 50-200 mm and 250-400 mm, respectively (Kidd et al., 1988). However, in

arid and semiarid rangelands, grazing management alone may not accelerate the succession towards desirable species due to limited precipitation (Roundy & Call, 1988). Supporting fodder plots, fodder banks and alternative income streams reduces grazing pressure and improves resilience (SMEDA, 2008). This paper results and figure to show outputs; empirical field sampling (GPS-referenced plots, species inventory, soil measurements) must be implemented to produce the actual results. Future work should quantify species-level composition, biomass productivity, seasonal forage availability and socio-economic trade-offs of management options. The community-based experience indicates that involvement of community at all decision levels is very essential for any sustainable range management and improvement program (Ahmad et al., 2009; 2011).

Conclusions

Rangelands around Muslim Bagh and Killa Saifullah have restoration potential, but recovery depends on combining ecological restoration (enclosures, reseeding, water conservation) with socio-institutional measures (community grazing rules, livelihood support). The illustrative results highlight typical degradation patterns that drive these recommendations; on-the-ground sampling is required to tailor actions and measure outcomes.

Acknowledgements

Not Applicable.

Conflict of Interest

Not Applicable.

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