

Grassland Ecology, Habitat Requirements, and Conservation Challenges of the Lesser Florican (*Sypheotides indicus*) in Human-Dominated Landscapes of India



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ABSTRACT

The Lesser Florican (*Sypheotides indicus*), a critically endangered bustard species, faces significant ecological challenges in the human-dominated grassland landscapes of India. Human activity has effects that go beyond the obvious destruction of habitat. These ecosystems deteriorate as a result of shifts in land use intensity, which are frequently caused by urbanization and agricultural growth. Additionally, overgrazing, altered flood patterns, and the introduction of alien species can all worsen grassland deterioration. Effective conservation of the Lesser Florican necessitates a multi-faceted approach. Metapopulation models, grounded in empirical data, can provide a robust framework for assessing conservation strategies and trade-offs between ecosystem restoration and species conservation. Community-based conservation approaches are crucial, especially in human-dominated landscapes where local communities rely on grassland resources. This includes rigorous scientific research, community engagement, and policy interventions that promote sustainable land use and recognize the intrinsic value of grasslands as critical ecosystems for biodiversity.

Keywords: Lesser Florican, *Sypheotides indicus*, Grassland ecology, conservation, habitat.

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INTRODUCTION

The Lesser Florican (*Sypheotides indicus*), a critically endangered bustard species, faces significant ecological challenges in the human-dominated grassland landscapes of India [1,2]. Its survival is intricately linked to the dynamics of grassland ecosystems, which are increasingly under pressure from anthropogenic activities [3,4]. Understanding the species' habitat requirements and the conservation challenges it faces is crucial for developing effective management strategies [1,2]. Grasslands in India, particularly those in semi-arid regions and the Gangetic Plains, harbor significant biodiversity but are often overlooked in conservation efforts compared to forests [3,5,6]. These ecosystems are essential for species like the Lesser Florican, which relies on specific grassland characteristics for breeding and foraging [1]. Studies have shown that the home range and habitat use of the Lesser Florican are influenced by a complex interplay of extrinsic and intrinsic factors, emphasizing the need for detailed ecological research [1]. For instance, satellite telemetry studies in Gujarat, India, have provided insights into the species' movement patterns and habitat preferences [1,7]. However, these vital grasslands are under constant threat. Rapid expansion of agricultural land and human settlements, coupled with significant changes in climate and land cover, directly impacts wildlife habitats, both within and outside protected areas [8,2,3].

The conversion of grasslands to croplands and the establishment of anthropogenic features have made large, intact grasslands rare [9]. This is particularly evident in the Thar Desert region of Rajasthan, where agricultural conversion has considerably damaged unique desert ecosystems and their associated species, including other bustard species [10,11]. Similar challenges are faced by other grassland-dependent species, such as the Bengal Florican (*Houbaropsis bengalensis*), which has experienced catastrophic population declines in areas like Cambodia and Nepal due to habitat loss and agricultural intensification [12,13,14,15,16,17,18]. The impact of human activities extends beyond direct habitat loss. Land use intensity changes, often driven by agricultural expansion and urbanization, contribute to the degradation of these ecosystems [8,3,4]. Remote sensing models have been used to analyze urban density dynamics, highlighting the rapid urbanization that contributes to environmental change [19]. This urbanization and agricultural intensification lead to habitat fragmentation, making conservation efforts more complex [20]. The degradation of grasslands can also be exacerbated by factors such as overgrazing, changes in flood patterns, and the introduction of invasive species [21,5]. Effective conservation of the Lesser Florican necessitates a multi-faceted approach.

Metapopulation models, grounded in empirical data, can provide a robust framework for assessing conservation strategies and trade-offs between ecosystem restoration and species conservation [22]. Ecological niche models (ENMs) and species distribution models (SDMs) are increasingly utilized to understand species distribution patterns and processes, offering valuable tools for identifying critical habitats [23]. Adaptive spatial planning is also being explored to enhance climate resilience for endangered species, integrating habitat connectivity and complexity [24]. Community-based conservation approaches are crucial, especially in human-dominated landscapes where local communities rely on grassland resources [12,13,25]. Engaging local communities in grassland management and educating them about the reasons for species decline can significantly contribute to conservation success [25]. Sustainable land-use practices, such as planning agriculture based on land-use responses of threatened semi-arid grassland species, are essential to balance biodiversity conservation with rural food security [2]. The broader context of grassland ecology in India highlights the ongoing transitions from grasslands to woodlands and the impacts of management practices on tropical riverine grasslands [26,5]. The underappreciation of tropical grasslands, unlike tropical forests, often leads to their widespread degradation [5]. Therefore, scientifically validated management strategies that consider the unique ecological characteristics of grasslands and their vulnerability to human pressures are urgently needed [5]. Research into grassland ecology should encompass multi-level studies, including the impact of climate change and human activities, adaptive management, and the sustainability of grassland systems, emphasizing transdisciplinary approaches [19].

The research object classification in grassland ecology often progresses from focusing on "Soil" and "Grass" in habitat-centered research to incorporating "Animal" in ecosystem-centered research, and ultimately including "Human" in social-ecological system research, reflecting the increasing complexity and human-centricity in understanding these ecosystems [19]. This evolution in research perspective from habitat-based to transdisciplinary approaches is critical for effective grassland conservation (Fig.1) [19]. The hierarchical structure of grassland research, moving from multidisciplinary studies of plant community structure and soil erosion (Type I) to interdisciplinary investigations of climate change and human activity impacts (Type II and III), and finally to transdisciplinary research on ecosystem services, human well-being, and adaptive management (Type IV), underscores the complexity of conserving species like the Lesser Florican (Fig. 2) [19]. This transition signifies increasing degrees of transdisciplinarity and a greater emphasis on human well-being, which are vital for integrating conservation with sustainable development in human-dominated landscapes [19].

Ecology and Sustainability of the Inner Mongolian Grassland			
	Ecology in the Grassland	Ecology of the Grassland	Sustainability of the Grassland
The perception of grassland	Habitat	Ecosystem	Social-Ecological system
Research object	"Soil" and "Grass"	"Soil-Grass-Animal" coupled	"Soil-Grass-Animal-Human" coupled
Role of Human	Little attention	An interference type	Part of the system
Level of focus on	Community ecology	Ecosystem ecology	Sustainability science
Key research methods	Regional survey; Community survey	Long-term positioning research; control experiment	Questionnaire survey; Scenario simulation
Sustainability applications	Only emphasizes the environmental integrity	Three pillars are sufficient but weak sustainability	Strong sustainability

Fig.1: Science Field and Research Direction

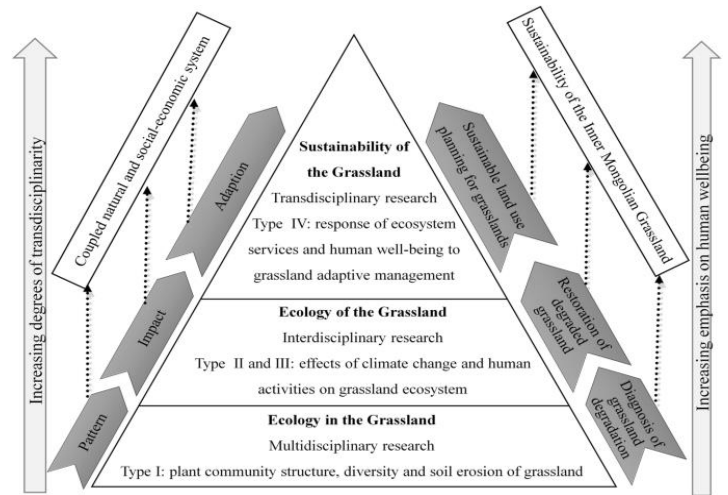


Fig. 2: Grassland Research Levels

CONCLUSION

The conservation of the Lesser Florican in India's human-dominated landscapes demands an integrated and adaptive approach that goes beyond conventional protection strategies. It requires a deep ecological understanding of the species' habitat requirements, coupled with the incorporation of socio-economic realities that shape land-use practices. Effective conservation must therefore combine rigorous scientific research, participatory community engagement, and evidence-based policy frameworks that encourage sustainable land management. Recognizing grasslands not as wastelands but as ecologically vital and productive ecosystems is central to this effort. Ultimately, long-term conservation success will depend on harmonizing biodiversity preservation with human well-being, ensuring that both ecological integrity and livelihood security are sustained in these dynamic landscapes.

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