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Peri-urban cropland sustains avian biodiversity in tropical cities: evidence from urban India

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Abstract

Rapid urban expansion in India, projected to add over 350 million urban residents by 2050, occurs through converting peri-urban croplands, plantations and fallows into built-up land. While these croplands sustain food production, their impact on urban biodiversity remains poorly understood, despite relevance to multifunctional land-use design in the Global South. Most urban ecology evidence comes from temperate cities with diverse agricultural systems. This study examines whether peri-urban croplands support bird communities comparably to built-up and other vegetated covers across three tropical Indian cities representing distinct biogeographies.

Bird data came from 360 fixed-radius point counts (120 per city) during December-February of 2020–2021 (Bhopal, Patna) and 2023–2024 (Coimbatore), yielding 14,576 individuals across 155 species. Observations were paired with land-cover data (Bhuvan Level-II) within 100 m of each site, and a multi-scale framework combined community-level richness with species-level occurrence and abundance models to disentangle impervious cover from vegetated and agricultural matrix. City-wide change was quantified in Google Earth Engine using GHSL built-up (2000–2020) and ESA WorldCover cropland (2021).

Within sampling buffers, cropland accounted for 67 % of vegetated cover, indicating birds encountered an agricultural rather than remnant natural matrix. City-wide built-up expanded 23–49 % (2000–2020; Bhopal 49 %, Coimbatore 37 %, Patna 23 %), while cropland still occupied 7–32 % of municipal area in 2021. Negative binomial mixed-effects and species-level probit and negative binomial regressions spanned 55,800 species-by-site observations. Site-level richness declined with built-up cover, but disappeared once vegetation and water cover were included (ΔAIC = 24.2), with vegetation remaining a positive predictor. The cost of impervious surface, therefore, operates through loss of the vegetation it replaces. Replacing 1 % built-up with 1 % cropland raised occurrence probability by 0.020 and abundance by 0.16 individuals per species per site (both $p < 0.001$); cropland was statistically equivalent to fallow and plantation, with only scrubland supporting significantly higher abundance. Built-up cover also restructured composition through turnover rather than nested loss (partial Mantel r=0.098, $p = 0.001$), with declining multivariate dispersion, a signature of biotic homogenisation that cropland retention helps offset. For tropical cities, where most of this century's urban growth will consume peri-urban agriculture, these findings reframe cropland as multifunctional land delivering biodiversity alongside food.

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