

Cropland and concrete

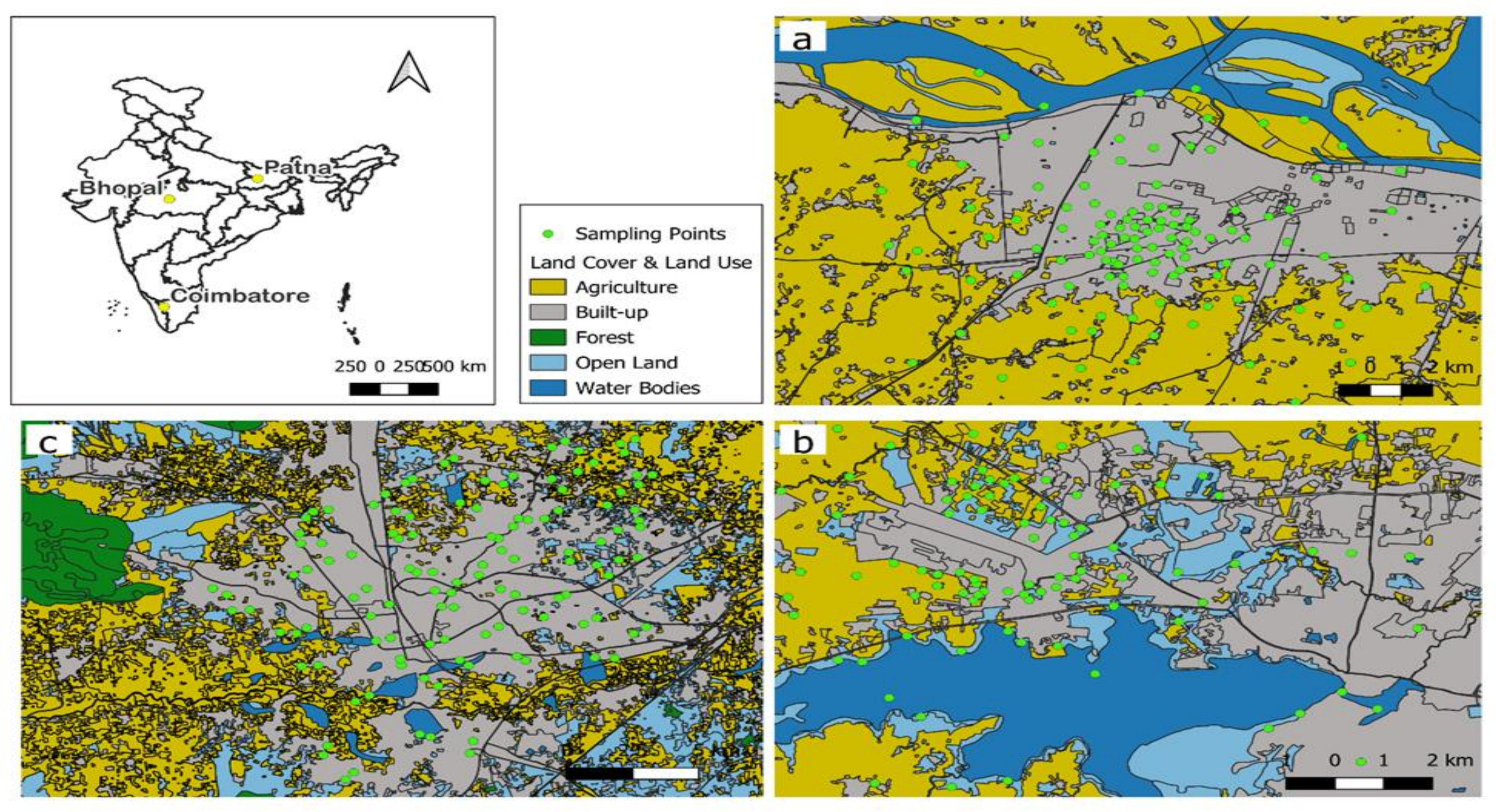
Peri-urban cropland supports urban bird biodiversity comparably to semi-natural cover across three tropical Indian cities

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The question

- India will add over 350 million urban residents by 2050, largely by converting peri-urban croplands, plantations and fallows into built-up land.
- Croplands sustain food production. Do they also sustain bird biodiversity, alongside other vegetated covers, in expanding tropical cities?

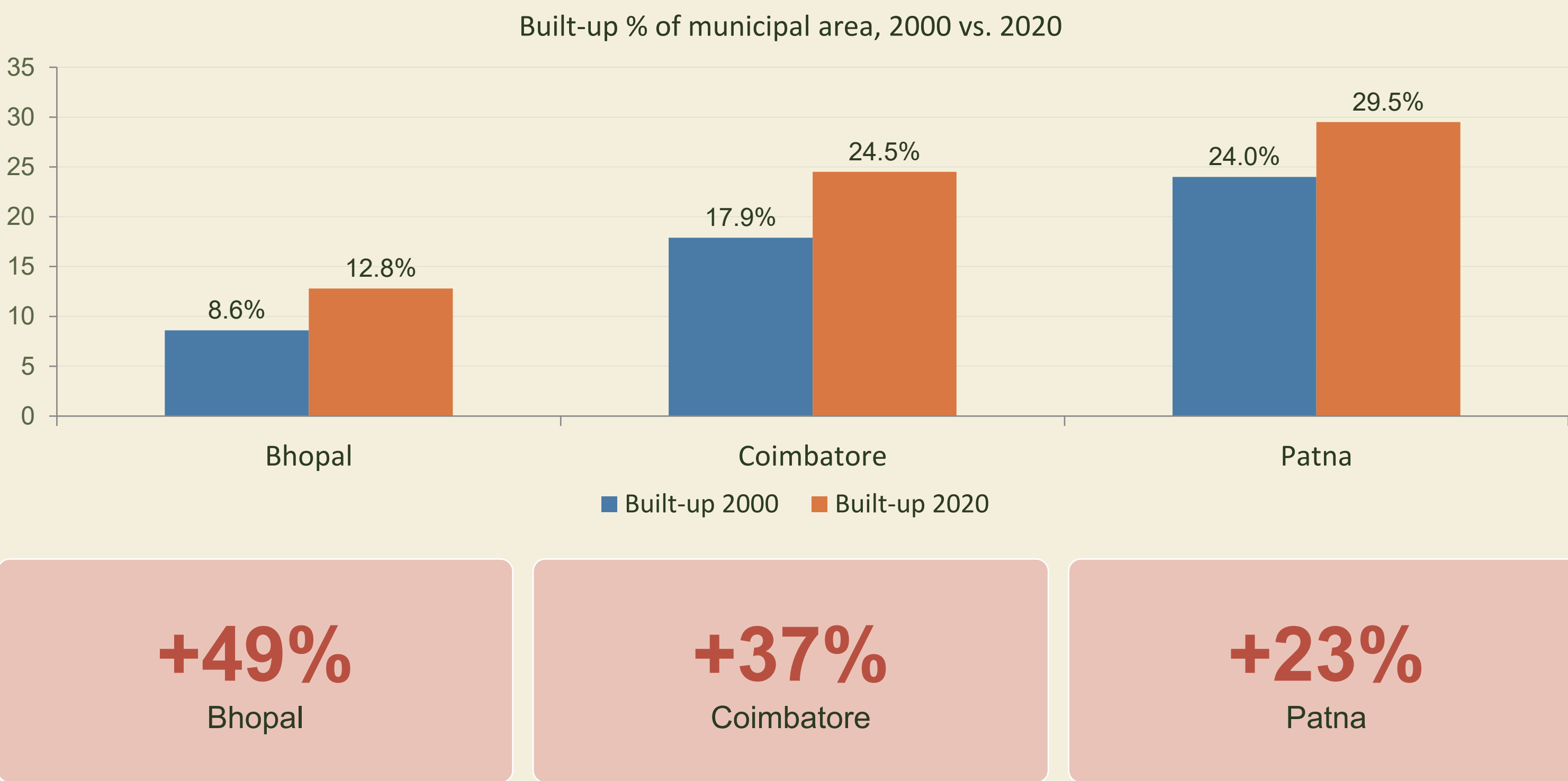
When land competes between food and biodiversity, does peri-urban cropland deliver both?

Three biogeographically distinct Indian cities:
Bhopal: Malwa Plateau · 411 km² area
Coimbatore: Western Ghats foothills · 261 km² area
Patna: Gangetic floodplain · 102 km² area

Study system and methods

Fixed-radius (100 m) point counts at 360 sites across Bhopal, Coimbatore, and Patna (120 per city; December–February 2020–21 in Bhopal and Patna, 2023–24 in Coimbatore) yielded 14,576 individuals of 155 species. Site-scale land cover within 100 m came from the Bhuvan Level-II LULC dataset (NRSC/ISRO); city-scale land-use / land-cover change was quantified in Google Earth Engine using GHSL built-up surface (2000–2020) and ESA WorldCover cropland (2021). Community richness was modelled with negative binomial GLMMs; species-level occurrence and abundance with probit and negative binomial regressions across 55,800 species–site observations, using post-estimation lincom contrasts to compare cropland against each other land cover.

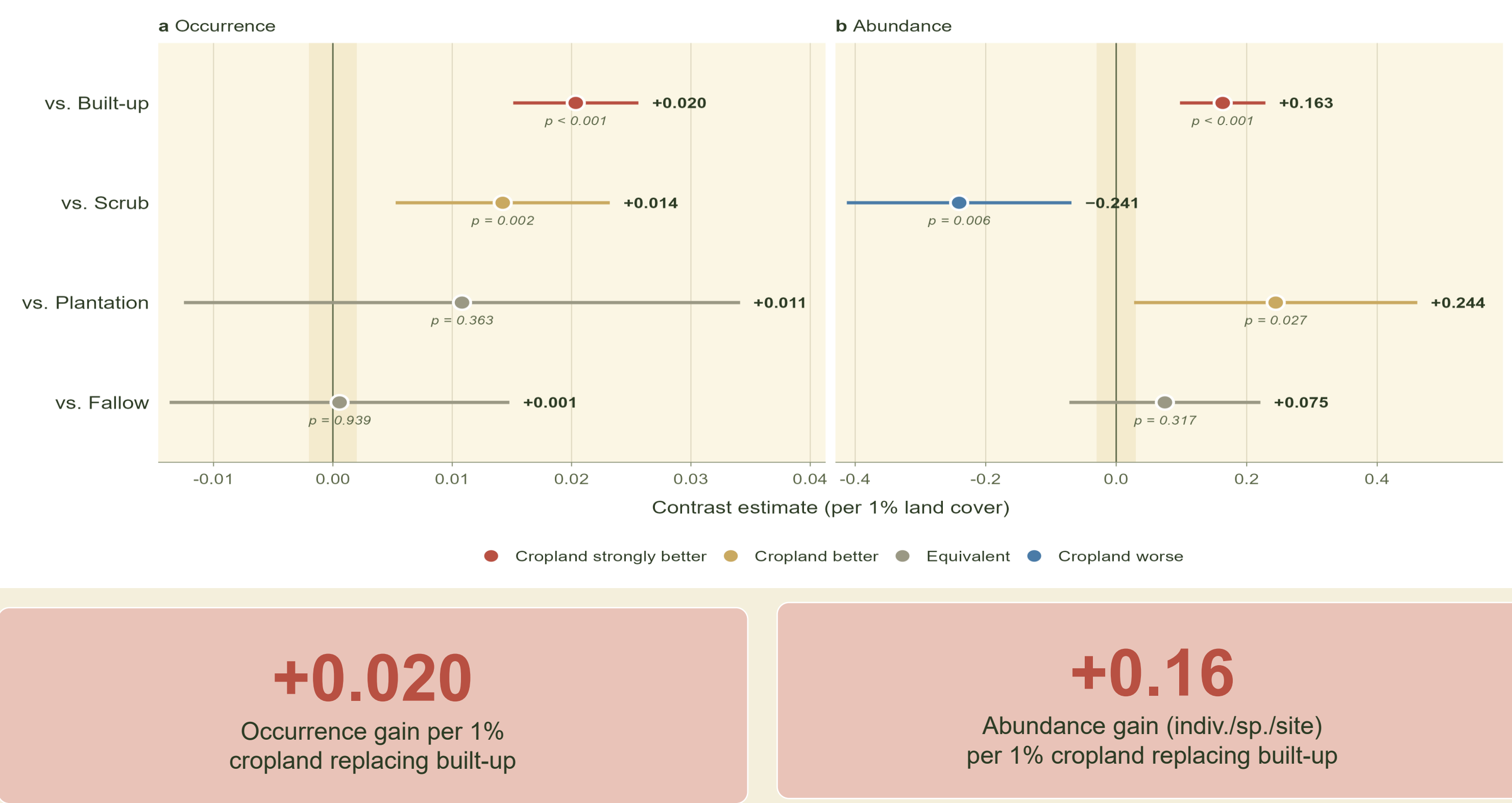
1 Two decades of built-up expansion



Built-up surface growth, 2000–2020 (GHSL BUILT-S)

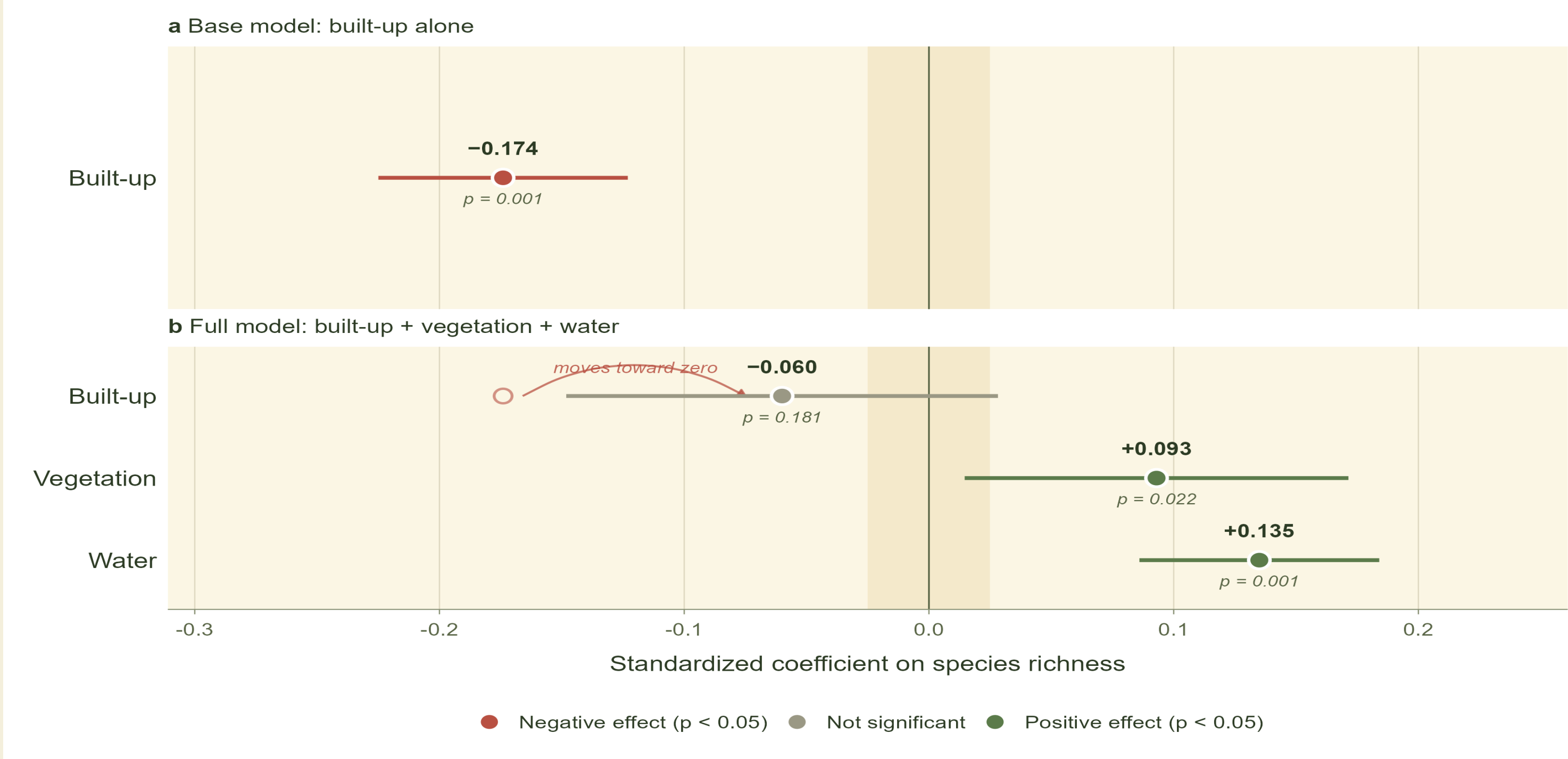
- Built-up area grew 23–49% across all three cities.
- Cropland still occupies 7–32% of the municipal area (2021, ESA WorldCover) — a real land-use choice remains.

3 Cropland matches semi-natural cover



- Cropland statistically equivalent to fallow and plantation for occurrence; only scrub outperforms cropland for abundance.

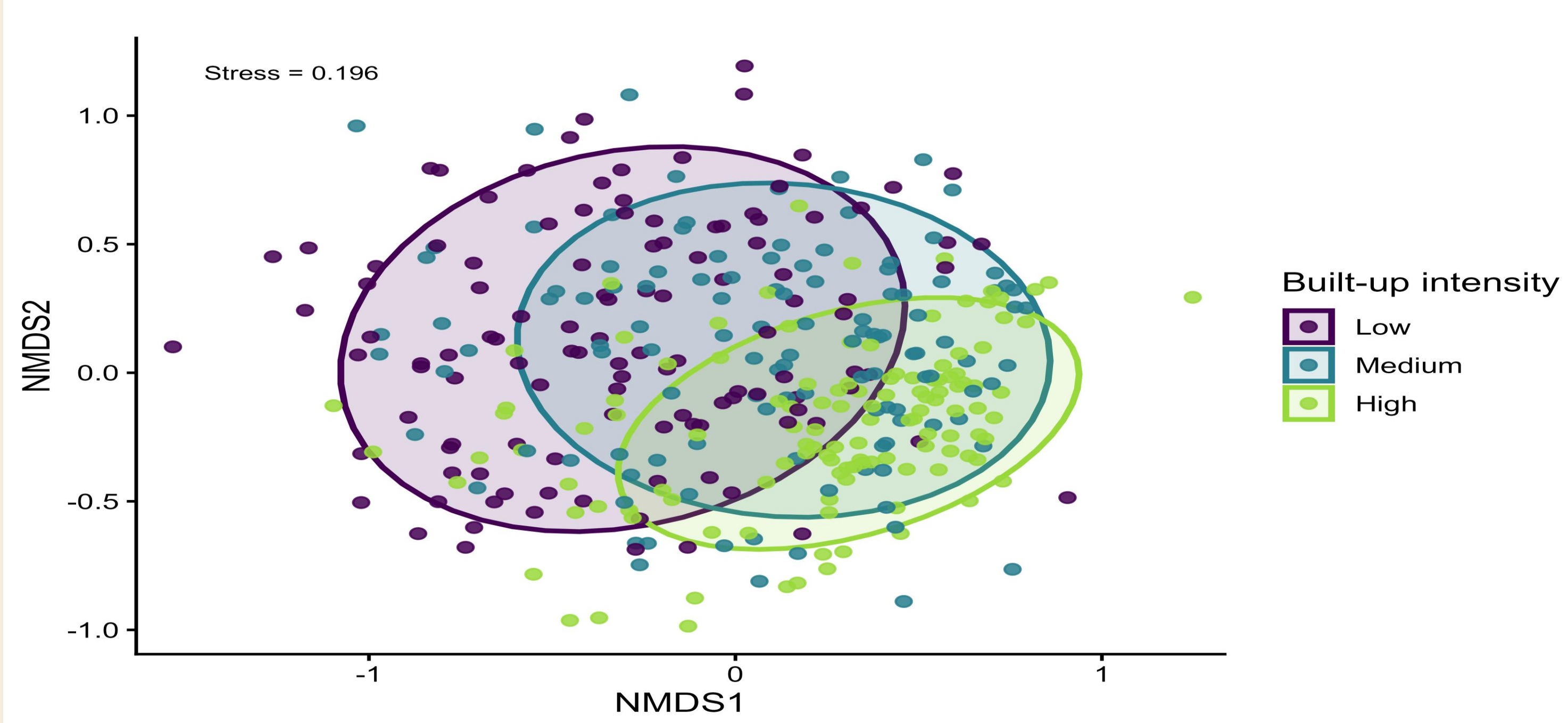
2 Losing vegetation is the real cost



Richness declines with built-up cover ($\beta = -0.174$, $p < 0.001$)
Effect disappears once vegetation and water are added ($p = 0.181$, $\Delta AIC = 24.2$)

The cost of concrete operates through the vegetation it displaces — cropland retained is birds retained.

4 Cropland loss homogenizes cities



Composition shifts along built-up gradient ($PERMANOVA R^2 = 0.046$, $p = 0.001$)
Species turnover, not nested loss ($partial\ Mantel\ r = 0.098$, $p = 0.001$)

Cropland retention preserves each city's distinctive avifauna against homogenization.

Peri-urban cropland is multi-functional land use

1 Half as costly as built-up

Every 1% cropland replacing built-up raises bird occurrence by 0.020 and abundance by 0.16 individuals per species per site.

2 Comparable to semi-natural cover

Cropland matches fallow and plantation for bird occurrence - a real biodiversity contribution, not a placeholder.

3 A climate-resilient strategy

Retaining peri-urban cropland delivers food, biodiversity, and homogenization buffering in one land use for the tropical Global South.



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Data sources: Bhuvan LULC Phase-II (NRSC/ISRO); GHSL BUILT-S R2023A (JRC-EC); ESA WorldCover v200 (ESA).
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References and comments:

