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nature cities

Article

https://doi.org/10.1038/s44284-026-00425-z

Impacts of nature-inclusive urban development on well-being and fairness perceptions

Received: 19 March 2025

Accepted: 9 March 2026

Published online: 7 April 2026

Check for updates

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Nature-inclusive urban development (NIUD) is central to international frameworks such as the Global Biodiversity Framework, yet its implementation risks fostering social inequity and green gentrification. This study examines these social impacts through a sequential mixed-methods investigation combining semi-structured interviews and a representative survey in Qunli New Town, Harbin, China, a prominent case of NIUD incorporating landscape-level ecological mitigation and compensation. Here we found that well-being changes among original residents were linked to adaptation to the new context. Compared to non-agriculturalists (for example, former small-scale industry workers), former agriculturalists reported a sharper happiness decline relative to the pre-urbanization era (odds ratio (OR) = 0.15, $P < 0.001$). Among all original residents, those perceiving increases in social (OR = 1.30, $P = 0.0049$) and esthetic (OR = 1.53, $P < 0.001$) values of green spaces reported happiness gains. A critical finding was the stark divergence in fairness perceptions: original residents perceived ecological fairness to be substantially lower than newcomers (OR = 0.54, $P < 0.001$) but economic fairness higher (OR = 1.93, $P < 0.001$). This was shaped by the rural reference points of original residents—both former agriculturalists and non-agriculturalists—which led them to value economic upgrades, while experiencing ecological displacement from the loss of customary practices and access to previously accessible landscapes. To advance equitable NIUD, social impact assessments should explicitly manage the gentrification trade-off between new green infrastructure and the loss of cultural landscapes, promoting justice for different waves of settlement.

The expansion of cities transforms natural landscapes such as forests and wetlands, a major driver of global biodiversity decline[1]. If insufficiently mitigated, these impacts are projected to affect over 30,000 species of native terrestrial vertebrates by 2050, with 855 species directly threatened[2]. For decades, global conservation agreements largely overlooked urbanization's impact compared to sectors such as agriculture and forestry[2]. However, a pronounced shift has occurred with the 2022 Global Biodiversity Framework (GBF), which aims to halt and reverse nature loss by 2030 in a socially fair manner. Crucially, the GBF's Target 12 explicitly promotes 'biodiversity-inclusive urban planning', calling to 'significantly increase the area and quality and connectivity of, access to and benefits from green and blue spaces in urban and densely populated areas sustainably'[3].

Urban planners are increasingly embedding nature values into land-use and infrastructure planning to conserve ecosystems, habitats and biodiversity[4]. This approach is encapsulated in the concept

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of 'nature-inclusive urban development' (NIUD), defined as an urban development approach that proactively integrates conservation into urban design and development through impact mitigation and compensation, aiming to achieve no net loss (NNL), and ideally a net gain (NG), in ecological value[4–8]. The conceptualization aligns closely with the notion of biodiversity-sensitive urban design, which provides principles for achieving urban development that delivers quantifiable biodiversity benefits[9,10]. While sharing this core goal, NIUD places a stronger emphasis on the policy and governance mechanisms required to implement the 'mitigation hierarchy'—a sequence of avoiding, minimizing, remediating and offsetting impacts—within complex urban developments[4,5]. Furthermore, NIUD extends beyond 'nature-based solutions' by emphasizing this systematic, pre-emptive integration into urban form rather than discrete interventions and resonates with initiatives such as 'eco-city' and 'garden city' in the Chinese context[11,12].

A central objective of NIUD is to achieve ecological NNL/NG relative to a pre-development baseline[7,8]. To operationalize this, the mitigation hierarchy has become a cornerstone strategy for urban designers and planners[6,7,9,13]. Blending this hierarchy into urban planning helps identify areas for effective and efficient impact mitigation and nature recovery[7,14,15].

Gentrification theory posits that urban development and environmental improvements can displace long-term, often marginalized, communities, often by attracting affluent newcomers[16,17]. This displacement may result from rising property costs, erosion of cultural identity and community networks and unequal access to upgraded amenities[16,18]. In the literature, gentrification and its displacement effects remain underexplored in contexts outside the global north[16,18]. Understanding these dynamics in such contexts is critical, as distinct governance structures, urbanization patterns and socio-cultural relationships to land can produce different manifestations of gentrification[19–21].

Gentrification theory suggests that while well-implemented NIUDs can enhance environmental quality and urban livability, they may simultaneously exacerbate social inequalities[22]. Recent research emphasizes that understanding how urban nature enhancement—particularly through NNL/NG and nature-positive approaches—may inadvertently drive green gentrification is crucial for mitigating its adverse well-being impacts[23]. However, there are few empirical studies demonstrating these dynamics. As more governments require developers to implement ecological mitigation and compensation to counterbalance negative impacts[24,25], this social issue is becoming increasingly relevant.

Urban planning frameworks have also long embraced the principle of 'do no harm, and if possible, do good', requiring that project-affected persons be at least no worse off, and preferably better off, than they would have been in the absence of development[26–29]. The integration of nature values into urban development has the potential to impact local communities. This requires explicit scrutiny, however, as NIUD may not guarantee positive outcomes for everyone[30–32], with gentrification processes potentially serving as a notable driving force behind such uneven outcomes[22,23]. Practically, an effective social impact assessment must evaluate how urban planning and nature-enhancement measures affect local communities and identify strategies to mitigate negative effects[29,33].

Well-being is typically treated as multi-dimensional, involving three interrelated dimensions: material (what a person has), relational (what they can do with what they have) and subjective (what they think about what they have and can do)[33–35]. A change in a person's resources and states, and their activities, can lead to change in perceived happiness[36]. While perceived happiness is a key measure widely used to assess subjective well-being, the perceived fairness of benefit distribution has been recognized as another important indicator[35,37]. This multi-dimensional framework has been extensively applied to assess social impacts of environmental interventions in both global north[37,38] and global south[39,40] contexts.

Whereas material indicators such as income and wealth are fundamental to assessing equity, a singular focus on them can obscure important subjective experiences, such as the erosion of cultural identity, positive or negative impacts on people's sense of place and different perceptions of the fairness of the transformation process[18,41,42]. Therefore, we also examine perceived fairness—whether residents view the distribution of the transformation's benefits and costs as impartial. We distinguish between economic fairness (changes in housing, jobs, infrastructure and services) and ecological fairness (changes in green spaces, ecosystems and conservation rules). To explore these fairness perceptions in depth, we complement our quantitative analysis with qualitative data, capturing dimensions of gentrification that standard metrics often miss.

We examine Qunli New Town, Harbin, China—a recently urbanized area developed rapidly since 2006. Under China's 'eco-city' movements[11,12], Qunli government's urbanization plan for the town was based on the 'principle of ecological priority', with the goal of creating an 'ecological garden city' whose aim was to 'increase the proportion of green space, water surfaces and park areas, establishing an ecological urban area characterized by a clean and beautiful environment, a sustainable urban ecosystem and the coordinated development of the environment, economy and society'[43]. To fulfill these goals, numerous ecological mitigation and compensation measures were designed and implemented (Case Study). Qunli represents a prominent example of rapid, nature-inclusive urbanization that achieved demonstrable net ecological gains[44], offering a unique opportunity to assess its socio-ecological trade-offs.

The experience of Qunli encapsulates a critical tension emerging globally: urban development that incorporates nature-positive targets can simultaneously trigger gentrification processes that reshape communities and unevenly distribute its benefits[23]. By examining this tension, our study provides timely empirical insights into the complex interplay between conservation and well-being in rapid urbanization. We conceptualize gentrification not only in terms of economic displacement but also through the lenses of 'exclusionary displacement'—when original residents are unable to remain in a neighborhood of choice—and 'psychological displacement', where residents feel socially and culturally out of place in the transformed environment[45,46]. In China's context, this is often a state-led process involving land acquisition and resettlement, which reshapes the socio-demographic composition and socio-ecological dynamics of an area[19–21]. Qunli thus provides a counterpoint to the typically documented market-driven gentrification processes, illustrating how state-led urbanization can generate distinct social impacts and fairness perceptions under NIUD.

To guide our investigation, we address three research questions: (1) how do original residents perceive changes in their well-being following NIUD? (2) How do fairness perceptions differ between original residents and newcomers, and what drives these differences? (3) What are the broader implications for theory and practice?

Case study

We focus on Qunli New Town, Harbin, China, a large-scale urban development that exemplifies the ambitious implementation of nature-inclusive principles (Fig. 1). Between 1982 and 2010, Harbin's population expanded from 2.5 million to 10 million. The new town, designed to support 322,000 residents, was established on the western outskirts of Harbin (Methods).

Qunli represents a prime example of NIUD, where ambitious ecological goals were embedded in the master plan from the outset and backed by substantial public investment, moving beyond rhetoric to measurable implementation[44]. The Qunli National Urban Wetland Park was specifically highlighted by UN Habitat as a positive example of ecological restoration within a new town development, demonstrating how a wetland ecosystem can be integrated into urban fabric to regulate urban flooding, enhance biodiversity and provide recreational space[47]. It also involved the creation of interconnected green corridors to support ecological processes such as wildlife movement and dispersal. These measures were supported by stricter conservation regulations, including patrolled, protected areas.

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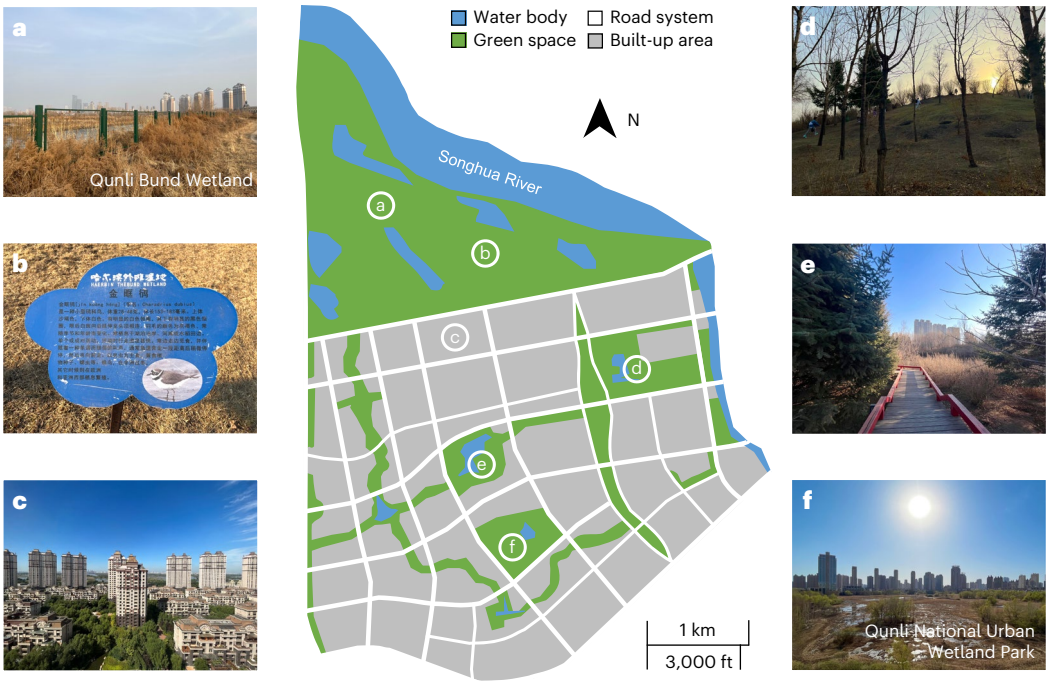

Fig. 1 | Land-use and nature-related features of Qunli New Town, Harbin. This study focuses on the eastern developed area of Qunli New Town (boundaries defined in Methods), representing the first phase of construction. The western expansion (second phase) beyond the Third Ring Road had not undergone land acquisition or development during the research period. The 2023 land-use map of Qunli New Town shows the newly created Qunli Bund Wetland and Qunli National Urban Wetland Park, both of which are enhancing degraded wetlands, with green corridors connecting the various urban spaces. The built-up zones (gray) integrate substantial fine-grained green space (for example, street trees, pocket parks) as part of the nature-inclusive design, which are not resolved at this mapping scale. **a**–**f**, Additional images illustrate specific nature-inclusive features: a fenced-off protected area along the urban river (that is, Songhua River) (**a**); an educational sign about a local migratory bird, the little ringed plover (*Charadrius dubius*) (**b**); compensatory afforestation at a housing site (**c**); a signature park (that is, Lilac Park, where the Lilac (Syringa), the city flower of Harbin, is featured) where a group of young people is exploring the hilly area (**d**); an urban park with restricted access to mitigate human disturbance on migratory species and ecosystems (**e**) and an urban wetland (part of the 'sponge city' scheme) for urban flood control and as a natural habitat (**f**). All photographs taken by S.G. Map adapted from OpenStreetMap under a CC BY-SA 2.0 license and validated through fieldwork.

Whereas initial construction caused degradation, subsequent monitoring reported a recovery in green space, water quality and biodiversity[44]. For instance, the number of bird species in the wetland park increased to 49, and fish species richness in the adjacent Songhua River rebounded from fewer than 40 to over 60 (refs. 44,48). This documented ecological success makes Qunli an ideal setting to investigate the concomitant social impacts of NIUD. The transformation from a rural to an urban landscape, involving farmland and rural commercial/industrial land acquisition and population relocation, provides a critical context for examining well-being dynamics among different resident groups.

To address our research questions, we employed a sequential mixed-methods approach. First, exploratory qualitative interviews ($N = 42$) with residents identified key well-being themes and fairness perceptions, providing contextual depth and informing hypothesis development. Second, a representative survey ($N = 1{,}018$) quantitatively tested these emergent hypotheses (Table 1), allowing for generalizable insights across resident groups.

Our findings are structured around the research questions. We first present results on perceived well-being changes among original residents, followed by an analysis of fairness perceptions between original residents and newcomers. Implications for theory and practice are discussed in 'Discussion'.

Results

Perceived well-being of original residents

Quantitative survey results offer a before-and-after perspective through retrospective comparisons, enquiring into how original residents perceived changes in their environment and how these changes had affected happiness. Among the 1,018 residents surveyed, 289 were long-term residents and thus able to make retrospective comparisons. Most of these residents perceived positive changes in all types of economic and ecological aspects addressed in the survey, compared to the pre-urbanization era (Fig. 2). However, there was less consensus on changes in secure jobs and income (with ~51% perceiving an improvement), harvesting of ecosystem goods (~52%), social activities with family and friends in local natural areas (~59%) and the beauty of local nature (~58%). These results demonstrated that, although some original residents could adapt to the new situation over time, a large proportion still felt negatively affected by the development.

Regression modeling (Fig. 3a) revealed which perceived changes were significantly associated with changes in happiness. Over the period since the town had been built, people perceived that housing, markets and malls and medical and educational infrastructure had changed for the better. However, these changes in economic aspects were not significantly associated with changes in happiness (Fig. 3a). As shown in Fig. 3a, the perception of improved job and income was a significant predictor of increased happiness (odds ratio (OR), 1.22; 95% CI, 1.04–1.44; $P = 0.014$), as were increased social activities in nature (OR, 1.30; 95% CI, 1.08–1.55; $P = 0.0049$) and the perceived beauty of nature (OR, 1.53; 95% CI, 1.32–1.77; $P < 0.001$). Conversely, being a former agriculturalist was a strong predictor of decreased happiness (OR, 0.15; 95% CI, 0.06–0.41; $P < 0.001$). Notably, other material improvements such as housing and infrastructure, while widely acknowledged (Fig. 2), were not significantly associated with increases in happiness (Fig. 4).

Qualitative interviews provided depth and context to these patterns. Respondents reported that changes across multiple well-being dimensions influenced their overall happiness. Economically, these included housing improvements, such as better security and

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Table 1 | Variables included in the ordinal logistic models and their expected associations

Variable	Data type	Description*	Reverse coding*	Model	Expected association	Supporting evidence
Dependent variables						
Happiness	Ordinal	The economic developments (for example, housing, malls, jobs, hospitals, schools) and associated ecological compensation measures (for example, urban green spaces and parks, restored or newly created) in the area have made me happier, compared to before the land-use change. (Figures featuring both local 'natural' and 'managed' ecosystems are part of the ecological compensation scheme (Fig. 1) are presented.)	No	1	NA	NA
Fairness (economic)	Ordinal	Considering what different resident groups have gained and lost, the economic changes (for example, housing, malls, jobs, hospitals, schools) in the new town have been fair for residents in the area.	No	2	NA	NA
Fairness (ecological)	Ordinal	Considering what different resident groups have gained and lost, the ecological changes (for example, urban green spaces and parks, restored or newly created) in the new town have been unfair for residents in the area.	Yes	3	NA	NA
Independent variables						
Elements of well-being						
Housing	Ordinal	Despite the economic developments in the new town, my housing has not improved, compared to before the land-use change.	Yes	1	+	90–92
Markets and malls	Ordinal	Due to the economic developments in the new town, I now have better access to markets and malls, compared to before the land-use change.	No	1	+	93,94
Jobs and income	Ordinal	Despite the economic developments in the new town, my job or source of income has not improved, compared to before the land-use change.	Yes	1	+	95,96
Medical facilities	Ordinal	Due to the economic developments in the new town, I now have better medical facilities, compared to before the land-use change.	No	1	+	97,98
Educational facilities	Ordinal	Despite the economic developments in the new town, access to educational facilities has not improved for me (or my household), compared to before the land-use change.	Yes	1	+	97,98
Ecosystem goods	Ordinal	Due to the ecological compensation measures in the new town, I now have more natural resources (for example, food, medicine) harvested from local natural areas, compared to before the land-use change.	No	1	+	99
Social activities in nature	Ordinal	Despite the ecological compensation measures in the new town, I now do fewer social activities in local natural areas, compared to before the land-use change.	Yes	1	+	100,101
Beauty of nature	Ordinal	Due to the ecological compensation measures in the new town, I find the area more beautiful, compared to before the land-use change.	No	1	+	102,103
Air quality	Ordinal	Despite the ecological compensation measures in the new town, I find the air quality in the area has not improved, compared to before the land-use change.	Yes	1	+	104,105
Flood control	Ordinal	Due to the ecological compensation measures in the new town, I find the urban flooding events in the area have decreased, compared to before the land-use change.	No	1	+	106,107
Natural knowledge	Ordinal	Despite the ecological compensation measures in the new town, I have not gained more knowledge about local nature (for example, a bird or habitat type), compared to before the land-use change.	Yes	1	+	108,109
Socio-demographics						
Gender	Dummy	0 = male, 1 = female	NA	1–3	?/?/?	NA
Age	Interval	0=18–30, 1=30–45, 2=45–60, 3=>60	NA	1–3	+/?/?	110
Education	Ordinal	0 = no education, 1 = primary, 2 = lower secondary, 3 = upper secondary, 4 = college diploma, 5 = bachelor's degree; 6 = master's degree; 7 = doctoral degree	NA	1–3	+/+/+	110
Income (per month)	Interval	0 = less than ¥1,000, 1 = between ¥1,000 and 5,000 2 = between ¥5,000 and 10,000 3 = between ¥10,000 and 20,000 4 = More than ¥20,000	NA	1–3	+/+/+	110
Agriculturalist	Dummy	If respondents were agriculturalists before land conversion; 0 = non-agriculturalist, 1 = agriculturalist	NA	1–3	−/?/?	111
Original resident	Dummy	If respondents were local residents before land conversion; 0 = newcomer, 1 = original resident.	NA	2, 3	?/?	NA

*Survey items for dependent variables and well-being elements were evaluated on a 7-point scale from −3 (strongly disagree) to +3 (strongly agree). To ensure consistency and minimize response bias, the questionnaire alternated between positively and negatively worded statements; negatively worded items (indicated under 'reverse coding') were reverse coded before analysis. NA, not applicable.

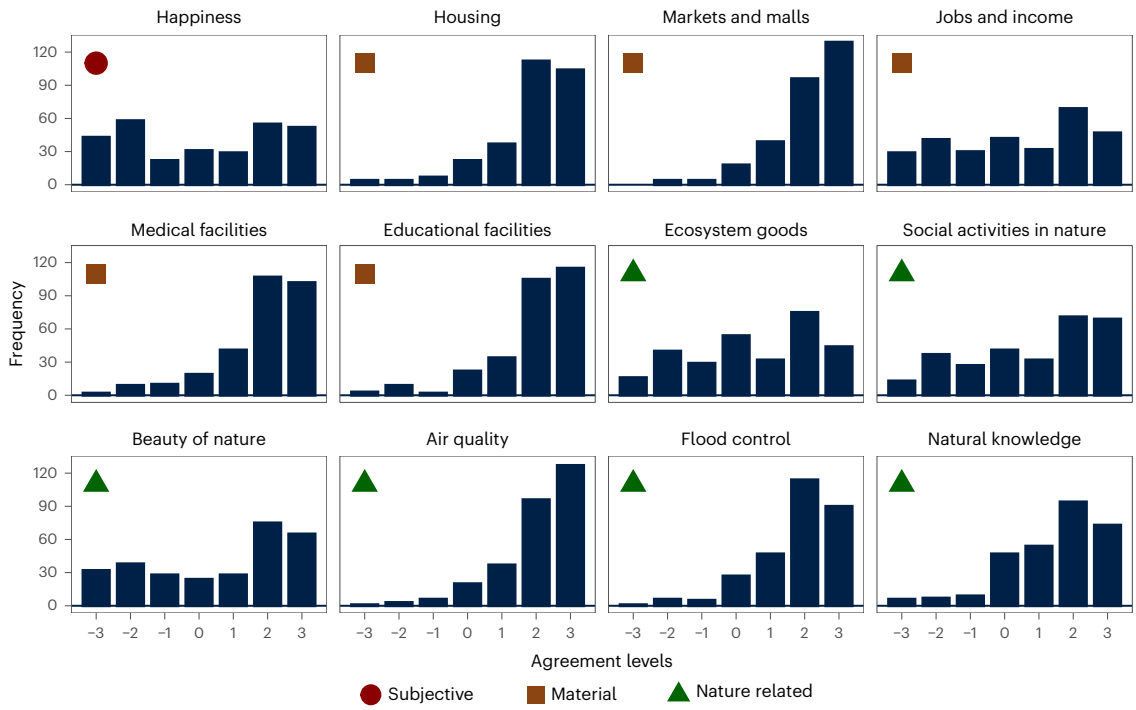

Fig. 2 | Perceived changes in well-being elements due to land-use change in Qunli New Town. Agreement is measured on a −3 to +3 scale, where −3 indicates strong disagreement that the element had improved and +3 indicates strong agreement that the element had improved.

accessibility. Many original residents' farmlands and village bungalows were acquired for the new town's development. They were compensated with state-subsidized resettlement housing on the town's southwestern edge.

Interviews indicated that new markets/malls offered better local access to non-local products (for example, food). The addition of new schools and hospitals increased the availability of vital public services. The development also created jobs, for example, for construction workers, cleaners and security guards. However, in contrast to new residents who did not change jobs or changed jobs for reasons unrelated to the new town, many original residents felt pushed into non-standard or contingent employment due to the development. They noted that, although some local jobs offered higher pay than their previous work in the villages, they were more insecure and subject to rapid changes.

Ecologically, interviews revealed that the development which introduced new green spaces has transformed the availability of natural resources. Farmlands that were once collectively owned by previous villagers and used to grow crops, including culturally valued lilac trees, were acquired for development. Additionally, many new parks—whether created through habitat restoration or artificial landscaping—were established with physical barriers. These caused loss of well-being by, for example, preventing original residents from harvesting wild products from wetlands (for example, wild duck eggs).

Institutional changes also impacted harvesting. Previously, less restrictive rules allowed practices such as 'harvesting birds with mist nets'—a primary source of sustenance and a way of life for some. Stricter conservation regulations and enforcement measures (for example, frequent park patrols) prevented them from continuing these practices.

Yet, ecological compensation measures increased the availability of some harvestable natural resources. As part of the river compensation scheme, temporary fishing bans, along with restrictions on the mesh sizes of fishing nets, led to increased populations and sizes of many edible fish species. Additionally, ecological changes in the parks created new harvesting opportunities, including for resources used in traditional Chinese medicine such as dandelions.

Many interviewees highlighted changes in regulating services from local ecosystems. For instance, both original and new residents perceived that new parks provided health benefits through improved air quality. Original residents especially noted that some new parks functioned as 'sponges' to mitigate urban flooding, with many reporting that both the quantity and intensity of local floods were better controlled compared to the pre-urbanization era.

Additionally, echoing the findings of a recent study on the Qunli National Wetland Park[49], we found that some residents reported that the parks in Qunli enhanced their knowledge of nature by providing opportunities for nature-based activities such as bird watching and through educational and informative signs placed throughout these areas. Some original, middle-aged individuals mentioned passing this natural knowledge down to their children and future generations to promote ecological literacy. Nevertheless, compared to incomers, original residents viewed this knowledge as a less important element of their happiness.

Original residents expressed contrasting views about how the development had impacted the esthetic and social value they perceived in the town's green areas. Some had adapted to the new environment and appreciated the transformation, valuing the structured and organized landscape over the previously wild, unmanaged environment, partly because it provided more people-friendly spaces for social events. However, some perceived a loss of social and cultural importance, particularly those with personal connections to the pre-urbanized landscape. For example, some villagers lamented the disappearance of spaces where they had engaged in activities such as 'fishing in local ponds'.

Perceived fairness among original residents and incomers

Our survey quantitatively examined fairness perceptions across resident groups. Of the 1,018 residents surveyed, 789 commented on economic fairness and 959 on ecological fairness. Differing response rates probably stemmed from factors such as limited literacy and the topic's sensitivity, which interviews revealed.

Of those commenting on economic fairness, 82.6% were positive about the fairness of the development, while of those commenting

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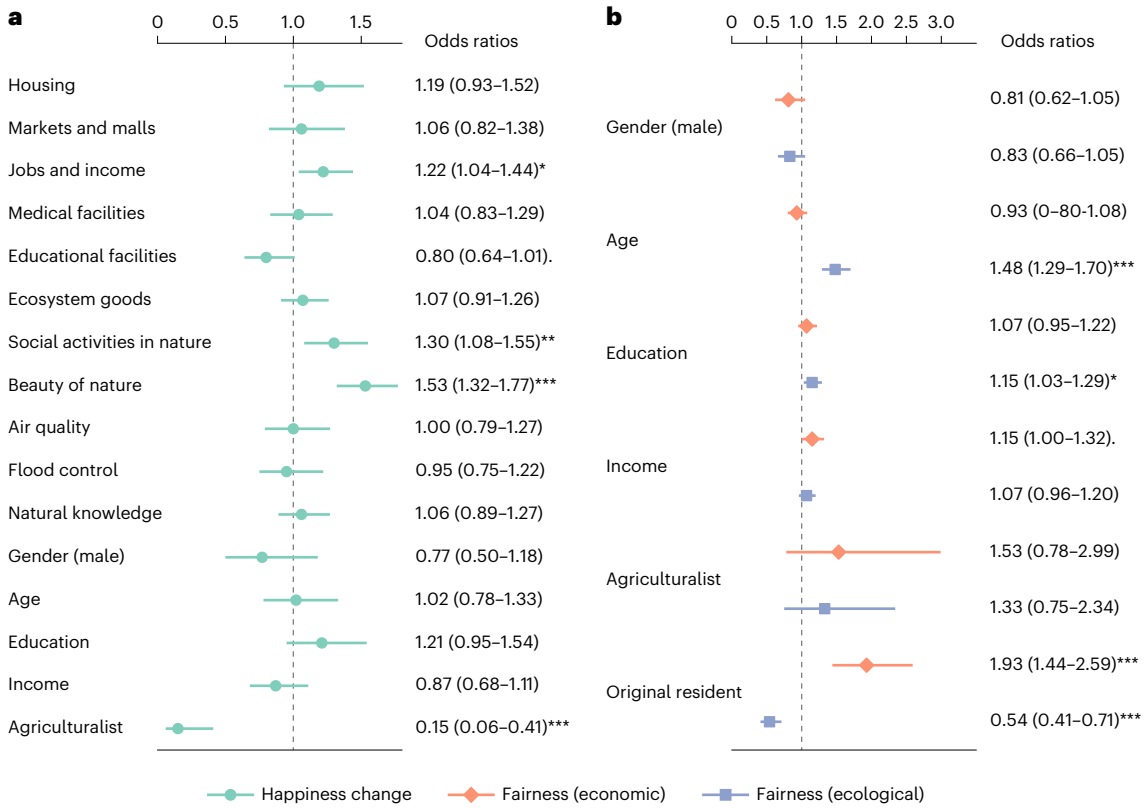

Fig. 3 | Ordinal logistic regression modeling results. Data are presented as odds ratios with 95% confidence intervals (error bars). All *P*-values are two sided, and no adjustments were made for multiple comparisons. Full model results for all predictors are provided in Supplementary Tables 3–5. **a**, Association between perceived changes in well-being elements and happiness among original residents ($N = 289$). Significant predictors include jobs and income ($\beta = 0.20$, $z = 2.45$, $P = 0.014$), social activities in nature ($\beta = 0.26$, $z = 2.82$, $P = 0.005$), beauty of nature ($\beta = 0.42$, $z = 5.61$, $P < 0.001$) and former agriculturalist status ($\beta = -1.87$, $z = -3.74$, $P < 0.001$). Educational facilities showed marginal significance ($\beta = -0.22$, $z = -1.89$, $P = 0.058$). **b**, Perceived fairness among original residents and newcomers. For economic fairness ($N = 789$), original residents perceived significantly greater fairness ($\beta = 0.66$, $z = 4.37$, $P < 0.001$), with income marginally significant ($\beta = 0.14$, $z = 1.91$, $P = 0.056$). For ecological fairness ($N = 959$), original residents perceived significantly lower fairness ($\beta = -0.62$, $z = -4.43$, $P < 0.001$), while older residents ($\beta = 0.39$, $z = 5.55$, $P < 0.001$) and more educated residents ($\beta = 0.14$, $z = 2.47$, $P = 0.013$) perceived greater fairness. Statistical tests were performed using ordinal logistic regression (clm function in R). Significance levels are denoted as: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$,. $p < 0.1$, ns $p > 0.05$.

on ecological aspects of fairness, 79.8% expressed positive views. The models in Fig. 3b demonstrated that original residents perceived ecological aspects as significantly less fair than newcomers (OR, 0.54; 95% CI, 0.41–0.71; $P < 0.001$), but economic aspects as fairer (OR, 1.93; 95% CI, 1.44–2.59; $P < 0.001$). Additionally, older residents (OR, 1.48; 95% CI, 1.29–1.70; $P < 0.001$) and more educated people (OR, 1.15; 95% CI, 1.03–1.29; $P = 0.013$) perceived the ecological aspects to be fairer.

Qualitative interviews provided depth and revealed the reference points and mechanisms underlying these patterns. Residents generally defined fairness as everyone in the town sharing both the rewards (for example, access to green spaces) and the responsibilities (for example, contributing to park changes).

Economically, the development was seen as enabling people from diverse socio-economic backgrounds to meet basic needs. Wealthier individuals, mostly newcomers, reported expanded opportunities to pursue their valued lifestyles. However, newcomers did not perceive greater economic fairness than original residents, as both groups used different reference points. Original residents often evaluated economic fairness by comparing current living conditions to their previous rural communities, frequently highlighting benefits such as 'nearby groceries and supermarkets', 'elevators' and 'heating systems in the flats'.

Notably, many original residents, though experiencing job insecurity, viewed the economic changes as promoting fairness. They believed these changes not only provided them with 'jobs like cleaners and security guards' that 'the town's wealthy newcomers wouldn't take', but also offered them and their descendants 'better schools and public services as urbanites', enabling upward mobility. However, newcomers, who had relocated from more developed, urban areas, evaluated economic fairness against a higher baseline of urban services and generally perceived fewer substantial improvements.

Stringent ecological requirements disproportionately affected original residents, who perceived the changes as less fair than newcomers. This divergence stemmed from contrasting reference points shaped by physical transformations and changing institutional frameworks. Many newcomers from Harbin's city center or other cities viewed Qunli's green spaces as fair interventions due to increased park density, making green areas 'more accessible to locals'. Many original residents, however, compared the present landscape to its earlier state, felt urban development had 'decreased their ability to explore green areas freely and spontaneously'. Institutional changes, such as new regulations restricting traditional practices such as harvesting wild products, further reinforced these differences. Some original residents viewed these changes as unfair, feeling that the loss of these cultural practices was inadequately compensated. Newcomers, disconnected from this historical relationship with the land, generally perceived these same regulations as fair.

Unequal access to and quality of on-site ecological compensation reinforced perceptions of ecological unfairness. Many nature-enhancement projects functioned as 'club goods'. For example, green spaces in some residential developments were fenced and restricted to their residents. This exclusivity was especially evident in developments

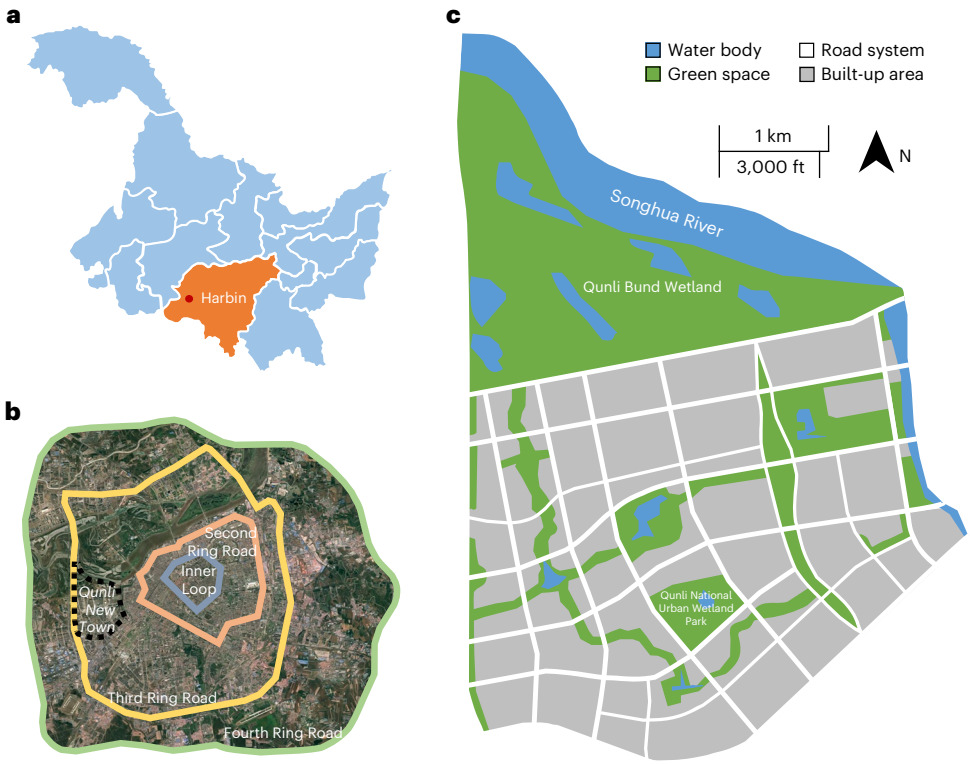

Fig. 4 | The location of and current land use in Qunli New Town, Harbin City, Heilongjiang Province, China. This study focuses on the eastern area of Qunli New Town (45° 44′ 19.7′ N 126° 33′ 01.9′ E), where development has been completed; the western expansion beyond the Third Ring Road had not yet undergone land acquisition or development during the research period. **a**, Location of Qunli within Heilongjiang Province. **b**, Location within Harbin City (black dashed line); ring roads are based on Harbin's latest arterial road network planning. **c**, 2023 land-use map of the eastern area, cross-checked with local planning authorities and validated through fieldwork. Boundaries follow the 12th Five-Year Development Plan of Qunli New Town and the Decision of the People's Government of Harbin on Strengthening the Development and Construction Management of Qunli New Town (East Area), which defines the area from Qunli Dike (Songhua River) in the north to Gongnong Avenue, Airport Expressway and Hashuang North Road in the south and from Hejiagou Stream in the east to the planned Third Ring Road in the west. Imagery in **b** from Google Maps © 2023; map in **c** adapted from OpenStreetMap under a CC BY-SA 2.0 license.

aimed at attracting newcomers from other parts of the city rather than accommodating original residents. Consequently, these new green spaces were typically of higher quality and better maintained in areas designated for newcomers, deepening the unfairness perceptions among original residents:

'The housing developments of [complex names] are well-known for their property prices and their green coverage… Compared to the resettlement site where I live now, it is much richer [in natural features]: more mature trees, colorful blossoms and small lakes… The green areas in my site have already been cleared by my neighbors to grow crops' (male, aged 61, former villager).

This crop growing exemplifies the bottom-up phenomenon of 'informal ruralization', which has been occurring across China[50], in this case is characterized by former agriculturalists resumed customary farming. They spontaneously ruralized their green spaces, where they 'removed the grass, turned the soil and sowed vegetable seeds'. Some sold their harvests for sustenance, while many primarily engaged in these practices to maintain their traditional way of life.

Perceived ecological fairness also varied according to socio-demographic characteristics. Many older interviewees perceived green spaces as fairer: interviews suggested that this was partly because they and their social group were able to visit more regularly and engage in activities such as exercising and socializing. Meanwhile, those with more formal education, mostly newcomers, perceived greater fairness. Interview accounts suggested one reason could be that they recognized the benefits these spaces offered not only to themselves, their families and friends but also to the wider community, including improved health and social opportunities.

Discussion

Well-being changes and associated factors

NIUD can be associated with reduced well-being among original residents across material, relational and subjective dimensions. A substantial proportion of original residents, particularly former agriculturalists, reported feeling less happy than before urbanization. Both qualitative accounts and regression results indicated that perceived changes in jobs and income, esthetic value and social activities in nature were the primary factors residents attributed to changes in happiness. These findings suggest that the well-being benefits associated with nature-based environments depend not solely on ecological enhancement, but on the preservation of socio-ecological access and livelihood continuity.

Conversely, the absence of association between increased happiness and other perceived improvements (for example, in housing and infrastructure) underscores the multi-dimensional and adaptive nature of well-being. Improvements in material conditions may be normalized over time, consistent with hedonic adaptation[51] and therefore exert limited influence on long-term happiness. Together, these findings suggest that future NIUDs should prioritize these well-being factors—for instance, through creating multifunctional green spaces that support social interaction and recreation, alongside mechanisms that sustain stable and meaningful employment.

Divergent fairness perceptions

A fairness perspective revealed a critical divergence: original residents perceived economic changes as fairer but ecological changes as less fair than newcomers did. This pattern aligns with prospect theory,

specifically reference dependence, whereby individuals evaluate gains and losses relative to prior reference points[44,52–54]. Original residents referenced their rural past, weighing limited prior economic resources against state-provided improvements in housing and infrastructure. Many therefore perceived the economic transformation as fair, viewing these gains as enabling intergenerational mobility even amid job insecurity. This finding contrasts with typical global north gentrification, where a lack of public investment often makes rising costs punitive for existing residents[20,55,56]. It suggests that in certain developmental contexts, state-mediated provision of basic infrastructure can create a sense of opportunity that partially offsets immediate grievances, a critical nuance for gentrification theory.

The comparatively low ecological fairness perceived by original residents appears linked to losing culturally important ecosystem services through two interconnected mechanisms identified qualitatively: the physical enclosure of formerly accessible landscapes into exclusive 'club goods' and institutional shifts that restricted previously permitted practices without offering alternatives. This was experienced as prompting 'informal ruralization'[50], a form of cultural displacement where residents recreated agricultural plots, reflecting psychological impacts that extend beyond economic metrics. These findings suggest that pursuing biodiversity NNL/NG or broader nature-positive objectives can require not only creating ecologically beneficial space, but also ensuring its governance and design respect diverse cultural relationships with nature[22,23].

Contextualizing ecological and social outcomes

Situating Qunli within the planning debate on greenfield versus brownfield development reveals a critical nuance. Whereas brownfield development is typically ecologically preferred[57–59], Qunli represents a rare counterexample: this primarily greenfield project achieved reported ecological recovery and biodiversity increases through extensive restoration[44]. This outcome may depend on specific contextual factors: a baseline of degraded ecosystems with substantial potential for ecological uplift[44] and strong institutional capacity to implement and enforce ambitious mitigation measures[60]. Thus, while greenfield expansion generally poses a grave threat to nature[3,61], this case illustrates that ecological outcomes are not predetermined but can depend on site conditions and governance capacity.

The same contextual conditions that enabled ecological improvements appear to have shaped residents' social experiences in uneven ways. The degraded landscape created scope for measurable ecological restoration, yet that restoration was experienced by some farmers as restricting traditional practices. Strong institutional capacity facilitated both ecological enforcement and social compensation. In this case, the conditions associated with ecological gains were also linked to social trade-offs for certain groups, illustrating how ecologically successful NIUD can coincide with uneven social outcomes.

Implications for nature-inclusive urban development

The pronounced differences in perceived well-being and fairness between waves of settlers carry implications for NIUD practice. If social impact assessments are to meaningfully address these divides, they should differentiate between settler waves alongside conventional categories[29]. Besides, planning processes should also actively minimize inter-group inequalities by avoiding exclusive designs and adopting flexible governance that respects historical relationships with land. This suggests ensuring green spaces function effectively as public goods rather than 'club goods' that exacerbate divisions. It also means involving original communities in co-designing green spaces to reflect the diverse ways nature is valued—for instance, through multifunctional areas that support recreation, nature recovery and culturally valued practices. Realizing these priorities is likely to require dedicated funding and institutional support for social safeguards. Without such resources, similar dynamics may emerge in comparable contexts, potentially undermining social equity and the long-term legitimacy of conservation initiatives.

Contributions to theory and policy

This study contributes to gentrification theory by showing how reference points, state-led provisioning and socio-ecological displacement shape fairness and well-being perceptions in ways distinct from market-driven processes documented primarily in the global north[16,18]. By distinguishing between fairness judgments, shaped by structural positions, and happiness, grounded in lived experiences, it offers a more nuanced framework for assessing the social impacts of urban transformation.

Our findings also speak directly to global policy frameworks such as the Global Biodiversity Framework. They underscore that ecological gains alone may not ensure social equity. If NIUD is to contribute to sustainable and just cities, social safeguards should be embedded from the outset with the same rigor and resourcing as ecological mitigation. Addressing potential tension between new green infrastructure and the loss of cultural landscapes is essential if justice across different waves of settlement is to be achieved.

Methods

Study design and data collection

Our study focuses on Qunli New Town, a large-scale, nature-inclusive urban development on the western outskirts of Harbin, China[62,63] (Fig. 4). The town's current population of ~140,000 is lower than the projected 322,000 it was designed to support. This phenomenon is observed in many of China's new towns, often attributed to over-ambitious planning, a supply–demand mismatch in real estate and limited economic opportunities[64].

We employed a sequential mixed-methods approach consisting of two stages: an initial exploratory qualitative phase followed by a quantitative phase involving a population-based survey. This design allowed for an in-depth understanding of local well-being impacts to be derived from the qualitative data, which then directly informed the design of the quantitative survey to test emergent hypotheses across a representative sample.

Qualitative data collection and analysis. We carried out semi-structured interviews following a semi-randomized street-by-street sampling within the study area[65,66]. Data were collected from all main roads, including all natural parks and from the west and south edges of the town where original residents had been relocated. S.G. resided in the town from November 2022 to May 2023 and from August to September 2023, facilitating extensive field observations and informal conversations that built foundational contextual knowledge.

Participants were approached in public areas. We aimed for data saturation[67–73] defined as the point where new interviews ceased to provide new understanding of the well-being impacts of local economic development and ecological mitigation activities and where responses adequately covered the main dimensions of well-being (material, relational, subjective)[33–35,74–79]. In total, 42 interviews were conducted, lasting between 25 minutes and 1.5 hours. The respondent demographics reflected the age and sex composition of Harbin's most recent (2020) census. All interviews were conducted in the local language and dialect, transcribed verbatim and translated into English. Translation accuracy was verified through back-translation with the assistance of local assistants[80,81].

A thematic analysis was performed using the six-phase guide by Braun and Clarke[82]. The coding process was deductive, guided by the pre-established multi-dimensional well-being framework (material, relational, subjective)[33–35,74–79]. The process involved familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining themes and producing the report. Thematic coherence was ensured through iterative review and discussion among co-authors.

Quantitative survey design and administration. The questionnaire was designed based on key themes and insights derived from the qualitative interview analysis. This ensured the survey systematically captured how individuals engaged with local nature and experienced environmental changes. The questionnaire included a retrospective comparative component, asking participants to evaluate changes in well-being elements and overall happiness since before the urbanization, given the absence of baseline data.

To ensure clarity and reliability, the questionnaire was piloted with a small group of local residents ($n = 42$) before full deployment. Feedback from this pilot phase led to refinements in question wording and structure to enhance comprehensibility and relevance. The final survey was administered via Wenjuanxing (http://www.wjx.cn/), a widely used online survey platform in China that also provides survey distribution services[83–89]. A total of 1,326 responses were collected. Of these, 308 were removed due to incomplete answers to key questions or because respondents were not local residents, resulting in a final analytical sample of 1,018 respondents. The demographic profile of the final sample mirrored the age and sex distribution outlined in the city's most recent (2020) census.

Variable measurement and analytical approach

The survey used ordinal scales to capture perceptions. Evaluative elements included both positively and negatively worded items in an alternating pattern; negatively worded items were reverse coded for consistent analysis (Table 1 in main text provides full details).

We used ordinal logistic regression models to test our hypotheses, using the clm() function from the ordinal package in R version 4.3.1. Three primary models were specified: Model 1 analyzed the relationship between perceived changes in well-being elements (and socio-demographics) and the perceived change in happiness among original residents ($N = 289$). Model 2 analyzed the relationship between socio-demographic factors (including original resident status) and perceptions of economic fairness for the full sample of respondents who answered this question ($N = 789$). Model 3 analyzed the relationship between socio-demographic factors (including original resident status) and perceptions of ecological fairness for the full sample of respondents who answered this question ($N = 959$).

This study has several limitations. First, well-being and fairness were assessed using retrospective self-reported comparisons in the absence of baseline data—a common challenge in urban transformation research. This approach may be subject to recall bias and post-hoc rationalization (that is, interpreting past events in light of present circumstances). Nevertheless, residents' current perceptions—shaped by these very cognitive processes—are what inform their present-day well-being, fairness judgments and views on the legitimacy of urban transformation. Second, not all respondents answered the fairness questions, which may introduce non-response bias (that is, systematic differences between those who responded and those who did not). Third, although ordinal logistic regression was employed, results depend on model assumptions and may be sensitive to unobserved confounders.

Ethics statement

The qualitative and quantitative data in this study was collected with approval from the University of Oxford's Central University Research Ethics Committee (CUREC reference number R84176/RE001). All interviewees provided informed consent and were assured that interview data would remain confidential.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

To protect the confidentiality of local residents—especially original villagers and other potentially vulnerable groups—and in accordance with our ethics approval, fully identifiable data are not publicly available. To prevent potential re-identification given the small population of original residents in Qunli, access to anonymized excerpts of qualitative themes and the anonymized survey dataset is available from the corresponding author upon reasonable request.

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Acknowledgements

We thank all the residents of Qunli New Town who participated in the interviews and survey for their time and invaluable insights. We are grateful to the local research assistants who facilitated fieldwork and provided translation support. We thank N. Seddon, J. Montana, M. Grace, O. Lewis, S. Papworth and J. Baker for their support during the initial screening and/or review of the research. S.G. acknowledges research support from St Hilda's College, University of Oxford, and the China Scholarship Council. This work was also supported by the National Natural Science Foundation of China (grants nos. 72293573, 72025402, 72440005 and 524B2110).

Author contributions

S.G. conceptualized the study with E.J.M.-G., J.B. and S.O.S.E.z.E. S.G. conducted the data collection and analysis with assistance from

W.Z. and T.P. and wrote the manuscript. All authors reviewed the manuscript and approved the final version.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s44284-026-00425-z.

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Peer review information *Nature Cities* thanks Claudia de Luca and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.

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Last updated by author(s): Feb 24, 2026

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Software and code

Policy information about availability of computer code

Data collection	Wenjuanxing (http://www.wjx.cn/), an online survey platform in China.
Data analysis	R version 4.3.1 was used for all statistical analyses. The ordinal package (clm function) was used for ordinal logistic regression models. Qualitative data analysis was performed using NVivo 14.

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To protect the confidentiality of local residents—especially original villagers and other potentially vulnerable groups—and in accordance with our ethics approval, fully identifiable data are not publicly available. To prevent potential re-identification given the small population of original residents in Qunli, access to anonymized excerpts of qualitative themes and the anonymized survey dataset is available from the corresponding author upon reasonable request.

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Reporting on sex and gender	Demographic information on gender was collected via self-report in the survey questionnaire. Participants were provided with response options including male, female, other, and prefer not to say. Due to the very limited number of respondents selecting "other" or "prefer not to say" (N=4), these responses were excluded from statistical modelling to ensure model stability, but they are included in descriptive summaries where appropriate.
Reporting on race, ethnicity, or other socially relevant groupings	Socio-economic status was captured through multiple variables including education, income, and occupation. These variables were included as covariates in all regression models to control for confounding, as they are known to influence well-being and fairness perceptions.
Population characteristics	The study included 1,018 residents of Qunli New Town, Harbin, China. The sample included both original residents and newcomers, with demographic characteristics reflecting the age and sex distribution of Harbin's 2020 census.
Recruitment	Participants for qualitative interviews (N=42) were recruited through semi-randomized street-by-street sampling within the study area. Survey participants (N=1,018) were recruited through Wenjuanxing, an online survey platform in China.
Ethics oversight	The study was approved by the University of Oxford's Central University Research Ethics Committee (CUREC reference number R84176/RE001). All participants provided informed consent.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

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Study description	Sequential mixed-methods design with two phases: (1) exploratory qualitative interviews (N=42), (2) representative quantitative survey (N=1,018).
Research sample	The study sample comprised 1,018 residents of Qunli New Town, Harbin, China, including both original residents and newcomers. Original residents were defined as individuals who lived in the area prior to urbanisation; newcomers arrived after development. The sample included former agriculturists and non-agriculturists. Demographic characteristics (age, gender, education, income) reflected the age and sex distribution of Harbin's most recent (2020) census, ensuring representativeness of the local population. The qualitative sample (N=42) included residents from all main roads, natural parks, and resettlement areas, capturing diverse experiences of the urban transformation. This study site was chosen because Qunli represents a prominent example of nature-inclusive urban development with documented ecological gains, offering a unique opportunity to assess social equity outcomes alongside ecological success.
Sampling strategy	Semi-structured interviews were conducted following a semi-randomised street-by-street sampling approach within the study area. Data were collected from all main roads, including all natural parks, and from the west and south edges of the town where original residents had been relocated. Sampling continued until data saturation was reached—defined as the point where new interviews ceased to provide new understanding of the well-being impacts of local economic development and ecological mitigation activities, and where responses adequately covered the main dimensions of well-being (material, relational, subjective). A representative survey was administered via Wenjuanxing. The target sample size (N=1,000+) was chosen to ensure sufficient statistical power for subgroup analyses (e.g., comparisons between original residents and newcomers, former agriculturists and non-agriculturists) and to enable ordinal logistic regression modelling with multiple covariates. A total of 1,326 responses were collected, of which 308 were removed due to incomplete answers or because respondents were not local residents, yielding a final analytical sample of 1,018 respondents.
Data collection	Qualitative interviews (25 minutes to 1.5 hours) were conducted in person by the first author (SG) between November 2022-May 2023 and August-September 2023. The quantitative survey was administered online via Wenjuanxing.
Timing	November 2022 – September 2023.
Data exclusions	A total of 1,326 survey responses were collected. Of these, 308 responses were excluded from the final analytical sample. Exclusion criteria were pre-established: responses were removed if they were incomplete on key questions (e.g., dependent variables or core demographic items) or if respondents indicated they were not local residents of Qunli New Town. These criteria ensured the integrity

of the dataset for subgroup analyses comparing original residents and newcomers. No data were excluded from the qualitative analysis.

Non-participation	For the qualitative phase, all approached individuals who agreed to participate completed the interview; no formal record was kept of individuals who declined, as recruitment occurred in public spaces. For the quantitative phase, the survey was distributed via Wenjuanxing, which does not track invitation response rates. Of 1,326 individuals who initiated the survey, 308 did not complete it fully or were ineligible. No participants formally dropped out after completing the survey.
Randomization	This was an observational study; participants were not allocated to experimental groups. Comparisons were made between naturally occurring groups defined by resident status and prior occupation. Covariates including age, gender, education, and income were controlled for statistically in ordinal logistic regression models to account for potential confounding.

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