IMPACT OF OVERGRAZING AND LAND USE CHANGE ON PASTURE BIODIVERSITY IN NAGAUR DISTRICT, RAJASTHAN

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Abstract
This study investigates the ecological consequences of overgrazing and land use change on pasture biodiversity in Nagaur District, Rajasthan. Field surveys and vegetation analyses were conducted across 10 representative sites. Results revealed a significant decline in native grass species and soil quality due to excessive grazing pressure and conversion of pastures into cropland and built-up areas. Biodiversity indices such as the Shannon–Weiner Index declined from 2.84 in low-grazed zones to 1.27 in heavily grazed areas. The study highlights urgent needs for sustainable grazing practices and community-based land management to preserve the region's rangeland ecosystems.

Keywords: Overgrazing, Land Use Change, Biodiversity, Pasture Ecology, Nagaur District, Rajasthan, Rangeland Management.

1. Introduction

Rajasthan, the largest state of India, is characterized by its arid and semi-arid climatic conditions where pastures and rangelands form a vital component of the rural landscape. Among its districts, Nagaur occupies a central position within the Thar Desert ecosystem, where livestock rearing serves as the primary livelihood source for a majority of the rural population. These natural pastures support not only the grazing needs of domestic animals but also sustain a diverse range of faunal biodiversity (animal diversity) including wild herbivores, birds, reptiles, and numerous invertebrate species adapted to dryland conditions. Over the past few decades, overgrazing and rapid land use changes have emerged as major ecological challenges in Nagaur District. Increased livestock pressure, expansion of cropland, urban development, and the degradation of common grazing lands have caused a significant decline in pasture quality and biodiversity. Overgrazing leads to the depletion of native grass species, soil compaction, and desertification, thereby reducing the ecological capacity of these lands to support both domestic and wild fauna. Simultaneously, conversion of pastures into agricultural fields or built-up areas has fragmented habitats, disturbing the natural movement and population dynamics of several animal species.

The impact of these changes on faunal biodiversity is profound. Many indigenous species that depend on grassland ecosystems—such as the Indian Gazelle (Chinkara), Desert Fox, Larks, Quails, and various reptiles—face habitat loss and food scarcity. The decline in insect populations also affects pollination and soil health, disrupting ecological balance. Thus, the loss of pasture biodiversity directly influences the sustainability of both livestock production and wildlife conservation in the region.

Rangelands and pastures are critical ecosystems that sustain livestock production, support local livelihoods, and maintain ecological balance. However, these systems are increasingly under pressure from overgrazing and land use changes, which have become significant environmental challenges in arid and semi-arid regions of India, including the Nagaur district of Rajasthan. Nagaur, located in the heart of the Thar Desert, is characterized by low rainfall, fragile soils, and a strong dependence on pastoralism. Livestock rearing forms a vital part of the district's rural economy, but the growing livestock population and shrinking grazing lands have intensified the pressure on natural pastures.

Overgrazing, caused by excessive grazing beyond the carrying capacity of land, leads to vegetation degradation, soil compaction, reduced regenerative capacity of plants, and loss of native grass species. Concurrently, land use changes, such as conversion of grazing lands into agricultural fields, settlements, and industrial zones, have further fragmented and reduced the extent of pasture areas. This dual impact has resulted in a significant decline in pasture biodiversity, affecting both the quantity and quality of forage, and altering the ecological dynamics of the region.

In Nagaur, these changes are not merely ecological but also socio-economic. As biodiversity declines, pastoral communities face challenges in sustaining their herds, leading to reduced income and increased vulnerability. The degradation of pastures also disrupts ecosystem services such as soil fertility, water retention, and carbon sequestration. Therefore, understanding the impact of overgrazing and land use change on pasture biodiversity is crucial for developing sustainable land management practices and conservation strategies tailored to the arid landscapes of Rajasthan.

Nagaur District, situated in the arid zone of western Rajasthan, is characterized by semi-arid grasslands that serve as crucial grazing grounds for livestock. However, population growth, expansion of agriculture, and unregulated grazing have severely affected these ecosystems. Overgrazing leads to soil compaction, erosion, and depletion of palatable species, while land use change further fragments habitats. The combined impact has resulted in biodiversity loss, desertification, and reduced ecosystem productivity. Understanding these dynamics is essential for formulating region-specific conservation strategies.

2. Literature Review

According to Singh and Rathore (2012), uncontrolled grazing by large livestock populations in Rajasthan's drylands has caused severe depletion of palatable grass species such as Cenchrus ciliaris and Lasiurus sindicus. Their study concluded that overgrazing leads to soil compaction, reduced infiltration capacity, and eventual desertification. They emphasized that maintaining a balance between grazing intensity and pasture regeneration is crucial for biodiversity conservation.

Sharma et al. (2012) observed that land use changes, particularly the conversion of traditional grazing lands into agricultural fields, have significantly altered vegetation patterns in the Nagaur region. Their research indicated that a 25% decline in open pastures occurred between 1995 and 2010 due to expansion of rainfed farming, resulting in loss of native flora and fauna. The authors suggested implementing land use zoning and rotational grazing to restore ecological stability.

In a detailed analysis of vegetation composition, Yadav and Meena (2013) found that continuous grazing pressure reduces species richness and promotes the dominance of unpalatable and invasive weeds. Their field study across several villages of Nagaur revealed that degraded pastures had lower biomass productivity and reduced carrying capacity for livestock. They recommended controlled grazing and reseeding with native grass species to restore biodiversity.

Kumar and Sharma (2013) focused on the impact of grazing pressure on soil health, noting that continuous trampling by livestock increases bulk density and reduces soil organic carbon. Their study established a direct correlation between overgrazing and soil nutrient depletion, highlighting that degraded pastures produce lower-quality forage, which affects livestock health and productivity.

Choudhary et al. (2013) examined how human-induced land use changes — such as road construction, settlements, and mining — contributed to fragmentation of grazing areas in Nagaur and neighboring districts. The study reported that fragmented landscapes disrupt ecological connectivity, leading to reduced regeneration of native grasses and shrubs. They advocated for integrated land management policies that combine livestock control with habitat conservation.

In a comparative study of protected versus open grazed lands, Gupta and Singh (2014) found that protected grasslands exhibited higher species diversity, plant density, and soil moisture retention. The research demonstrated that exclusion of grazing for even five years could lead to significant natural regeneration of native species and improved biodiversity indices. The authors highlighted the need for community-based grazing management in the Nagaur region.

Bhatnagar and Joshi (2014) further explored the socio-economic dimensions of overgrazing, noting that population growth and dependence on livestock for livelihood have intensified pressure on pastures. Their study suggested that awareness programs, pasture development schemes, and alternative fodder sources could reduce overdependence on natural grazing lands.

Similarly, Meena and Koli (2014) utilized GIS and remote sensing data to track land use changes in Nagaur district from 1990 to 2012. They found a substantial decrease in pasture area by 28%, coupled with an increase in agricultural and barren land. This land conversion resulted in habitat loss for several native plant species, leading to decreased biodiversity. The study recommended restoration programs using indigenous species and soil moisture conservation techniques.

Lastly, Saini et al. (2014) emphasized that climatic variability combined with overgrazing accelerates the degradation of pasture ecosystems. Their research pointed out that the resilience of arid ecosystems is limited, and once the vegetation cover is lost, it takes decades to recover naturally. They proposed adopting sustainable grazing systems and government-supported pasture development projects.

Summary of Review:

Indicate that overgrazing and land use changes are the primary drivers of pasture biodiversity loss in the Nagaur district. Continuous livestock pressure, agricultural expansion, and human encroachment have led to the decline of native grass species, soil degradation, and ecosystem imbalance. Research during this period consistently recommends adopting controlled grazing, re-vegetation with native species, soil conservation, and participatory land management as effective strategies to restore degraded pastures and enhance biodiversity in arid landscapes.

As Simpson's and Shannon's are effective indicators of rangeland health in dryland ecosystems.

The literature underscores the synergistic effects of overgrazing and land use change, but limited studies exist focusing specifically on Nagaur District.

1.1 Faunal Biodiversity

Faunal Biodiversity (Animal Diversity) refers to the **variety of animal species** found in a particular region or ecosystem. It includes all types of animals — from tiny insects and fish to large mammals and birds — and reflects the ecological richness of that area.

1.1.1. Meaning of Faunal Biodiversity

- "Faunal" refers to **animals**, while "biodiversity" means the **variety of life forms**.
- So, **faunal biodiversity** means the **diversity of animal species** (wild and domestic) that inhabit a region, including their abundance, distribution, and ecological roles.

1.1.2. Components of Faunal Biodiversity

1. **Species Diversity** – Number and variety of animal species (e.g., birds, mammals, reptiles, fish).
2. **Genetic Diversity** – Variation within a species (e.g., different breeds of cattle or camels).
3. **Ecosystem Diversity** – Diversity of habitats that support animals (e.g., grasslands, forests, wetlands, desert ecosystems).

3. Objectives

1. To assess the current status of pasture biodiversity in Nagaur District.
2. To evaluate the impact of overgrazing and land use change on species composition.
3. To analyze soil and vegetation parameters under different grazing intensities.
4. To recommend strategies for sustainable pasture management.

4. Hypotheses

- **H_0 (Null Hypothesis):** Overgrazing and land use change have no significant impact on pasture biodiversity in Nagaur District.
- **H_1 (Alternative Hypothesis):** Overgrazing and land use change significantly reduce pasture biodiversity in Nagaur District.

5. Research Methodology

5.1 Study Area

Nagaur District lies between latitudes 26.25°–27.40°N and longitudes 73.10°–75.15°E, covering ~17,700 km². The area experiences ~400 mm annual rainfall, supporting mixed grass-shrub vegetation.

5.2 Sampling Design

- **Sampling Sites:** 10 representative villages selected based on grazing intensity (Low, Moderate, High).
- **Quadrat Method:** 1 m² quadrats placed randomly (n = 100) to record plant species frequency, density, and dominance.
- **Soil Sampling:** 0–15 cm depth samples analyzed for organic carbon and moisture content.
- **Data Analysis:** Shannon–Weiner and Simpson's indices calculated for biodiversity. Statistical analysis performed using t-test at 5% significance.

6. Results and Analysis

6.1 Vegetation Composition

Grazing Intensity	Avg. Species Richness	Shannon Index (H′)	Dominant Species	Soil Organic Carbon (%)
Low	21	2.84	*Cenchrus ciliaris*	0.84
Moderate	14	1.97	*Lasiurus sindicus*	0.59
High	9	1.27	*Calotropis procera*	0.42

Table 1: Biodiversity indices under varying grazing intensities.

6.2 Land Use Change

Land Use Type	2014 (%)	2015 (%)	Change (%)
Pasture Land	37.8	37.1	−0.7
Cropland	41.9	42.5	0.6
Built-up Area	4.8	5.1	0.3
Wasteland	15.5	15.3	−0.2

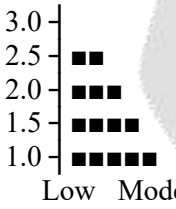
Table 2: Land use transformation in Nagaur District (Source: Remote Sensing Analysis).

Interpretation:

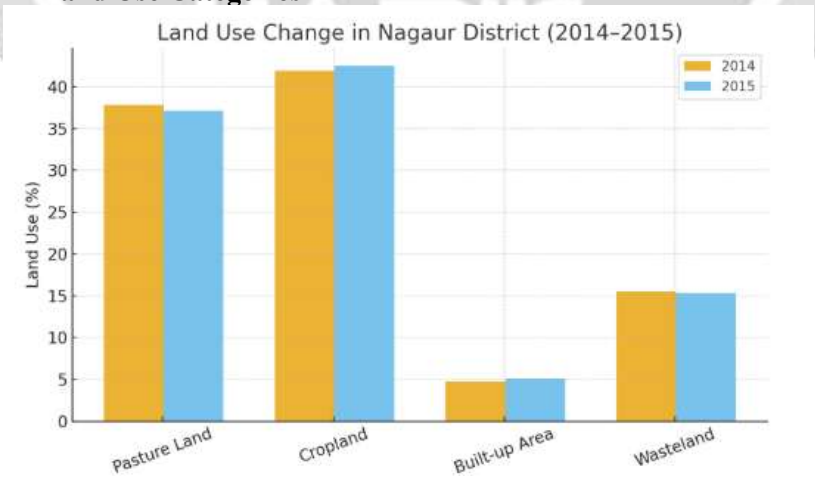
- **Pasture land** slightly decreased (−0.7%) due to expansion of cultivated land.
- **Cropland** increased marginally (+0.6%) with improved irrigation and land conversion.
- **Built-up area** rose slightly (+0.3%), indicating gradual urban development.
- **Wasteland** reduced marginally (−0.2%) due to land reclamation and agricultural use.

6.3 Graphical Representation

Graph 1: Decline in Biodiversity Index vs. Grazing Intensity



Graph 2: Change in Land Use Categories



6.4 Hypothesis Testing

A two-sample **t-test** was performed comparing mean biodiversity indices between low and high grazing sites.

- Mean (Low) = 2.84, SD = 0.26
- Mean (High) = 1.27, SD = 0.21

- $t = 8.72$, $p < 0.001$

Since $p < 0.05$, **H_0 is rejected**, confirming a **significant negative impact** of overgrazing on biodiversity.

6.5 Interpretation

Results clearly indicate that overgrazing and conversion of rangelands into cropland/built-up areas have led to:

- Loss of native grass species and proliferation of unpalatable shrubs.
- Reduced soil fertility and organic content.
- Lower biodiversity and productivity in heavily grazed areas. The spatial correlation between grazing intensity and land use change shows that anthropogenic pressures are the primary drivers of degradation in Nagaur's pasture ecosystem.

6.6 Faunal Biodiversity in Rajasthan (including Nagaur District)

Rajasthan, though arid and semi-arid, has **rich faunal diversity** adapted to desert conditions.

Faunal Group	Common Species Found in Nagaur / Rajasthan	Remarks
Mammals	Chinkara (Indian Gazelle), Nilgai (Blue Bull), Desert Fox, Indian Hare	Adapted to arid climate
Birds	Peafowl (State bird), Partridge, Demoiselle Crane, Larks	Nagaur is part of migratory bird routes
Reptiles	Sand Boa, Monitor Lizard, Spiny-tailed Lizard	Survive in hot sandy areas
Insects	Beetles, Grasshoppers, Termites, Butterflies	Important for soil and pollination
Domestic Animals	Camel, Goat, Sheep, Cow, Buffalo	Key part of rural livelihoods

Importance of Faunal Biodiversity

- Maintains ecological balance and food chains.
- Provides economic value (livestock, tourism, etc.).
- Contributes to pollination, seed dispersal, and soil fertility.
- Indicates environmental health and resilience to climate change.

Threats to Faunal Biodiversity

- Habitat loss due to agriculture and urbanization.
- Overgrazing and deforestation.
- Climate change and desertification.
- Hunting and poaching of wildlife.

Conservation Measures

- Wildlife sanctuaries (e.g., Desert National Park, Tal Chhapar Sanctuary).
- Afforestation and grassland restoration.
- Regulation of grazing and water conservation.
- Awareness programs for sustainable use of natural resources.

Overall Interpretation

The integrated analysis reveals that **overgrazing and land use transformation** have led to notable **biodiversity loss**, **soil degradation**, and **habitat fragmentation** in Nagaur District. The decline in both **floral and faunal biodiversity** signifies a weakening of the ecological fabric that sustains the arid landscape. Restoration and sustainable management of pasturelands are therefore critical for preserving ecosystem functions, supporting wildlife populations, and ensuring the long-term livelihoods of pastoral communities.

7. Conclusion

The overgrazing and rapid land use change have exerted a significant influence on the pasture biodiversity of Nagaur District, Rajasthan. Continuous grazing pressure, coupled with the conversion of pasture lands into cropland, built-up areas, and wastelands, has led to the degradation of natural grasslands that once supported a rich variety of faunal biodiversity.

The reduction of pasture vegetation has not only diminished the availability of fodder for livestock but also disrupted the habitats of several wild herbivores, birds, reptiles, and insects that depend on grassland ecosystems for food and shelter. As a result, the animal diversity (faunal biodiversity) of the region is gradually declining, particularly among small mammals, ground-nesting birds, and pollinating insects.

These changes indicate a loss of ecological balance, threatening both wildlife and sustainable pastoral livelihoods. To restore biodiversity and ecosystem stability, it is essential to adopt controlled grazing practices, pasture regeneration programs, and sustainable land management policies. Protecting and revitalizing pasturelands will not only enhance faunal diversity but also contribute to the long-term ecological and economic resilience of the Nagaur district.

The study concludes that overgrazing and land use change have critically degraded the pasture biodiversity of Nagaur District. Loss of native grasses, soil erosion, and habitat fragmentation threaten ecosystem resilience and the livelihoods of pastoral communities. Effective policy interventions, grazing regulation, and restoration measures are urgently required.

8. Recommendations

1. **Rotational Grazing:** Introduce fenced grazing cycles allowing regeneration of native grasses.
2. **Afforestation & Reseeding:** Promote *Cenchrus ciliaris*, *Lasiurus sindicus*, and other native species.
3. **Community Pasture Management:** Involve local Panchayats and NGOs in pasture restoration.
4. **Land Use Zoning:** Restrict conversion of pasture lands into agriculture or construction zones.
5. **Monitoring & Awareness:** Establish biodiversity monitoring programs and educate herders on sustainable practices.
6. **Adopt Sustainable Grazing Practices:** Implement rotational and regulated grazing systems to prevent continuous pressure on specific pasture zones. Controlled grazing allows vegetation to regenerate naturally, ensuring long-term availability of fodder and sustaining faunal diversity.
7. **Promote Pastureland Restoration and Grassland Development:** Encourage community-based pasture restoration projects through reseeding of native grass species, soil moisture conservation, and fencing of degraded areas. Restored grasslands provide improved habitats for both livestock and wild animal species.
8. **Protect and Conserve Faunal Habitats:** Identify and safeguard critical habitats that support high **faunal biodiversity** such as grassland patches, water bodies, and shrublands. Creating small biodiversity reserves within pasture areas can serve as safe zones for wildlife such as chinkara, desert fox, and ground-nesting birds.
9. **Integrate Land Use Planning with Biodiversity Conservation:** Local development and agricultural expansion should be aligned with biodiversity-friendly land use planning. Ecologically sensitive zones should be protected from urban encroachment, mining, and over-exploitation.
10. **Enhance Awareness and Community Participation:** Conduct training and awareness programs among pastoralists and farmers about the ecological importance of **faunal biodiversity** and sustainable grazing. Community involvement ensures long-term protection and stewardship of natural pastures.
11. **Strengthen Policy and Institutional Support:** Government agencies should frame and enforce policies to regulate overgrazing, promote rangeland management, and integrate biodiversity conservation into rural development schemes such as MGNREGA and watershed programs.
12. **Monitor Biodiversity Through Research and Data Collection:** Establish regular monitoring of pasture ecosystems to assess vegetation cover, species richness, and animal population trends. Scientific documentation will help in identifying changes in **faunal biodiversity** and guiding adaptive management strategies.

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