

EVALUATING THE INFLUENCE OF PLANTING DENSITY ON USER PERCEIVED SAFETY AND NEGATIVE BEHAVIOURS IN URBAN PUBLIC SPACES: A CASE STUDY OF BEIRA LAKE, COLOMBO, SRILANKA

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Abstract: Urban public spaces in Colombo play a critical role in shaping social interaction, recreation, and the overall well-being of city dwellers, yet many of these spaces face persistent challenges related to safety and misuse. While landscape research has examined planting and perceived safety in residential areas, little literature addresses this link in urban parks. Beira Lake, a major urban space, is increasingly associated with safety concerns influenced by its vegetation patterns. This study evaluates the influence of planting density on user perceived safety and negative behaviors in Beira Lake (South-West), Colombo. A mixed-method approach was employed, combining site observation, photo-questionnaire survey, and user questionnaires based on a Likert scale, alongside correlation analysis to identify relations between planting density, safety perception, and behavioral outcomes. The results indicate that among the examined factors, visibility exerts the strongest influence on perceived safety within urban public spaces, surpassing the effects of social interaction and physical accessibility. Dense planting often reduces visibility and perceived safety while correlating with higher levels of undesirable behaviors, whereas open planting patterns enhance accessibility, interaction, and security. The findings underscore the importance of vegetation density as a key design factor for balancing ecological, aesthetic, and safety outcomes in Colombo's public spaces.

Keywords: *Perceived Safety, Negative Behaviours, Urban Public Space*

1. Introduction

Urban public spaces (UPS) are essential components of cities, providing venues for recreation, relaxation, and social interaction while enhancing public health, inclusivity, and cultural identity (Gehl, 2011). However, concerns about safety, misuse, and bad habits frequently make it difficult for them to function effectively. Dense vegetation and inadequate spatial sequencing can lead to visual isolation, break continuity, and encourage negative behavior, as noted by Cullen (1961). In the Sri Lankan context, underutilized pockets within parks have been associated with behaviors such as drinking, substance use, and informal gatherings, all of which compromise safety and inclusivity (Karunananda, Rajapakse, & Ratnayake, 2015).

The Broken Windows Theory (Wilson & Kelling, 1982) further suggests that minor signs of disorder can escalate into larger social problems, discouraging positive use and increasing fear in public spaces. Although the socio-economic or regulatory factors of safety are frequently examined as the main variables of global studies, the role of the physical environment, specifically, the density of planting and vegetation composition, has been relatively under-researched. The studies conducted by different researchers worldwide have revealed that vegetation density, visibility and enclosure largely determine the perceived safety and behavioral effects (Fisher and Nasar, 1995; Michael and Hull, 1994; Kuo and Sullivan, 2001). But the results of this study cannot be directly generalized to Colombo, where tropical vegetation, cultural orientation or practices and tendencies of urban utilization intersect to develop unique circumstances and, therefore, respond to safety differently.

Though these are some of the studies that have focused on planting density and safety perceptions, including those by Hami et al. (2014) in Iran, the studies reveal that the context of the research tends to be variative and necessitates local research. Urban parks are essential hubs in the wellbeing of the community in Colombo and when they become susceptible to negative behaviors, their potential is compromised. Therefore, the analysis of the relationship between the planting density, safety, and behavior is critical in this context in order to create evidence-based design strategies.

The purpose of this study is to assess how planting density affects negative behaviors and perceived safety in urban public spaces in Colombo, using Beira Lake as a case study. The objectives of this study are outlined below:

- To assess the relationship between planting density and the parameters of visibility, accessibility, and social interaction in public spaces.
- To analyse how varying planting densities influence perceived safety and the occurrence of negative behaviours in selected locations around Beira Lake.
- To identify the types and frequency of negative behaviors associated with different planting densities.
- To suggest planting arrangements for landscape design that improve safety and lessen undesirable behaviors.

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2. Literature review

2.1 URBAN PUBLIC SPACES AND SAFETY

Urban public spaces form an essential part of the external urban environment (Swanwick et al., 2003) and contribute significantly to community well-being. Their usability is strongly influenced by perceived safety, which depends on visibility, lighting, maintenance, and openness (Gehl, 2011; Whyte, 1980). When areas become isolated, hidden, poorly lit, or neglected, users avoid them, worsening abandonment and disorder (Carmona, 2010). In Colombo, studies show that medium complexity in street-view vegetation results in higher perceived safety than overly dense or overly sparse scenes. Media reports note that Beira Lake's overgrown vegetation, litter, broken pathways, and poor maintenance reduce comfort and safety (Daily Mirror, 2025). Developing cities often face similar issues where vegetation becomes unkempt and infrastructure deteriorates (Rupp et al., 2025). Therefore, effective safety planning includes not only physical amenities but also organizing vegetation and spatial openness to allow users to move freely with visual clarity (Gehl, 2011).

2.2 THEORIES ON SAFETY AND ENVIRONMENTAL BEHAVIOR

Several environmental-behavior theories explain how planting layout influences perceived safety. Jacobs (1961) highlights that natural surveillance people seeing and being seen reduces opportunities for crime. Appleton's Prospect-Refuge Theory (1975) explains that people prefer spaces offering clear outward views while still providing psychological shelter; excessive vegetation blocks prospect, while overly open spaces lack refuge. Routine Activity Theory (Cohen & Felson, 1979) states that crime occurs when a motivated offender, suitable target, and absence of guardianship coincide conditions often created by secluded, low-visibility vegetation zones. Concepts of enclosure and spatial legibility further clarify that vegetation and built edges should define space without creating excessive visual barriers or confusion (Coleman, 1985; Lynch, 1960). Collectively, these theories show that planting density directly shapes surveillance, openness, and user comfort.

2.3 PLANTING DENSITY AND SPATIAL PERCEPTIONS

Planting density reflects how vegetation is arranged across layers groundcovers, shrubs, and trees and measured through metrics such as canopy cover, LAI, and stem density. CPTED-related studies emphasize that low to moderate density vegetation improves surveillance (Lis et al., 2025). Dense shrubs or mid-height vegetation obstruct visibility and create blind corners, reducing safety (Fisher & Nasar, 1995). Studies show that medium structural complexity in parks is perceived as safer than both dense overgrowth and barren minimal vegetation (Sezavar et al., 2023). Psychologically, dense planting raises fear of concealment, ambush, or claustrophobia, while overly open settings feel exposed; the optimal condition lies in balanced naturalness with visual openness (Kaplan & Kaplan, 1989). Colombo research also shows an inverted-U relationship where medium visual complexity maximizes perceived safety (Weerasinghe et al., 2022).

2.4 VISIBILITY, ACCESSIBILITY, AND SOCIAL INTERACTION AS MEDIATORS

Planting density influences safety indirectly through key mediating variables: visibility, accessibility, social interaction, and enclosure. Visibility determines how clearly users can see across space; obstructed sightlines increase fear (Fisher & Nasar, 1995), while CPTED guidelines recommend clear understory and pruning (Mosqueda, 2024). Accessibility shapes how easily users move, enter, and exit spaces; overgrown footpaths in Sri Lankan parks reduce movement and comfort (Rukshan & Chandrasekara, 2019), whereas Gehl (2011) stresses circulation clarity. Social interaction provides informal guardianship active, well-used spaces deter negative behavior (Jacobs, 1961; De Nadai et al., 2016), and social belonging further improves perceived safety (Hou, 2025). Enclosure created by vegetation defines edges and spatial structure, but excessive enclosure restricts sightlines and increases discomfort, while balanced edge definition supports orientation and movement (Cullen, 1961; Lynch, 1960).

2.5 NEGATIVE BEHAVIOURS IN URBAN PARKS

Negative behaviours in urban parks fall into two main categories: undesirable activities and criminal activities, each emerging due to environmental neglect and weak supervision. Undesirable activities refer to non-criminal but socially inappropriate behaviours such as loitering, public drinking, littering, and graffiti that disturb comfort and disrupt intended public use. These behaviours typically arise not from criminal intent but from poor maintenance, unclear spatial boundaries, and low surveillance. According to Wilson & Kelling's (1982) Broken Windows Theory, such minor signs of disorder, when unmanaged, signal neglect and can gradually escalate into more serious issues. In contrast, criminal activities such as harassment, vandalism, drug use, or assault directly threaten personal safety and often exploit dense vegetation, secluded corners, or poor visibility. These align with Routine Activity Theory (Cohen & Felson, 1979), which argues that crime occurs when a motivated offender meets a suitable target in the absence of capable guardianship. High-density planting and visually concealed zones reduce guardianship and increase opportunities for concealment, making parks more vulnerable to such acts.

3. Research design and methodology

3.1 RESEARCH VARIABLES, STRATEGY, AND APPROACH

This study investigates how planting density influences safety and behavioural outcomes in urban public spaces by analysing one independent variable, three mediating variables, and two dependent variables. Planting density defined as low, medium,

or high based on vegetation arrangement around Beira Lake acts as the independent variable. Its effects are examined through the mediating factors of visibility, accessibility, and social interaction, which relate to sightlines, ease of movement, and human presence. The dependent variables focus on users' perceived safety and the occurrence of negative behaviours such as loitering, drinking, urinating, harassment, and other anti-social acts.

A mixed-method approach was used, combining both quantitative and qualitative techniques. Quantitative data were gathered through a questionnaire completed by 40 individuals, including people encountered at the site and frequent visitors of Beira Lake. Their ratings helped calculate a Composite Safety Index (CSI) for three planting patterns single-row (low density), double-row (medium density), and triple-row (high density). Qualitative methods such as field observations and behavioural mapping captured the distribution of undesirable and criminal activities across these planting zones. Together, these methods enabled the study to link measurable perceptions of safety with actual behavioural patterns, providing a grounded understanding of how planting density shapes spatial dynamics at Beira Lake.

3.2 DATA COLLECTION AND ANALYSIS METHODS

The questionnaire systematically captured demographic details, perceptions of planting density, and experiences related to safety. It included sections on demographics (Section A), ratings on visibility, accessibility, and social interaction (Section B), and photographic scene evaluations for these variables and safety (Section C). Section D measured overall planting density impacts at Beira Lake, while Section E gathered user observations of undesirable behaviours such as drinking, gambling, loitering, harassment, unlawful gatherings, and unauthorized settlements. Section F asked participants to propose design and planting improvements, and Section G contained an attention-check question to ensure response accuracy. This structured format enabled the collection of both quantitative ratings and qualitative insights.

Quantitative data from Likert-scale (1 = Strongly Disagree, 5 = Strongly Agree) responses were analysed using descriptive statistics such as totals, means, and weighted scores for the three mediating variables. These scores were combined to produce a Composite Safety Index (CSI), allowing comparison of perceived safety across the three planting densities. Correlation analysis was used to examine how strongly visibility, accessibility, and social interaction relate to safety perceptions. Qualitative field observations captured the presence of negative behaviours within each planting density zone (low, medium, high). Open-ended responses were thematically coded to identify recurring safety concerns and perceptions. Using both statistical and thematic methods strengthened data triangulation, enhancing the validity and reliability of the study's findings.

4. Analysis, result and interpretations

4.1. SELECTION OF CASE STUDY

4.1.1 Site overview & Site observational analysis

Southwest Beira Lake was chosen as the case study because it is a major urban public space in Colombo that increasingly faces safety concerns and antisocial behaviour. Situated within the Colombo Municipal Council area, it combines recreational, ecological, and social functions, making it an ideal site to study how planting density shapes perceived safety and negative behavioural patterns. Although culturally and scenically important, the lake and its sub-areas such as the South-West Lake, Gangarama Temple Lake, and adjoining canals show signs of neglect. Reports highlight deteriorating bridges, damaged pavements, and fallen trees obstructing paths (Daily Mirror, 2025). Despite these issues, Beira Lake remains a key urban green asset with strong potential for public use, justifying its selection as the focal site for this research.



Figure 1: Identified Negative Behavior (Urinating) & planting patterns in Beira Lake in Beira Lake

4.1.2 Analysis of demographic distribution and usage

The sociodemographic details of the 40 study participants including people present during site visits and frequent visitors of Beira Lake are shown in Table 1. With 60% of participants being men and 40% being women, the sample is slightly male-dominated in terms of gender, offering a somewhat balanced but male-leaning viewpoint on safety perceptions. The majority (72.5%) are married, whereas 27.5% are single, indicating that family obligations may affect how people perceive safety and how they use public areas.

Table 1: Participants' Backgrounds

Participant		Number	Percent
Total public participation		40	100
Factors Sub-category			
Gender	Male	24	60
	Female	16	40
Marital status	Single	11	27.5
	Married	29	72.5
Age (years old)	19-29	9	22.5
	30-39	7	17.5
	40-49	15	37.5
	Above 50	9	22.5
Education	Primary education (Grade 1–5)	12	30
	Secondary education (Grade 6–11)	9	22.5
	Tertiary education (A/L and above)	19	47.5
Occupation	Governmental employee	10	25
	Private sector	9	22.5
	Student	10	25
	Household	4	10
	Business	4	10
	Others	3	7.5

Overall, the demographic distribution shows that the study involved a wide range of participants with regard to gender, age, education, and occupation, which guaranteed that the perception of planting density, safety, and negative behaviours at Beira Lake is based on a variety of social perspectives.

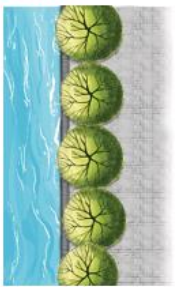
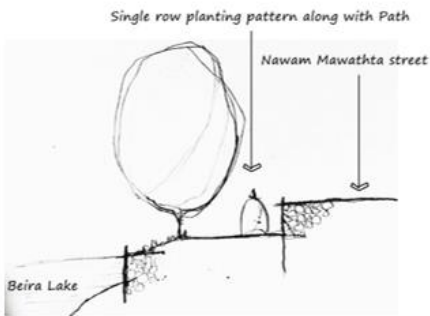
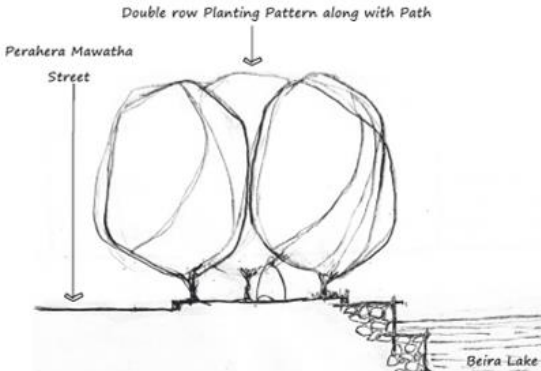
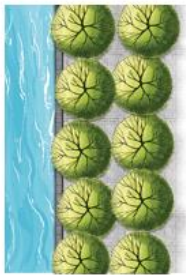
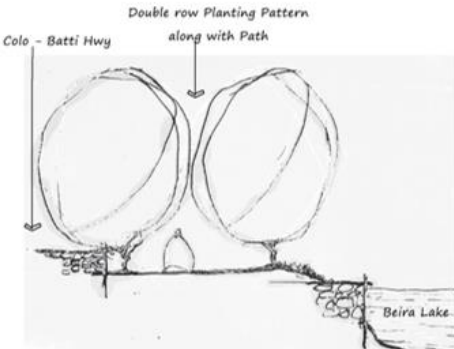
4.2 PLANTING DENSITY CLASSIFICATION



Figure 2 : Identified planting patterns in Beira Lake

Three density levels of vegetation were identified throughout Beira Lake, as shown in Figure 2: Location A low planting density (single row), Location B high planting density (triple row), and Location C medium planting density (double row). Because planting density directly affects visibility, enclosure, and accessibility, which influence user perceptions of safety this classification is essential. According to earlier research, the placement of vegetation in public areas has an impact on both human comfort and surveillance (Kuo & Sullivan, 2001; Fisher & Nasar, 1995). The study creates a framework for examining how landscape design either promotes or inhibits both positive and negative behaviors by differentiating these three conditions.

Table 2: Planting Density Classification

Locations (plan)	Physical Character of Location (sections)	Descriptions
Location A (Nawam Mawatha) 		Single-row planting pattern (Low planting density): Here trees planted in a <i>single linear arrangement</i> , usually along a path or boundary, leaving wide open space between planting lines.
Location B (Perahera Mawatha) 		Triple-row planting pattern (High planting density): Here (Perahera Mawatha) <i>three or more consecutive rows of trees</i> .
Location C (Colombo – Batti Hwy) 		Double-row planting pattern (Medium planting density): Here, vegetation is arranged in <i>two parallel rows</i> along with the pedestrian path.

4.3 ROLE OF PLANTING IN PERCEIVED SAFETY

4.3.1 Factor weights derived from participant importance ratings

Table 3 show that, with a relative weight of 0.41, visibility had the highest cumulative score (166) and mean rating (4.3). This indicates that the ability to perceive the environment clearly was consistently regarded by participants as the most important factor influencing safety in urban public areas. Social Interaction followed with a total of 141 and a mean of 3.52, yielding a weight of 0.35.

This indicates that Social interaction is a significant yet secondary factor in perceptions of safety. The lowest total score (97), and mean (2.43), which corresponds to a weight of 0.30, were assigned to Accessibility, meaning that the access and exit had a positive effect, but participants rated it as less decisive than visibility and presence of other people of space. These normalized weights (0.41, 0.35, 0.30), with which visibility and physical legibility of space were closely related, were then incorporated into the calculation of Composite Safety Index (CSI), so that the priorities of participants directly contributed to the quantitative evaluation of safety.

Table 3 : Weights of each factor

Factor	Total Score (n=40)	Mean Score	Weight
Visibility	166	4.15	0.411
Accessibility	97	2.43	0.301
Social Interaction	141	3.52	0.349

4.3.2 Scene-level safety ratings.

As shown in Table 4, participants' evaluations of the six landscape scenes showed clear differences based on planting density. Table 5 further presents the average score values for each location, highlighting how visibility, accessibility, and social interaction varied across the low-, medium-, and high-density planting zones. The low-density scenes (P1 and P4) received the highest scores for visibility, accessibility, and social interaction, as open planting allowed clear sightlines, reduced hiding opportunities, and encouraged casual interactions, supporting Cullen's (1961) view on visual continuity and safety. In contrast, the high-density scenes (P3 and P6) recorded the lowest scores, with dense vegetation restricting openness, movement, and surveillance. The medium-density scenes (P2 and P5) showed moderate visibility and accessibility but relatively higher social interaction, indicating that this "in-between" density created ambiguous spaces that neither felt open nor safely enclosed, reducing overall comfort.

Table 4 : Total ranking for perceived visibility, accessibility & social interaction in landscape scenes by the public

Scene Number	No of Participant	Visibility	Accessibility	Social Interaction
P1				
	40	186	178	118
P2				
	40	122	120	122
P3				
	40	110	80	68
P4				
	40	180	180	120

P5

40 108 128 114

P6

40 100 84 76

Table 5 : Average score values by location

Locations	Visibility	Accessibility	Social interaction
Location A (P1, P4)	183	179	119
Location B (P3, P6)	105	82	72
Location C (P2, P5)	115	124	118

4.3.3 Composite Safety Index (CSI) application

Based on visibility, accessibility, and social interaction means, the Composite Safety Index (CSI) values for the three locations are shown in Table 6. Because of its higher visibility and accessibility scores, Location A has the highest CSI (4.266) of all of them, indicating a stronger sense of perceived safety. Location B shows the lowest CSI (2.324), reflecting weak user perceptions of safety, possibly due to poor accessibility and low social interaction. Location C demonstrates a moderate CSI (3.144), suggesting balanced safety perceptions with relatively stronger accessibility and social interaction compared to Location B. These findings highlight that planting density directly influences safety perception through its effect on visibility, accessibility, and opportunities for social engagement.

Table 6: Composite Safety Index (CSI)

Location	Visibility means	Accessibility means	Social mean	CSI_weighted
Location A	4.575	4.475	2.975	4.266
Location B	2.625	2.050	1.800	2.324
Location C	2.875	3.100	2.950	3.144

CSI_weighted = (0.411 x Visibility mean) + (0.301 x Accessibility mean) + (0.349 x Socialinteraction) (1)
(Each mean is on the 1–5 scale.)

4.4 ROLE OF PLANTING DENSITY IN NEGATIVE BEHAVIORS

4.4.1 Distribution of Negative Behaviors across Beira Lake

Survey responses from 40 participants revealed eight negative behaviours around Beira Lake. As summarised in Table 6, 69% were undesirable activities such as loitering, urinating, drinking, illegal gatherings, and unauthorized settlements, which create disorder and reduce public comfort. Criminal activities made up 26%, including hiding offenders, sexual attacks, and gambling, indicating spatial areas where poor visibility and weak surveillance enable more serious safety risks.

The overall distribution of reported negative behaviors in Beira Lake is displayed in Table 7. According to the data, the most common activities drinking (120 reports, 26%) and loitering (95 reports, 21%) account for over half of all incidents. Urination (65 reports, 14%) and sexual assaults (78 reports, 17%) also stand out as serious problems, suggesting that social disorder and space abuse are common. In contrast, behaviours such as gambling (18 reports, 4%), hiding (22 reports, 5%), unauthorized settlement (14 reports, 3%), and illegal gatherings (21 reports, 5%) occur less frequently but still contribute to the overall Table 4.7 Overall Distribution of Reported and Observed Negative Behaviours across Beira Lake insecurity of space. These findings suggest that while loitering and drinking dominate, a broad spectrum of negative behaviours collectively undermines the perceived safety and usability of Beira Lake.

Table 7 : Classification of Negative Behaviors in Beira Lake.

Undesirable Activities (69%)	Criminal Activities (26%)	Others (5%)
Loitering (21%) Urinating (14%) Drinking (26%) Illegal gatherings (5%) Unauthorized settlements (3%)	Hiding criminal individuals (5%) Sexual attacks (17%) Gambling (4%)	

4.4.2 Negative Behaviour Distribution by Location

Table 8 : Percentage Distribution of Negative Behaviors Across Locations.

Identified Negative Behaviors	Location A	Location B	Location C
Hiding criminal people	6.49	4.76	4.19
Sexual attacks	5.19	15.71	24.55
Gambling	0	4.29	5.39
Unauthorized settlement	5.19	2.38	2.99
Loitering	45.45	16.67	14.97
Illegal gathering	10.39	3.33	3.59
Urinating	7.79	12.86	19.16
Drinking	12.99	35.71	20.96
Others	6.49	4.29	4.19

■ Undesirable Activities
 ■ Criminal Activities
 ■ Others

The distribution of negative behaviours in Location A, as shown in Table 8, is one that is characterised by low planting density. The statistics suggest that the problem of loitering (45.45) is by far the most widespread, and the problems of drinking (12.99) and illegal gatherings (10.39) rank second and third. There are also minor problems, including the hiding (6.49%), unauthorized settlement (5.19%), and sexual attacks (5.19%), and gambling (0%) is entirely absent. The prevalence of loitering indicates that open and accessible areas encourage a group of people to linger around and the reduced rates of severe behaviors (e.g., sexual attacks, urination) demonstrate that visibility does not provide the means of concealment. This helps justify that having low planting density, although prone to social abuse like sitting around, prevents more illicit criminal conduct.

The high planting density in Location B is depicted in Table 8. In this case, drinking is the most frequently reported behavior (35.71%), followed by urination (12.86%) and sexual assaults (15.71%). While gambling (4.29%), unlawful gatherings (3.33%), and unauthorized settlement (2.38%) occur at lower but discernible levels, loitering, which dominated Location A, only makes up 16.67%. Relative to Location A, the increase in drinking and sexual harassment shows that dense vegetation forms hidden spots where these types of behaviours can be practiced. The reduction in loitering is an indication that heavy planting is a deterrent to open congregation and instead, it encourages more serious hidden activities.

The behavioral distribution in Location C, which has a medium planting density, is displayed in Table 8. The findings show a more evenly distributed range of problems, with the most common ones being drinking (20.96%) and sexual assaults (24.55%), followed by urination (19.16%) and loitering (14.97%). Smaller percentages of people engage in minor behaviors like gambling (5.39%), hiding (4.19%), and unlawful gatherings (3.59%). Location C has the highest percentage of sexual attacks compared to Location A and B and it can be considered to give good cover, though not open enough, so this creates a grey area that supports such activities. This means that neither extreme openness can result in critical safety challenges, and neither full density can result in critical safety challenges, but something in-between, can.

4.4.3 Comparative Analysis Across Planting Densities

A strong correlation between vegetation structure and user safety is demonstrated by the comparison of negative behaviors across various planting densities. The prevalence of loitering (45.45%) in Location A (low density) indicates that while open spaces draw people together, increased visibility deters more serious crimes. The highest percentage of drinking (35.71%) and sexual harassment (15.71%), on the other hand, they are recorded in Location B (high density), indicating that dense vegetation provides concealment that permits risky, hidden behaviors. Sexual harassment peaks at 24.55% in Location C (medium density), which also has high drinking (20.96%) and urination (19.16%) rates. These findings suggest that "in-

between" spaces with partial visibility promote unsafe and ambiguous use. All in all, the analysis has established that low density planting promotes visible, yet less harmful behaviours compared to the medium and high density that promotes more hidden and more harmful negative behaviours, which underlines the critical functionality of the planting design in determining safety outcomes

5. Conclusion

The findings of this study clearly demonstrate that visibility exerts the strongest influence on perceived safety within urban public spaces, followed by social interaction and physical accessibility. This observation emphasizes the fact that users attach importance to safety as primarily to the capability to keep visual relations clear throughout the space that limits the possibility of hiding and increases the environmental legibility. While accessibility and social interaction also contribute significantly, their relatively lower weights suggest that visibility remains the most decisive factor in shaping users' overall sense of security in the Beira Lake context.

Planting density plays a decisive role in shaping both perceived safety and the prevalence of negative behaviors in urban public spaces. Location A (low planting density) received the highest safety ratings according to the Composite Safety Index (CSI) analysis. This was primarily because easy accessibility and clear visibility decreased opportunities for concealment and increased users' sense of security. On the other hand, Location B (high planting density) had the lowest CSI value, indicating that dense vegetation made it difficult to see and move around, which in turn made people feel less safe. Location C (medium density) fell in between but displayed notable ambiguity, where partial concealment supported some social interaction while simultaneously raising safety concerns.

Parallel to this, the quantitative behavioral analysis revealed a strong density–safety gradient: low-density zones (Location A) recorded the highest proportion of undesirable but less-severe activities (81.83%) yet maintained the lowest incidence of criminal behaviors (11.68%), suggesting that open, visible environments promote community surveillance and deter serious offences. Medium-density zones (Location C) showed a clear shift toward riskier behaviors, with undesirable activities decreasing to 61.68% and criminal acts increasing to 34.13%, illustrating how partial enclosure and reduced visibility create psychological ambiguity and concealment opportunities that facilitate sexual harassment, gambling, and other deviant acts. High-density zones (Location B) intensified this pattern, with 70.75% undesirable and 24.96% criminal behaviors, demonstrating that thick vegetation and spatial isolation severely restrict visual access and passive surveillance, enabling hidden and socially destructive conduct. Behavioural analysis further confirmed that in low-density areas, loitering was the predominant negative behaviour - socially disruptive but relatively harmless due to the openness and natural oversight available in such spaces. Denser vegetation, on the other hand, made it easier for covert misuse to occur, as demonstrated by the notable increase in severe and covert behaviors like drinking, urinating, and sexual harassment in enclosed spaces. Medium-density areas accounted for the largest percentage of sexual harassment incidents, highlighting the ways semi-open planting patterns foster areas that are neither completely private nor completely visible, which in turn encourage risky behavior. When combining both safety and behavioural perspectives, a distinct pattern emerges, low planting density correlates with higher perceived safety and fewer severe offences, medium density produces spatial ambiguity and vulnerability, and high density corresponds to the lowest safety perception and highest behavioural risks.

The relationship between planting density, safety, and behaviour at Beira Lake therefore underscores that openness, visibility, and accessibility are essential to enhancing perceived safety and reducing serious negative activities, while excessive enclosure compromises safety by fostering concealment and misuse. Planting design must therefore be understood as a crucial factor in determining social safety, spatial experience, and behavioral regulation in urban public spaces, rather than just as an aesthetic or ecological choice. By strategically calibrating vegetation density to maintain sightlines, accessibility, and social visibility, urban designers can transform spaces like Beira Lake from fear-inducing, neglected zones into safe, inclusive, and ecologically balanced public landscapes that support both environmental and social resilience.

6. Recommendations for design applications and future studies

The findings emphasise the importance of treating planting density as a key design and management factor in urban public spaces. Designers should prioritise open or moderately structured planting that enhances visibility, accessibility, and social interaction, while reducing isolated zones that attract undesirable behaviours. Vegetation management techniques such as canopy lifting, selective pruning, and organised plant layering can strengthen natural surveillance without reducing ecological or aesthetic value, particularly in areas like Beira Lake. Future studies should examine multiple urban spaces to enable comparative analysis across different demographic and usage contexts, and longitudinal research could help reveal how vegetation changes over time affect safety perceptions and behaviour. Overall, future park designs should use balanced planting structures that maintain visual openness while supporting ecological and social functions.

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