

Article

Exploring the Nexus between Green Space Availability, Connection with Nature, and Pro-Environmental Behavior in the Urban Landscape

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Abstract: The correlation between connecting with nature and fostering pro-environmental behavior is essential to attaining sustainability targets. However, understanding how this connection is cultivated, particularly in the urban settings of the Global South, remains limited. This study delves into the impact of urban green space (UGS) availability on perceived connection with nature (CN) and its subsequent influence on pro-environmental behavior (PEB) among urban residents, focusing on Nagpur city. Employing a digital survey tool, data were collected from 2414 participants across ten administrative zones. Descriptive and exploratory analyses alongside multinomial logistic regression were conducted to assess variable associations using R programming. The results revealed that 91% of respondents frequented UGSs, while a smaller fraction cited time constraints for not visiting. Notably, respondents' perceived CN demonstrated significant associations with both UGS availability and PEB. A regression analysis underscored stronger PEB among those reporting a deeper connection with nature. Furthermore, demographic factors such as gender, age, and education were linked to variations in PEB. This study advocates for leveraging UGSs to bolster CN and PEB among urban populations, emphasizing the pivotal role of urban planning in nurturing human–nature connections. Future research should explore specific nature contact modalities conducive to fostering connectedness, especially in rapidly urbanizing locales.

Keywords: connection with nature; urban green spaces; pro-environmental behavior; sustainability; urban



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1. Introduction

The connectedness to nature directly correlates with well-being, human health, and conservation efforts [1–3]. The significance of this connection is evident through an increasing focus of the literature on reconnecting people with nature for sustainability transformations [4,5]. Thus, fostering connections to nature has been identified as a pivotal point for sustainability [6,7]. Such connections are important in urban areas, as the global population resides in urban areas [8]. According to the UN projection, the percentage of the global urban population is expected to rise to 66% by 2050 [9], highlighting the importance of nature in urban areas for reconnecting people with nature through urban landscapes.

Integrating nature in urban environments strengthens the connection with nature for urban dwellers and provides daily opportunities for interaction and engagement with nature, in contrast to more distant nature experiences [10]. With urbanization on the rise and limited access to natural environments, urban green spaces (UGSs) play a significant role in fostering a connection with nature among urban populations [11,12]. As UGSs offer daily opportunities for people to interact with nature [13,14], they serve as vital components of urban planning to promote pro-environmental behavior and sustainability.

The concept of connection with nature (CN) holds the potential for re-establishing intimate relationships with the urban environment. Previous studies have demonstrated

that individuals' interactions with nature foster and fortify their bond with the natural world [15,16]. This forging of CN has the potential to drive significant societal shifts towards the care and preservation of nature [4]. Furthermore, recent research underscores the crucial role of engaging with nature in enhancing human health and well-being and motivating environmentally responsible behavior [17,18].

In exploring the correlations between nature connectedness and various modes of engagement with the natural world, Lumber et al. identified pathways such as contact, beauty, emotion, meaning, and compassion [19]. Additionally, a variety of scales have been developed to measure different facets of connectedness to nature, including the Connectedness to Nature Scale (CNS), Nature Relatedness Scale, and Nature Connection Index [18,20].

Despite significant progress in the research on connectedness to nature, fundamental questions remain regarding the mechanisms and pathways influencing various outcomes [12,21]. To address these challenges and opportunities, the literature explores various conceptual frameworks, including nature connectedness [20], nature relatedness [22], and human–nature connection [4,23,24].

Ives et al. categorized five dimensions of connectedness with nature along a spectrum of individuals' inner and outer worlds, encompassing "material, experiential, cognitive, emotional, and philosophical" aspects (2018). In a similar vein, other scholars have categorized connectedness with nature through three distinct relationships: intertwined, inclusive, and indistinguishable [25]. Schultz's "Inclusion with Nature in Self" scale, which features overlapping circles labeled "Self" and "Nature", has been instrumental in assessing biospheric attitudes, NEP scores, and self-reported behavior [26].

While these constructs exhibit nuanced differences, they collectively convey a subjective and enduring sense of interconnectedness between humans and the natural environment, encompassing cognitive, emotional, and behavioral dimensions [27]. In this study, we adopt the term connection with nature (CN) and utilize Schultz's Inclusion with Nature in Self (INS) scale [26]. The Inclusion of Nature in Self (INS) scale primarily targets the cognitive dimension, assessing the degree to which individuals integrate knowledge about the natural world into their self-concept [26,28].

Engagement in environmental activities, a key component of environmental education [29], is instrumental in mobilizing individuals towards actions beneficial to the environment. Volunteering in specific natural settings facilitates direct engagement and fosters pro-environmental behaviors. Such involvement cultivates a sense of connection between individuals and their environment [30,31], thereby nurturing civic responsibility for environmental stewardship [32].

While this engagement yields positive outcomes by fostering pro-environmental behaviors, it also enhances individuals' understanding of natural systems, thereby influencing their environmental conduct [33,34]. The research underscores the correlation between feeling connected to nature and exhibiting environmentally responsible behavior [18], with scholars such as Schultz [26] and Zylstra et al. [21] highlighting its pivotal role. Additionally, a robust connection to nature has been linked to diverse pro-environmental activities [35,36], underscoring its significance in driving environmental engagement. However, despite the documented benefits of engaging in pro-environmental activities and cultivating a strong connection to nature, a notable gap exists in understanding how these relationships translate into sustained pro-environmental action.

The escalating global urbanization and a burgeoning urban population place significant pressure on UGSs. These spaces serve as the primary conduit for urban dwellers to connect with nature, offering crucial opportunities to foster relationships with the natural environment. Interactions with urban nature, ranging from passive strolls to active engagement, yield diverse benefits. Studies have underscored the substantial contribution of UGSs to overall health and well-being, encompassing physical, emotional, and mental aspects [37–39]. Recognizing their pivotal role, the World Health Organization (WHO) deems UGSs essential for fostering healthy, sustainable, and livable urban environments [40].

Despite their importance, it remains unclear which specific types of natural settings within urban areas enhance connections with nature and how this influences pro-environmental behavior. CN demonstrates a positive correlation with individuals' interactions with natural environments, with even brief exposure to nature evoking a sense of connection [41]. Against this backdrop, understanding the association between UGSs, CN, and pro-environmental behavior is imperative. This research aims to elucidate these relationships, supported by empirical evidence, to inform effective urban planning and environmental management strategies.

The primary aim of this study is to investigate the CN within urban landscapes, focusing on an urbanizing city in the Global South. Specifically, we examine a case study of an Indian city characterized by disparities in UGS provision. We aim to assess the relationship between UGS availability, CN, and engagement in environmental activities indicating pro-environmental behavior (PEB). To achieve this, we analyze UGS provision data and survey questionnaire responses to understand how urban dwellers perceive their connection with nature in cities, the influence of UGS availability on these perceptions, and the relationship between perceived CN and PEB.

This paper aims to address three main objectives:

1. To explore the impact of UGS availability on different levels of perceived CN.
2. To understand the association between perceived CN and engagement in environmental activities, reflecting PEB.
3. To investigate the relationships between demographic factors such as gender, age, education, and work status on EB.

This research is exploratory and contributes to the existing literature by focusing on urban landscapes in the Global South, where challenges related to urbanization and environmental degradation are pronounced. By shedding light on the associations between UGSs, CN, and EB, this study aims to provide insights that can inform urban planning and environmental management strategies in similar contexts.

The rest of the paper is structured as follows: The Section 2 outlines the methods, including the study area, survey method, data collection, measurement scales, and statistical analysis. In the Section 3, we present the results regarding the association between UGSs, CN, and EB. The Section 4 provides a discussion of the findings. Finally, in the last section, we draw conclusions based on this study's results.

2. Methods

2.1. Study Area

For this study, we have considered the case of Nagpur City. Situated in central India, the city is classified as a tier II city with a population of 2.4 million and a land coverage of roughly 218 km². Administrative divisions within Nagpur are structured into ten zones, amalgamating 136 electoral wards under the Nagpur Municipal Corporation (NMC). The city was once known for its greenery, but it is now grappling with substantial loss and degradation of its natural greenery, marking a notable shift in its urban landscape [42,43]. The city's landscape features natural and artificial lakes, the Nag and Pili River basins, urban forests, institutional greens, parks and gardens, playgrounds, greenery along roadways, and others. However, the existing public UGSs exhibit disparities in their provisions [44,45]. As identified by Lahoti et al., at the city scale, the per-capita public UGS stands at 3.65 m², which is quite below the WHO-recommended UGS provision standards, and this distribution varies significantly across the ten administrative zones [45]. Furthermore, the variation in proximity and service area coverage among the ten administrative zones is significantly high [45]. Accordingly, we divided the city's administrative zones into three categories based on UGS availability, as shown in Figure 1, for use in this study.

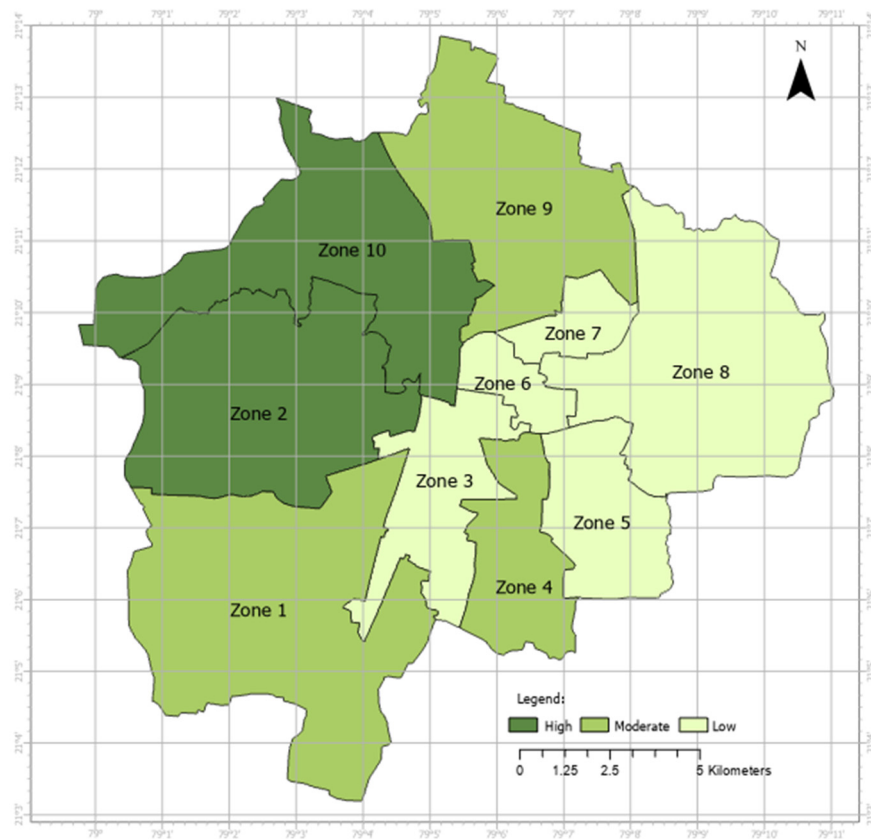


Figure 1. Map showing the ten administrative zones of Nagpur city with the demarcation of available UGSs among the zones as high, moderate, and low based on per capita public UGS in the zones [45].

2.2. Data Collection

For data collection, we conducted a face-to-face questionnaire survey with urban dwellers to ascertain their interaction and connection with urban nature and participation in environmental activities in Nagpur. Data collection was facilitated by a digital-based questionnaire administered through the Survey 123 field app (3.19.114). This enabled the capture of the respondents' residence location within the ten administrative zones. The respondents in the survey specified the UGS they visit and interact with, their perceived CN, and their participation in environmental activities. In this study, we mainly focused on (1) questions pertaining to interaction with UGSs, in terms of whether respondents visit UGSs or not, and if not, what the reasons are; (2) questions enquiring about respondents' relationship with urban nature; (3) a question to gauge respondent participation in pro-environmental activities; and (4) demographic-related questions including gender, age, household location, education, and work status.

Sixteen trained research assistants were surveyed in January 2024 using an electronic survey form to enhance the speed and scalability of the survey. The Survey123 field app offered features such as local language settings (English, Hindi, and Marathi) and geo-tagging. Soft data delineating administrative zones and public UGSs with the Google Maps interface were derived from previous fieldwork [45,46]. Respondents used the Google Maps interface to pinpoint their household location, which was then translated into the administrative zone. The questionnaire allowed participants to opt-out to maintain anonymity and confidentiality. The target population was respondents aged above 18.

2.3. Measures and Data Variables

UGS availability was categorized as high, moderate, and low (Table 1 and Figure 1). This categorization was based on per-capita UGS availability in each administrative zone, as detailed in a previous study by Lahoti et al. [45]. Although the focus in the current

study was the ten administrative zones within the city boundaries, some respondents from the periphery participated in the survey. Hence, their household locations are considered peri-urban.

Table 1. Categories used in the survey and data analysis for UGS availability.

Variable	Category	Administrative Zones Included	UGS Availability in Terms of per Capita	Source
UGS availability	High	Zone: 2, 10, and those in peri-urban areas	Above 6.5 m ²	Based on the output of previous research; for details, refer to Lahoti et al., [45]
	Moderate	Zone: 1, 9, 3	1.5–6.5 m ²	
	Low	Zone: 4, 5, 6, 7, 8	Below 1.5 m ²	

In our study, we utilized self-reported measures to assess both CN and EB. For CN, we employed a visual representation in the questionnaire, adapted from Schultz’s “Inclusion with Nature in Self” scale. This construct aims to gauge individuals’ perceptions of their relationship with nature by presenting two circles, one green representing nature and the other white representing the respondent. The participants were asked to choose from five options what best described their relationship with nature based on the proximity of the circles, which were subsequently used as terms in data analysis.

Self-reporting is a commonly used method for assessing pro-environmental behavior [47], valued for its cost-effectiveness, ease of administration, and flexibility [48]. Researchers often rely on self-report measures to determine the frequency of engagement in various pro-environmental behaviors [49]. In our study, EB was evaluated through a straightforward categorical question with response options of yes or no. While our survey covered multiple aspects of pro-environmental behavior, this study focuses on this measure.

In addition to measuring CN and PEB, demographic information, including gender, age, education, and work status, was also collected through the questionnaire. Participants were asked to provide their demographic details, and the categories for each demographic variable are listed below (Table 2). This information will be used to explore potential associations between demographic factors and PEB in our analysis.

Table 2. Categories used in the survey and data analysis for variables in CN, engagement in EA, and demographics.

Variable	Question	Category
Connection with nature (CN)		1—Separate
		2—Somehow connected
		3—Connected
		4—Close connection
		5—Human and nature are inseparable
Engagement with EA	Have you participated in environmental activities?	Yes/no
Demographic	Gender	Male, female
	Age	18–29, 30–39, 40–49, 50–59, over 60
	Education	Professional degree, graduate, diploma, high school, middle school, primary school, illiterate
	Work status	Working, studying, retired, unemployed

2.4. Statistical Analysis

We ran descriptive and exploratory statistics to provide an overview of the data. Spatial data processing was carried out using ArcGIS Pro 2.8, while R 4.3.2 was utilized for other analytical tasks. Descriptive statistics were used to identify the characteristics of the surveyed population, such as demographics and reasons for non-visitation to UGSs. An

exploratory analysis using chi-square tests and mosaic plots was carried out to examine relationships between variables, such as gender, work status, and reasons for non-visitation. A chi-square test explored the association between the respondent's perceived CN and UGS availability. Further analysis was warranted as the p -value was low, indicating a significant association.

Subsequently, multinomial logistic regression analysis was conducted to investigate the correlation between these variables. The analysis utilized the perceived CN variable as the outcome variable, with UGS availability as the predictor variable. Standard procedures for multinomial logistic regression were followed, with coefficients and standard errors calculated to assess the impact of UGS availability levels on perceived CN. The intercept coefficient represented the baseline comparison for the "separate" and "high" variable categories. Additionally, odds ratios were computed to quantify the likelihood of perceiving the CN categories compared to the reference category, providing insights into the strength and direction of these associations. Another multinomial logistic regression analysis was conducted to further explore the correlation between respondents' perceived CN and their engagement in environmental activities (EA). In this analysis, perceived CN categories were the outcome variable, while engagement in EA was the predictor variable. Coefficients (Coef.) and standard errors (SE) were calculated to assess the impact of engagement in EA on perceived CN.

A logistic regression analysis was performed to investigate the relationship between demographic variables and respondents' engagement in EA. Categorical variables, including gender, age, education, and work status, were coded as factors, and a binary logistic regression model was fitted using the generalized linear model function in R 4.3.2.

3. Results

3.1. Respondent Demographic Characteristics

In total, 2414 individuals responded to the survey, and 91% interacted with UGSs by visiting them, while 9% indicated no visits at all. The reasons cited for not visiting UGSs include "Do not have time" as the most prevalent (55%); other reasons included "Access" (14%), "Do not like" (13%), "No need" (11%), "Not safe" (2%), and "Others" (5%). Regarding gender distribution among the "No visitation" respondents, 60% were female, while 40% were male. Regarding work status, 61% of respondents reported being employed, while 31% were unemployed. Economic class distribution revealed a diverse sample, with the largest proportion of non-visiting respondents belonging to the "Lower middle" class (43%), followed by "Upper middle" (20%) and "Lower" (20%) classes. The chi-square tests did not reveal any significant correlations among the variables studied. However, the mosaic plot (Figure 2a) depicts gender against reasons for not visiting UGSs, and work status displayed some notable relationships (Figure 2b). Notably, males who do not visit UGSs often cite a lack of time due to their employment status. Intriguingly, there seems to be no discernible link between the availability of UGSs and non-visitors, as the frequency of non-visitors remains steady regardless of the level of UGS availability.

The average age of the respondents who visited UGSs ($N = 2193$) was 45.51 years, and the sample had a higher share of male respondents (Table 3). Among the respondents visiting UGSs, 65% were male, while 35% were female. A significant portion of the sample, 55%, reported being employed, with another 17% retired or unemployed and 11% currently studying.

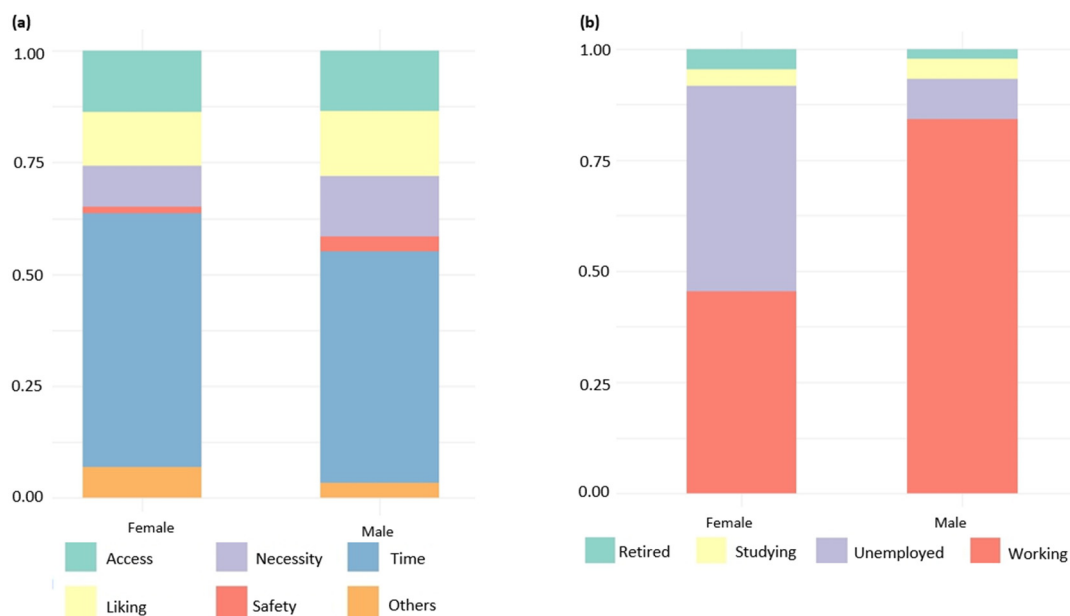


Figure 2. Demographic characteristics of respondents who visit UGSs. (a) Gender against reasons for not visiting UGSs. (b) Gender against work status.

Table 3. Demographic characteristics of respondents who visit UGSs.

	N	%
Gender		
Male	1420	65%
Female	773	35%
Age Group		
18–29	382	17%
30–39	359	16%
40–49	526	24%
50–59	416	19%
Over 60	465	21%
Education		
Professional degree	347	16%
Graduate	1015	46%
Diploma	218	10%
High school	394	18%
Middle school	105	5%
Primary school	63	3%
Illiterate	51	2%
Work status		
Working	1207	55%
Studying	232	11%
Retired	378	17%
Unemployed	376	17%

3.2. Connection with Nature against UGS Availability

The chi-square test revealed a significant association ($X^2 = 81.374$, $df = 6$, $p < 0.001$) between respondent's perceived CN and UGS availability, indicating a strong relationship between these variables. The logistic regression analysis revealed significant associations between respondents' perceived CN and the availability of UGS. Higher perceived CN scores, ranging from "Somehow connected" to "Human and nature are same", were positively associated with increased coefficients for UGS availability (Table 4). Specifically, those who perceived themselves as "Connected" had the highest coefficient of 2.17, followed by "Close connection" (2.27), "Human and nature are same" (1.93), and "Somehow connected" (1.70), all indicating positive relationships. Corresponding odds ratios were 5.47, 8.73, 9.7, and 6.9, respectively. These results with positive coefficients and odds ratios indicate that with increased UGS availability, respondents tend to report stronger CN. This suggests that the availability of UGS contributes to stronger CN.

Table 4. Correlation between respondents perceived CN against available UGSs based on multinomial logistic regression analysis (Coefficient: Coef., Standard Error: SE, Intercept: Int, UGS_moderate: UGS_mod).

Perceived CN	Coef. (Int)	Coef. (UGS_low)	Coef. (UGS_mod)	SE (Int)	SE (UGS_low)	SE (UGS_mod)	Odds Ratio
Somehow connected	1.699	−0.101	−0.639	0.199	0.275	0.302	5.467
Connected	2.167	−0.422	−0.646	0.193	0.270	0.290	8.733
Close connection	2.272	−0.208	−0.487	0.192	0.266	0.286	9.700
Humans and nature are the same	1.931	−0.493	−0.807	0.195	0.275	0.299	6.900

3.3. Connection with Nature and Engagement in Environmental Activities

Based on the strong association found between respondents' perceived CN and their engagement in EA, as evidenced by the Pearson's chi-square test ($X^2 = 81.374$, $df = 6$, $p < 0.001$), the multinomial logistic regression analysis was performed, which further confirmed a strong correlation between these variables (as in Table 5). The results showed higher coefficients for respondents who reported being more connected to nature, with "Close connection" having the highest coefficient (1.621), followed by "Connected" (1.525), "Somehow connected" (1.246), and "Human and nature are same" (0.889). These findings suggest that respondents with stronger perceived CN are more likely to engage in EA.

Table 5. Correlation between respondents' perceived CN against engagement in EA based on multinomial logistic regression analysis (Coefficient: Coef., Standard Error: SE, Intercept: Int).

Perceived Nature Connection (CN)	Coef. (Int)	Coef. (EEA_yes)	SE (Int)	SE (EEA_yes)	Odds Ratio
Somehow connected	1.246	0.792	1.592	0.266	3.488
Connected	1.525	0.952	0.135	0.260	4.593
Close connection	1.621	1.193	0.134	0.257	5.058
Human and nature are the same	0.889	1.592	0.145	0.265	2.945

3.4. Factors Influencing Engagement in Environmental Activities (EA)

The chi-square test results unveiled significant associations between gender and age ($X^2 = 13.7$, $p = 0.008$), gender and education ($X^2 = 81.4$, $p < 0.001$), and age and education ($X^2 = 174.1$, $p < 0.001$). Moreover, significant associations were observed between gender

and work status (chi-square = 531.0, $df = 3$, $p < 2.2 \times 10^{-16}$). These findings underscore the interdependence of gender, age, education, and work status in our dataset, suggesting uncovering the correlation between the demographic and engagement of respondents in EA. Hence, logistic regression analysis was employed to investigate the relationships between gender, age, education, work, and respondents' engagement in EA. As shown in Table 6, the results unveiled significant associations between gender and engagement in EA ($p < 0.001$). Specifically, males exhibited higher odds of engaging in EA than females (OR = 1.54). Age groups 30–39 and 50–59 were also significantly associated with EA ($p = 0.001$), indicating increased odds relative to the reference group (40–49). Moreover, various education levels demonstrated significant associations with engagement in EA ($p < 0.001$). Respondents with a high school education (OR = 0.63) and a professional degree (OR = 1.74) exhibited lower odds than their respective reference categories. Furthermore, investigating the impact of work status on engagement in EA revealed intriguing insights. The unemployed level displayed a coefficient of -0.869 , which is statistically significant, with a very low p -value (1.9×10^{-05}), suggesting a strong negative effect compared to the reference level. Conversely, for the working level, the coefficient was 0.161, indicating a positive effect relative to the other reference level. However, the evidence was insufficient to conclude whether the odds of engagement in EA were higher or lower for working respondents compared to the reference category.

Table 6. Logistic regression analysis between demographic variables against respondents' engagement in environmental activities.

	Predictor Variable	Coefficient	Std. Error	z-Value	p-Value	Odds Ratio (95% CI)
	(Intercept)	−0.374	0.125	−2.993	0.003 **	
Gender	Male	0.431	0.094	4.587	<0.001 ***	1.540
Age	30–39	0.268	0.151	1.777	0.076	
	40–49	0.045	0.139	0.325	0.746	
	50–59	0.475	0.145	3.279	0.001 **	
	Over 60	−0.018	0.145	−0.127	0.899	
Education	High school	−0.466	0.125	−3.725	<0.001 ***	0.630
	Illiterate	−0.939	0.327	−2.876	0.004 **	
	Middle school	−0.328	0.214	−1.530	0.126	
	Primary school	−0.479	0.269	−1.776	0.076	
	Professional	0.555	0.131	4.221	<0.001 ***	1.740
Work status	Vocational/Diploma	−0.337	0.152	−2.211	0.0270 *	0.710
	Studying	−0.161	0.260	−0.618	0.536	
	Unemployed	−0.869	0.203	−4.276	<0.001 ***	0.455
	Working	0.161	0.173	0.928	0.353	

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

4. Discussion

4.1. UGSs' Role in Enhancing Perceived CN

The results indicate a significant association between respondents' perceived CN and the availability of UGSs, highlighting a robust relationship. Specifically, the individuals in administrative zones with higher UGS provisions demonstrate a stronger perceived connection with nature. This underscores the importance of local planning agencies prioritizing the provision of UGSs, as being close to UGS leads to ease of experiencing nature and valuing nature as an integral part of everyday life. Numerous studies have demonstrated that exposure to nature, particularly in urban settings, can enhance individuals' sense of connection with nature [50]. Moreover, studies suggest that proximity to green spaces is vital in facilitating daily experiences and interactions with nature, which can promote emotional attachment to nature [10,14,50]. Sheffield and colleagues emphasize the importance of enhancing nature connectedness through simple activities and practices facilitated by the

availability and accessibility of nature-rich spaces within the city [51]. Regular engagement in such activities is emphasized to nurture nature connections, suggesting a potential role for UGSs in thoughtfully crafted interventions to evoke individuals' connection with nature. Research on Attention Restoration Theory (ART) posits that the natural environment supports recovery from mental fatigue by providing restorative experiences [52]. Similarly, a review by Hartig et al. [53] emphasizes that exposure to nature reduces stress. These theories underline the importance of immersive nature experiences in fostering a deeper connection to nature. Furthermore, the Biophilia Hypothesis, which asserts that humans have an innate affinity for nature, offers a foundational framework for understanding why and how UGSs contribute to stronger CN [14].

Additionally, the nature immersion experience varies significantly among different UGSs due to their diverse structural, ecological, and biophysical characteristics, which in turn can foster stronger connections to nature [54]. Thus, efforts to enhance contact with and connection to nature are likely necessary, as highlighted by Martin et al. [55]. Furthermore, as Dasgupta et al. suggest, parks should incorporate greater landscape diversity, including varied vegetation and water features, to enhance nature experiences [56]. Zhang et al. [57] argued that increasing visit frequency helps build and maintain social relations, contributing to the attachment to green spaces. Additionally, Raymond et al. [58] identified nature-bonding as a dependent variable influenced by the time spent engaging with nature. Moreover, qualitative aspects of nature are believed to significantly enhance connection, as Samus et al. suggested [59]. Studies also indicate that the duration of exposure to nature during childhood and adulthood is thought to strengthen one's connection to nature [12,60].

4.2. Connection to Nature and Its Association with Pro-Environmental Behavior

Our research indicates that individuals with a strong connection to nature tend to engage more in environmentally conscious activities. The finding resonates with other studies, such as those by Lovati et al. [61], Zelenski et al. [62], and Barbaro and Pickett [63]. While there is general agreement among scholars about the positive correlation between nature connection and pro-environmental behavior, some studies report variations in the strength of this association, with few showing negative or non-significant correlations [64]. Overall, the evidence for a correlation between these variables is compelling [35], emphasizing the importance of nurturing a deeper connection between urban dwellers and UGSs to encourage pro-environmental behaviors. The Theory of Planned Behavior (TPB) explains how CN influences PEB by suggesting that attitudes, subjective norms, and perceived behavioral control shape intentions and behaviors [65]. In this context, CN acts as a key attitudinal component shaping environmental intentions and actions. The Value-Belief-Norm theory also posits that personal values influence beliefs and norms, driving pro-environmental behavior [66]. CN thus fosters ecological worldviews and personal norms toward environmental stewardship.

Furthermore, the existing literature indicates a close association between connection with nature and environmental concern, attitudes, and behaviors, which are critical determinants of pro-environmental behavior [67]. Moreover, a recent meta-analysis by Whitburn et al. [36] demonstrated a moderate, positive relationship between the human-nature connection and pro-environmental behavior, highlighting the significance of strengthening individuals' bonds with nature to foster environmentally responsible actions. Furthermore, the degree of connectedness moderated crucial associations between interactions with nature, well-being, and pro-environmental behaviors [55]. This body of research underscores the importance of recognizing and fostering a connection to nature to promote sustainable behaviors and attitudes toward the environment.

4.3. Influencing Demographic Factors of Pro-Environmental Behavior

The study findings reveal significant associations between demographic factors and EB, particularly noting gender disparities where men exhibit higher participation rates in environmental activities than women. However, studies in the UK reveal that older women

with higher education and frequent garden visits display more positive environmental attitudes [68]. Additionally, it is evidenced that females exhibit stronger environmental attitudes and place attachment compared to males, suggesting gender-based variations in environmental involvement [35]. Furthermore, our findings indicate a U-shaped curve in environmental engagement with age, with middle-aged individuals exhibiting lower rates. Conversely, middle-aged individuals with graduate degrees show higher rates of environmental involvement [32]. Differences between adolescents and adults also suggest age-related variations in environmental engagement [69]. In other studies, age also predicts how individuals engage with and perceive environmental issues [70]. These findings underscore the complex interplay between gender, education, age, and environmental engagement, highlighting the need to explore demographic influences further. Furthermore, higher levels of education are linked with increased environmental participation, indicating a positive correlation between education and environmental engagement. However, this finding contradicts other studies, such as those by Ma et al. [71], highlighting higher environmental knowledge does not always fully translate into environmental protection actions, and Osuntuyi & Lean [72], suggesting that education may not necessarily lead to pro-environmental actions. This implies that while education may provide knowledge, it does not necessarily translate into environmental engagement.

Conversely, unemployment demonstrates a strong negative effect on PEB, with unemployed individuals showing a reduced likelihood of engaging in environmental activities. However, employed individuals exhibit a potentially positive effect on environmental participation, suggesting the influence of employment status on engagement. Further research is warranted to explore the dynamics of employment status and its influence on environmental engagement, considering factors such as available leisure time, financial resources, and workplace sustainability initiatives. Social Cognitive Theory (SCT), for instance, emphasizes on observational learning, social experiences, and reciprocal determinism in shaping behaviors [73]. Demographic factors such as age, gender, and education influence the social and environmental contexts, affecting environmental attitudes and behaviors [74]. Additionally, environmental identity, reflecting how individuals perceive themselves in relation to nature, is shaped by these factors and significantly influences pro-environmental behavior [75].

These findings highlight the need for targeted interventions to address gender disparities, leverage educational opportunities, and consider age-related patterns to promote broader environmental engagement. Future research should delve deeper into the mechanisms underlying these associations, exploring psychological, social, and cultural factors that shape individuals' attitudes and behaviors towards the environment.

4.4. Implications, Limitations, and Future Research

Our research underscores the urgent importance of UGSs in leveraging connectedness with nature (CN) and pro-environmental behavior (PEB). We propose that UGSs represent a valuable resource for enhancing both aspects (CN and PEB) among urban dwellers, thereby highlighting the role of urban planning and design in reviving the human–nature connection through urban landscapes [76]. The local planning agencies must prioritize providing and preserving UGSs to facilitate easier access to nature experiences; further efforts should promote regular engagement with nature through simple activities and practices [77]. For instance, Lumber et al. have identified heightened contact with nature through sensory and emotional activities to be effective [19], highlighting the importance of the type of interaction as pathways to nature connectedness [78]. These types of interaction include participation in management activities [78], volunteer work in nature [79], and recognition of the educational value of natural environments [3]. Additionally, incorporating nature into urban environments and raising awareness about the natural world can enhance individuals' connection with nature and inspire environmentally responsible behaviors [1]. Strengthening individuals' perceived connection to nature through UGSs may cultivate greater environmental awareness and stewardship within communities [35].

By ensuring available and accessible nature-rich areas, cities can facilitate meaningful interactions with nature. This aligns with the urgency identified by Sheffield et al. [51], who advocate for initiatives that increase nature connectedness in urban areas where natural settings may be scarce. Additionally, it is crucial to acknowledge the variation in the nature immersion experience among different UGSs due to their diverse characteristics, suggesting parks and green spaces should be designed to incorporate greater landscape diversity, including varied vegetation and water features [56]. Our study also underscores demographic disparities in environmental engagement, indicating the need for targeted interventions focusing on educational opportunities and addressing gender- and age-related differences to boost participation in environmental activities.

Nonetheless, the empirical result from this study should be interpreted with some degree of prudence. Firstly, the cross-sectional study limits our ability to draw causal inferences, highlighting the need for longitudinal research to better establish causality between various variables. Secondly, while valuable, self-reported measures can be subjective and prone to bias; hence, triangulating these with other data sources to enhance the reliability of findings is recommended. Additionally, this study focuses on available UGSs as a proxy for natural contact due to its ease of measurement and data availability. However, using available UGSs as a quantitative measure of nature contact may be limited compared to other measures, such as distance to greenspace and qualitative assessments that consider duration and frequency of exposure, vegetation type, biodiversity, and interaction with UGSs. Beyond contact with nature, various other traits of nature connectedness need to be considered in future research. The existing method of measuring CN using a single graphical item format may restrict the comprehensive assessment of various other dimensions of nature connection, as outlined by other multi-item concepts [28]. Additionally, our study predominantly examines the individual advantages of nature connection, leaving room for further investigation of the broader social context of nature connection.

Future research should explore the specific types of nature contact that foster connectedness, especially in urbanizing cities. Identifying which activities in nature are most conducive to enhancing nature connectedness could significantly influence planning policies [80,81]. Moreover, it is crucial to investigate how individuals perceive, interact with, and respond to different natural environments [78,82]. As Sheffield et al. [51] suggest, further investigation into the varying effects of these interactions could provide insights into effective strategies for reconnecting people with nature. Additionally, exploring moderators such as socioeconomic status and cultural factors will deepen our understanding of how nature connection influences pro-environmental behavior. While our findings from Nagpur provide valuable insights into the importance of UGS provisions, caution should be exercised when generalizing these results to other contexts. Comparative studies in diverse urban environments are necessary to validate and extend the applicability of these findings across different settings.

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