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Impact of Wetland Drying on birds In Uttar Pradesh: A Review

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ABSTRACT

The floodplains of the Indo-Gangetic Plain in Uttar Pradesh, India, forms a crucial wintering corridor along the Central Asian Flyway (CAF) and also provide non-breeding and breeding habitats for resident waterbirds. However, rapid land-use/land-cover (LULC) transformations, agricultural expansion, groundwater drawdown, and shifts in monsoonal patterns are driving widespread wetland shrinkage and desiccation. This literature review synthesizes research on avian population dynamics across Uttar Pradesh, emphasizing ecological guild responses and governance dichotomies between designated Protected Areas (Ramsar Sites and Bird Sanctuaries) and unprotected rural wetlands (jheels). Findings indicate that while protected wetlands maintain high seasonal congregations of migratory Anatidae, unprotected agricultural-wetland matrices harbor most breeding populations of flagship species such as the Sarus Crane (*Grus antigone*). Rapid desiccation differentially impacts avian guilds: benthic shorebirds and diving ducks experience severe habitat compression, whereas generalist species expand. We emphasize that current protected-area-centric conservation models overlook the ecological connectivity provided by non-protected rural wetlands, and propose landscape-level management strategies.

Introduction

Wetlands in northern India, particularly within the state of Uttar Pradesh (UP), constitute an indispensable ecological network for avian biodiversity across South Asia [1, 5]. Situated along the Central Asian Flyway (CAF), the Gangetic floodplains host over 100 species of migratory waterfowl every winter, alongside providing year-round refugia for vulnerable resident species including the Sarus Crane (*Grus antigone*), Black-necked Stork (Ephippiorhynchus asiaticus), and Woolly-necked Stork (Ciconia episcopus) and many other birds [2,7,13].

Despite their ecological significance, wetlands in Uttar Pradesh are among the most human-dominated and threatened aquatic ecosystems globally [3,14]. Over the past four decades, intensive agricultural development (e.g., the expansion of paddy-wheat crop rotations), urban infrastructure expansion, surface water diversion, and unsustainable groundwater extraction have severely altered regional hydrology [3,4,15]. Consequently, seasonal and permanent wetlands ranging from large floodplains to small village jheels are experiencing accelerated desiccation, siltation, and fragmentation [6, 12].

While formal conservation efforts in UP have centered on designating Ramsar sites (e.g., Haiderpur, Saman, Bakhira, Sarsai Nawar, Nawabganj) and wildlife sanctuaries, a substantial portion of the state's wetland area consists of small, unprotected rural waterbodies [5,6,11]. These unprotected sites are deeply embedded within the agricultural matrices [7,8]. This review synthesizes existing ecological literature to evaluate:

1. The primary hydrological and anthropogenic drivers of wetland desiccation in Uttar Pradesh [3,4].
2. The guild-specific responses of waterbirds to shrinking aquatic habitats [9,10].
3. The comparative effectiveness and structural vulnerabilities of protected versus unprotected wetland networks [5,8].

Drivers and Dynamics of Wetland Desiccation in the Gangetic Plains

Anthropogenic Land-Use Changes and Agricultural Conversion: The conversion of natural wetlands into agricultural land represents the primary driver of habitat loss across Uttar Pradesh [3, 7]. High agricultural density has led to the systematic draining of seasonal marshes for cultivation [8]. Unprotected rural jheels are routinely bunded, drained, or excavated for aquaculture, altering their natural hydroperiods [4, 7].

Hydrological Alterations and Groundwater Drawdown: The extensive canal networks and intensive tube-well extraction across central and western UP have disrupted local water tables [3, 15]. The drawdown of shallow aquifers prevents seasonal monsoonal recharge from persisting into critical pre-monsoon and summer months [4, 14]. Studies on waterbodies such as Sheikha Jheel highlight how altered hydrological connectivity accelerates drying phases, leaving waterbodies vulnerable to invasive macrophyte expansion (Eichhornia crassipes) and subsequent eutrophication [3, 5, 10].

Monsoonal Variability and Climate Influences: Precipitation patterns over the Gangetic Basin have displayed heightened inter-annual variability, characterized by intense short-duration rainfall events followed by prolonged dry spells [4, 12]. Inadequate monsoonal recharge leads to early desiccation of ephemeral wetlands, directly coinciding with the peak breeding season of resident species and the overwintering period of CAF migrants [4, 9]



Figure 1. Conceptual diagram illustrating anthropogenic and

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hydrological drivers of wetland desiccation and their guild-specific impacts on waterbirds in Uttar Pradesh.

Guild-Specific Ecological Impacts on Avian Populations

Wetland desiccation does not affect waterbirds uniformly; ecological impacts vary substantially according to foraging traits, body size, and habitat specificity [2, 9, 10].

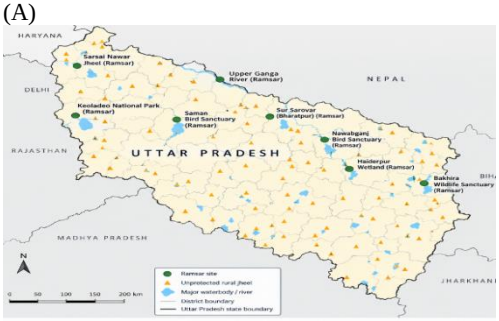
Shorebirds and Benthic Foragers (Waders): Species belonging to the orders Charadriiformes (e.g., lapwings, sandpipers, stints) rely on shallow littoral zones and exposed mudflats [6, 9]. Complete desiccation or rapid water-level drawdown hardens mud substrates, eliminating benthic macroinvertebrate communities and rendering foraging grounds inaccessible [9, 14].

Diving and Dabbling Waterfowl (Anatidae): Migratory ducks and geese (e.g., *Anas crecca*, *Anas acuta*, *Aythya ferina*) depend on open-water regimes and submerged aquatic vegetation [5, 6]. Shrinking water volumes reduce macrophyte biomass, forcing large congregations into a decreasing number of surviving waterbodies [1, 10]. This spatial crowding heightens interspecific competition and escalates disease transmission risks [5, 10].

Large Resident Waterbirds (Cranes and Storks): Flagship species such as the Sarus Crane (*Grus antigone*) utilize shallow wetlands for both nesting and foraging [7, 8, 13]. Premature drying of nesting marshes exposes eggs and chicks to terrestrial predators (e.g., feral dogs, jackals) and human disturbance [7, 13]. Additionally, reduced wetland availability limits chick provisioning success, causing localized population declines in agricultural landscapes [4, 8].



(A)



(B)

Figure 2. (A) Sarus Crane pair in an agricultural wetland matrix; (B) Geographical distribution of Ramsar sites and unprotected rural jheels across Uttar Pradesh.

Protected Areas vs. Unprotected Agricultural Matrices

Ecological Parameter	Protected Wetlands (Ramsar Sites & Sanctuaries)	Unprotected Rural Wetlands (Jheels & Farmland)
Site Examples	Haiderpur, Saman, Bakhira, Sarsai Nawar, Sandi [5, 6]	Village *jheels*, roadside borrows, agricultural marshes [7, 11]
Legal Status	Statutory protection under Wildlife Protection Act / Ramsar [5]	Zero formal statutory protection; community/private ownership [8, 11]
Hydrological Stability	Partial water-level intervention via feeder canals [3, 5]	Highly ephemeral; dependent on seasonal monsoon & drainage [4, 12]
Avian Usage Pattern	High-density winter congregations of migratory Anatidae [1, 6]	Vital breeding grounds for Sarus Cranes; stepping-stone networks [7, 8]
Primary Threats	Invasive weed growth, tourist disturbance, runoff [3, 10]	Complete land conversion, agricultural drainage, agrochemical toxicity [3, 14]

Research demonstrates a governance paradox: while protected areas receive the majority of conservation resources, more than 70% of the state's Sarus Crane population resides outside protected sanctuaries, relying entirely on unprotected agricultural jheels [7,8,13]. The desiccation of these small, scattered waterbodies severely diminishes overall landscape connectivity along the Central Asian Flyway [5, 7, 11].

Conservation Recommendations & Policy Synthesis

•Landscape-Level Management Beyond Protected Areas: Conservation policies must transition from strictly isolated sanctuary management to a landscape-matrix approach ("SarusScape") that incentivizes low-intensity agricultural practices and protects seasonal village jheels [7, 8, 11].

•Restoration of Hydroperiods: Strategic canal-water releases during dry months can sustain key unprotected wetlands, preventing early desiccation during crucial avian breeding windows [3, 4, 12].

•Community-Led Monitoring Networks: Involving local farming communities in wetland monitoring and ecotourism fosters traditional coexistence and protects nests from human interference [7, 13].

•Integration in State Wetland Authorities: Unprotected village waterbodies must be systematically mapped, prioritized, and recorded in official wetland registries to prevent legal and physical conversion [5, 6, 15].

Conclusion

Wetland desiccation across Uttar Pradesh poses a threat to both regional avian biodiversity and global migratory flyway networks. The loss of shallow, seasonal waterbodies disproportionately affects specialized foraging guilds and resident breeding species. Mitigating these ecological declines requires looking beyond designated sanctuaries to protect the vast network of unprotected rural wetlands that sustain northern India's waterbird populations.

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