Development and Validation of a Landscape-Security Framework for Perceived Safety in Urban Recreational Parks: A Case Study of Lagos, Nigeria

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ABSTRACT: Urban recreational parks in rapidly urbanizing cities of the Global South, such as Lagos State in Nigeria, encounter unique safety challenges that are distinct from those observed in Western contexts. This research established and validated an Integrated Landscape-Security Framework (ILSF) aimed at evaluating the connections between environmental design features and perceived safety within urban recreational parks. A descriptive quantitative cross-sectional methodology was utilized across 18 parks, from which 9 were purposefully selected for comprehensive spatial analysis. Data collection involved structured questionnaires distributed to park users ($n = 423$ valid responses), supplemented by expert evaluations and field observations. Reliability assessments indicated a high level of internal consistency across the measurement scales (Cronbach's $\alpha = 0.86$–0.90). Two composite indicators were formulated: the Mean Crime Perception (MCP) index and the Weighted Crime Safety Index (WCSI), with WCSI values normalized through min–max scaling. Analytical methods included descriptive statistics, Chi-square tests, and Exploratory Factor Analysis (EFA). Parks that featured sufficient lighting, enhanced visibility, and proper upkeep reported higher levels of perceived safety (WCSI ≥ 0.68), while areas with dense vegetation and inadequate surveillance were linked to lower safety perceptions (WCSI ≤ 0.61). Notable associations were identified between perceived safety and factors such as natural surveillance ($\chi^2 = 12.33$), access control ($\chi^2 = 14.23$), territorial reinforcement ($\chi^2 = 11.45$), lighting ($\chi^2 = 10.83$), and maintenance ($\chi^2 = 9.21$) ($p < 0.05$). EFA (KMO = 0.82; 66.8% variance explained) revealed two underlying dimensions—Design Integration and Maintenance and Lighting—thus empirically substantiating the ILSF framework. This study illustrates that both spatial design and operational management play crucial roles in influencing perceived safety within resource-limited urban settings. The validated ILSF provides an evidence-based planning tool to improve park safety and support sustainable management of recreational spaces in the Global South.

KEYWORDS: Landscape-security framework; Crime prevention; urban parks; CPTED; Safety perception

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I. INTRODUCTION

Urban parks are essential elements of sustainable cities, as they enable physical exercise, psychological rejuvenation, and social interaction, especially in metropolitan areas of high density like the Lagos State (World Health Organization, 2021; Jennings and Bamkole, 2022). These roles put parks not only as recreational facilities, but also as vital social and health infrastructure. In addition to these advantages, recent research indicates that parks can also have a role in influencing the safety situation through user behaviour, improving visibility, and strengthening the perception of territory in case of the planned design and effective maintenance (Marzbali *et al*., 2021; Kyaegba *et al*., 2024).

Global urban policy has come to treat green spaces as safe havens that can help alleviate fear of crime and increase resilience in communities (UN-Habitat, 2022; Rigolon and Németh, 2023). Nevertheless, even in the context of this emerging consensus, few empirical studies have been conducted to establish a correlation between particular landscape design variables and quantifiable security effects. A large part of the available literature is devoted to the perceived safety or overall environmental quality, and the spatial design features and visible safety performance are often not sufficiently integrated (UN-Habitat, 2022).

Crime Prevention Through Environmental Design (CPTED) has become the logical system in solving the safety issues in the parks of the city, and it is based on the natural surveillance, access control, territorial reinforcement, and maintenance (Kennedy *et al*., 2022). Its theoretical roots can be traced to such seminal publications as Newman (1972) that provided the concept of defensible space and had a strong impact on the development of environmental criminology and the practice of urban design.

Modern research proves that the principles of CPTED continue to be strong predictors of better security performance, especially when tailored to the local conditions and combined with community engagement and the technical system (Cozens *et al*., 2023; Chen and Marzbali, 2024; Choi *et al*., 2024). Empirical literature emphasizes the role of landscape quality, visibility, maintenance, and wayfinding in determining the safety of the park (Mansuroglus *et al*., 2021), whereas the use of softscape features like vegetation and natural barriers can be used to increase passive surveillance under favorable settings (Navarrete-Hernandez *et al*., 2023). Likewise, less visible features of design, such as lighting and surveillance systems,

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play a major role in territoriality and deterrence (Song and Zhang, 2020).

On one hand, this progress has resulted in a lot of evidence that is not African in nature, and tends to separate individual design factors instead of studying their joint contribution to the quantifiable safety states. Such restrictions are especially strong in cities of the Global South where the urban design systems worked out in the West are often imported without thorough local verification. In Lagos State, urbanisation, massive population and intense socio-economic activity generate complicated spatial conditions that impact the safety in the built and open environments.

According to the existing records, the Lagos State records some of the highest crime rates in the country, but these statistics are to be viewed with caution because of the established underreporting problems (Statistics Research Department, 2021; Pulse Nigeria, 2025). In the metropolis, Ikeja, Lagos Island, and Lekki have been recognized as significant crime hotspots (CKN News, 2025), which shows the strains related to the mobility, economic concentration, and spatial congestion. Such dynamics are not confined to residential and commercial areas but recreational areas, where the movement, visibility, and territorial ambiguity patterns are associated with specific safety issues.

The landscape design in these situations is important to organize surveillance opportunities, access control, and spatial legibility using vegetation organization, circulation patterns, lighting, and enclosure (UN-Habitat, 2022; Rigolon and Németh, 2023). Nevertheless, design compromises especially between ecological values (e.g., dense vegetation) and visibility are more acute in tropical contexts where the poorly managed vegetation may interfere with the viewline and diminish surveillance. The conditions of maintenance also affect the safety, as it is a signal of territorial control; unkept environments may suggest insufficient control and make the place more susceptible to crime.

Also, there is no even distribution of safety in urban parks. Park use and crime fear pattern depend on gender, age, and income to a significant extent. Women, older people, and lower-income users are the vulnerable populations that tend to be more sensitive to environmental risk, resulting in limited patterns of use and spatial avoidance. Informal surveillance and collective guardianship can be strengthened by social cohesion and diversity of the users, which supports the connection between social dynamics and spatial design (Talal and Santelmann, 2023).

Although there has been an increased appreciation of the association between environmental design and safety, the available research in Lagos is disjointed. Previous studies have investigated the security levels in parks and the rate of crime (Ajayi *et al*., 2020), landscape design as a form of residential crime prevention (Atoyebi, 2023), and the wellbeing of users and the sufficiency of the parks (Babamboni *et al*., 2025). Nevertheless, these studies lack an empirically verified comprehensive framework that can be used to relate the landscape design strategies to the security outcomes in recreational parks.

This is a critical gap to the practice of urban engineering and planning. The ongoing use of imported design principles that have not been validated to suit a context may lead to ineffective infrastructure development, inadequate use of civic space, and unequal access to city facilities. Understanding the environment of resource constraints, designed interventions that poorly align can not bring the desired safety benefits, compromising social and economic returns on government investment. In this regard, the research problem in this study is as follows: the lack of a context-specific empirically validated framework that would combine landscape design strategies and quantifiable security outcomes in recreational parks in Lagos State.

II. THEORETICAL AND CONCEPTUAL FRAMEWORK

A. Situational Crime Prevention Integrative Lens

This paper uses Situational Crime Prevention (SCP) as the main theoretical perspective, theorizing crime as dependent on the opportunity structures and focusing on the systematic manipulation of the environmental, managerial, and situational factors to decrease the probability of committing an offense (Mullenbach, 2022; Chen *et al*., 2020). In contrast to the offender-based theories, SCP accounts of criminal behaviour as a situational, but not inelastic, phenomenon, and thus offers a straightforwardly actionable basis of spatial and operational interventions in recreational parks.

SCP works in five mechanisms, which are: raising the cost of crime, raising the risk of being caught, decreasing the payoffs, decreasing the triggers, and removing justifications (Chen *et al*., 2020). Such mechanisms are directly translated to design and management strategies including access control, improvement of surveillance, environmental structuring and maintenance. SCP is the general integrative framework in this study and can be seen to connect the spatial design and operations practices to the security outcomes. In particular, it gives the conceptual linkage upon which other theories are synthesised and operationalised into the Integrated Landscape-Security Framework (ILSF). The ILSF is thus the spatial and managerial use of SCP principles in the recreational parks in Lagos.

B. Opportunity Structure: SCP and Routine Activity Theory.

Routine Activity Theory (RAT) is the complement to SCP as it explains that crime takes place when a motivated offender, a motivated target, and the absence of a competent guardian come together in space and time (Lis and Iwankowski, 2021). This view emphasizes the role of daily activity patterns and spatial arrangements in the development of crime opportunities.

Within recreational parks, design plays a very powerful role in such convergence. Poor visibility, poor circulation structure, and low user activity areas provide where visibility is minimal and targets are vulnerable to attack (Dizdaroglu, 2022). On the other hand, parks that are densely used, have clear routes and well-spread areas of activities contribute to informal surveillance and diminish the chances of offense (Bahriny and Bell, 2020).

The opportunity structure of crime, a joint phenomenon of SCP and RAT, is the theoretical basis of the Design Integration dimension of the ILSF. Landscape features like lighting, sightlines, access control, and spatial organisation impact the movement of the users, gathering of the users, and the efficiency of the users to offer natural surveillance. Design Integration is operationalised thus:

i. Opportunity reduction (SCP)
ii. Guardianship and activity patterns (RAT)

This dimension is very important in organizing environments that mitigate vulnerability to spatial configuration in Lagos parks where opportunistic crimes are likely to take place in unmonitored areas.

C. Spatial Control and Perception: Defensible Space and Broken Windows (Maintenance & Lighting Dimension)

Defensible Space Theory stresses the importance of environmental design to design spaces that facilitate surveillance, territorial delineation, and informal social control (Mullenbach, 2022). Distinct divisions, transparent sightlines, and transparent entrances are among the features that can improve the ability of users to control space and establish ownership (Lis and Iwankowski, 2021).

The use of defensible space however in Lagos parks has to be adapted. The original focus on individual territoriality of the theory is also in contrast to the community-based land-use patterns and communal use of the Western models, which makes it impossible to directly transfer them to the public parks. However, its main postulates are still applicable redefined as group territorial strengthening and joint control. Broken Windows Theory builds on this realization by emphasizing the importance of maintenance and environmental image in indicative control or lack thereof (Mark and Jim, 2022). Observable chaos like litter, vandalism, or uncontrolled vegetation sends a message of poor management and may raise the fear of crime and actual susceptibility. On the contrary, well-kept environments strengthen the territorial dominance and deter opportunistic offending. Combined, the Defensible Space and Broken Windows theories describe social-psychological processes of safety, which are the basis of the Maintenance and Lighting dimension of the ILSF. This dimension operationalises:

i. Defensible Space (Territorial reinforcement and visibility).
ii. Maintenance, environmental signalling, and order (Broken Windows)

In Lagos parks with uneven maintenance and thick vegetation that may compromise visibility and safety, this aspect is critical to maintaining long-term security performance.

D. Social Cohesion and Third-Generation CPTED

Although second-generation CPTED is based on physical design strategies, third-generation CPTED extends the model to social cohesion, community culture, and collective efficacy (Mullenbach, 2022). This evolution understands that physical interventions alone cannot sustain crime prevention but the active user engagement and social interaction have to be incorporated. Social cohesion promotes informal surveillance and fortifies guardianship in recreational parks. Parks that are more diverse in their use and enable community activities are more likely to have a high level of collective control and be less vulnerable to crime (Talal and Santelmann, 2023). In ILSF, third-generation CPTED acts as a cutting layer that connects the two dimensions:

i. It enhances Design Integration by facilitating active park use and active occupancy.
ii. It empowers Maintenance and Lighting by stewardship, community involvement, and collective responsibility.

Therefore, the approach to social usage, community-related activity, and informal surveillance effects incorporated into the framework indicates the incorporation of the third-generation CPTED principles. Social cohesion is not thus regarded as an end, but rather as a mediating process through which the effectiveness of both spatial design and maintenance strategies is increased. The Integrated Landscape Security Framework (ILSF) is the result of the combination of the complementary environmental criminology and urban design theories into a single framework of enhancing the security results in recreational parks. In principle, Situational Crime Prevention offers the general rationale of opportunity reduction, whereas Routine Activity Theory describes how spatial structure and movement patterns create opportunities to commit crime and, therefore, informs the Design Integration dimension.

Defensible Space Theory adds some information on how territories are controlled and how natural surveillance works and the Broken Windows Theory highlights the need to maintain the environment and signal processes; both of these theories form the basis of the Maintenance and Lighting dimension. The third generation CPTED enriches the model further by incorporating social cohesion as well as community participation on both levels. The ILSF creates through this theoretical convergence two interacting parts: Design Integration dealing with spatial layout, circulation and surveillance and Maintenance and Lighting dealing with environmental quality, visibility and territorial signalling. Taken together, these dimensions would translate the theoretical constructs into practical design and management strategies to decrease the opportunities of crime, decrease the fear of crime and increase the utilisation of the park. Figure 1 thus shows the four theoretical underpinnings coming to the two ILSF dimensions to achieve better security results in Lagos parks.

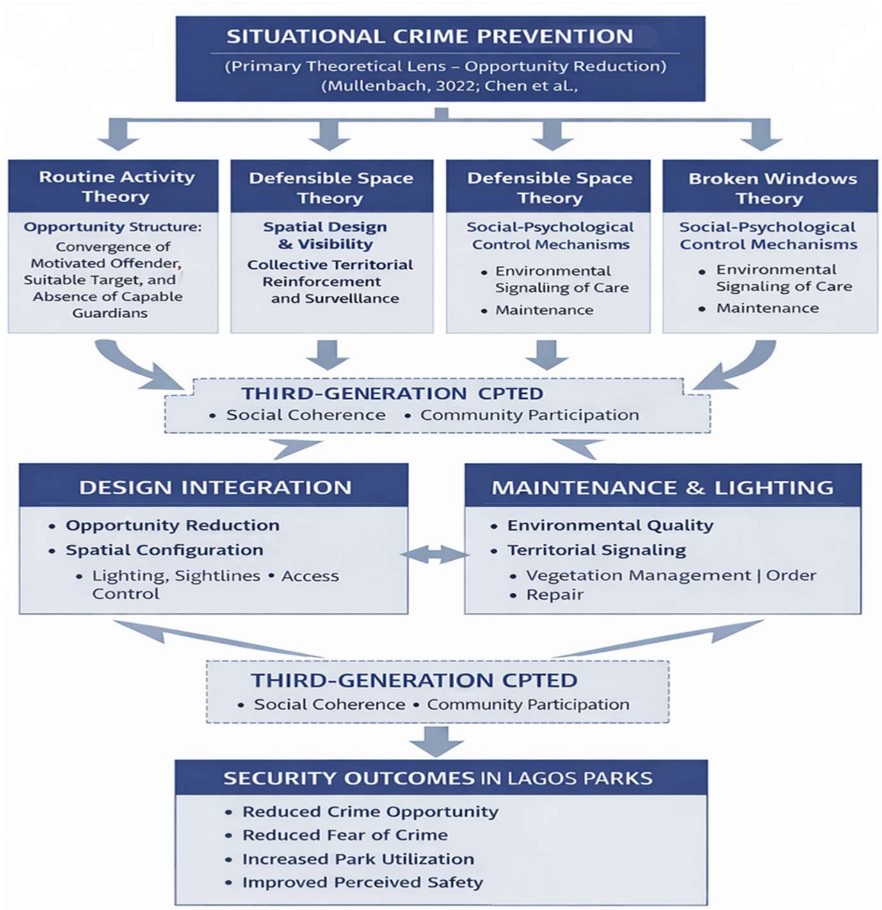

Figure 1 Theoretical Framework of the Study

III. MATERIALS AND METHOD

A. Research Philosophy and Design

This study adopted a positivist research philosophy to investigate the connection between landscape features and security provisions in recreational parks, which is premised on the fact that social phenomena can be objectively analyzed based on measurable variables and empirical observation (Mbanaso *et al*., 2023). Even though the constructs like fear of crime and perceived safety are subjective in nature, this paper operationalized them into measurable variables such as perceived rate of crime incidences, ratings of safety, and fear levels hence considering subjective perceptions as objective standardized data that can be subjected to statistical tests. This practice is in keeping with positivist traditions, in which the variables of perception are converted into measurable constructs to facilitate testing of hypotheses and identification of patterns.

It used a descriptive cross-sectional research design that would allow documentation and analysis of existing conditions without manipulation of variables (Wallwey and Kajfez, 2023). The research is thus aimed at finding relations and predetermining links among the features of landscape design, socio-economic factors and security measures instead of determining causality. It has a weakness of this design. One, the cross-sectional character limits causal inferences since relationships noted are not a reflection of conditions at a particular time. Second, seasonal changes in the use of parks and patterns of crime are not well captured. Third, it is possible that temporal variations and especially differences between daytime and evening use of the park in question affect both perceived and actual safety conditions but cannot be fully analyzed within a single-phase design. Therefore, to accurately reflect the scope of the cross-sectional data, this study develops a 'safety-perception correlation framework' to evaluate these environmental associations.

B. Population and Study Area

The research was carried in Lagos State, Nigeria (6°23N, 3°24E) because it was chosen based on the rate of its urbanisation, the variety of the typologies, and safety issues that were recorded. Lagos offers a useful backdrop to studying the relationships between landscape design and security due to its great population density, economic activity, and complicated spatial processes.

The research population included all the eighteen (18) formally recognised recreational parks in Lagos State of which fourteen (14) parks are owned by the government and four (4) are privately owned parks. These parks differed in terms of ownership, spatial size, models of management, and geographical spread. Out of this population, nine (9) parks were sampled through purposive sampling to represent important traits of the parks such as the ownership type (public and private), geographic distribution across Local Government Areas, park typologies (Neighbourhood, Special-Use, and Pocket parks), differences in spatial scale and user density, and operational status and accessibility. Framework development studies could be viewed as utilizing purposive sampling since it was necessary to cover all the diversity of cases. The use of pure random sampling method may have omitted some vital categories in the park, thus affecting the strength and generalizability of the framework derived. The chosen parks covered about half of the entire population and they were sufficient to cover the institutional and spatial diversity.

C. Sampling Strategy

The sample size was determined using Cochran's formula to estimate the minimum sample size required for statistical validity rather than as a finite population correction (Rahman, 2023):

$$n_0 = \frac{Z^2pq}{e^2} \quad (1)$$

where $Z = 1.96$ (95% confidence level), $p = 0.5$, $q = 0.5$, and $e = 0.045$. The calculated sample size was $n_0 = 475$. After adjusting for a 10% non-response rate, the required sample size became:

$$n = \frac{475}{0.9} = 528 \quad (2)$$

The 540 respondents were selected to provide a balanced representation and to make the statistics more robust because 60 respondents were selected per park. The data cleaning resulted in 423 valid responses, indicating a response rate of 78.3, which is higher than the minimum requirement.

Sampling was done on two levels. Purposive sampling was used at the park level to ensure that the sample covers a wide range of typology and management structure in the parks (Obilor, 2023; Aboah *et al*., 2023). Systematic intercept method was utilized at the user level to sample respondents in each park. Data collectors went to all fifth eligible users that they met at predetermined high flows points, such as entrances, main pathways, and activity nodes.

Data were collected at peak and off-peak periods to make the data representativeness in time. Peak periods were weekdays 4: 00 pm to 7: 00 pm and weekends 10: 00 am to 2: 00 pm and off-peak periods were weekdays 10: 00 am to 1: 00 pm. The survey of each park took between three and four days, including weekdays and weekends. Quota controls were used during data collection to achieve demographic balance according to gender (male/female), age groups (youth, adult, elderly) and frequency of visiting the park (frequent and occasional users). This systematic and quota-based sampling methodology guaranteed consistency and representativeness of selection and minimized sampling bias.

D. Data Collection Instruments

Data collection was conducted using two main tools, namely a structured questionnaire and a structured observation schedule. This questionnaire was theory-based and was divided into three main sections. The introduction part gathered data about the socio-economic and park utilization attributes of the respondents. The second part concerned perceived safety and perceived crime incidence, and it was measured on a seven-point Likert scale and the response was based on 1 (Never), 2 (Always), up to 7 (Very Frequently). The third part was a study on landscape design and safety variables, which was measured on a five-point Likert scale, where 1 (Strongly Disagree) to 5 (Strongly Agree) was used. The items in the questionnaire were based on the Crime Prevention Through Environmental Design (CPTED) principles that encompass the natural surveillance, access control, territorial reinforcement, maintenance, activity support, and security management. Moreover, a professional assessment tool was conducted on the professionals to confirm the relative significance of landscape-security variables.

It was also necessary to translate theoretical constructs into physical indicators that could be measured in the park, and so an observation schedule was created. The observation checklist was based on a five-point ordinal scale, with 1 (Very Poor) to 5 (Excellent). They evaluated six key categories, namely, natural surveillance, territoriality, access control, target hardening, maintenance and management, and activity support. Certain variables that were reviewed were the sufficiency of lighting, density of vegetation, signs, boundaries, walkway, and the quality of infrastructure.

E. Validity and Reliability

Expert review guaranteed content validity because it ensured that the instruments matched the relevant theoretical constructs (Lechien *et al*., 2023; Sukmawati, 2023). Face validity was determined through pilot testing of the users of the park to ensure that the items were clear and suitable. The Exploratory Factor Analysis (EFA) was performed in two phases: the pilot phase to optimize the structure of the instrument and the final phase with the actual dataset to determine the latent dimensions. Initial data testing ensured the appropriateness of the data in factor analysis, where Kaiser-Meyer-Olkin (KMO) was 0.82 and Bartlett Test of Sphericity was significant. The final instrument was dropped to items whose factor loadings were less than 0.40.

The reliability testing conducted by the use of Cronbachs Alpha showed that the scales had high internal consistency. The Perceived Crime Incidence Scale had a reliability coefficient of 0.88, the Landscape Design-Security Scale had 0.90, and the Observation Scale had 0.86. These values ensured that the instruments were valid to use in the study.

F. Statistical Analysis and Framework Analysis.

Statistical Package for the Social Sciences (SPSS) Version 27 was used to analyse the data. The variables of the study were summarised using descriptive statistics and to test the relationship among the variables of landscape design and the outcomes of security, inferential statistical techniques were applied. Perceived safety was determined using composite indices. The Mean Crime Perception (MCP) was derived as the average of the crime perception scores by taking the mean of all the scores by the following formula:

$$MCP = \frac{\sum S_i}{n} \quad (3)$$

where S_i represents individual item scores and $n$represents the number of items. Lower MCP values indicated higher perceived safety. To standardise the safety measure, a Weighted Crime Safety Index (WCSI) was computed using min–max normalisation:

$$WCSI = 1 - \frac{(MCP - MCP_{min})}{(MCP_{max} - MCP_{min})} \quad (4)$$

While individual Likert-scale items are ordinal, psychometric literature widely supports that composite scores derived from averaging multiple Likert items with high internal consistency ($\alpha > 0.70$) approximate continuous, interval-level data (Carifio & Perla, 2007; Norman, 2010). Given the high reliability coefficients ($\alpha = 0.86$–0.90) of our scales, treating the averaged composite scores as interval data is statistically justified. Consequently, min-max normalization was appropriately applied to rescale these continuous composite scores to a standardized 0–1 range, forming the WCSI. This normalization preserves the underlying data distribution and variance while allowing for meaningful cross-park comparisons.

This conversion scaled the MCP values to a standardized 0-1 range. The inversion facilitated interpretation, where higher WCSI values indicate better perceived safety conditions. Rather than using arbitrary thresholds, the WCSI performance categories were empirically derived based on the sample's descriptive statistics (mean and standard deviation). Specifically, scores falling within one standard deviation above the mean (WCSI $\geq$ 0.68) were classified as 'high perceived safety', scores within one standard deviation below the mean (WCSI $\leq$ 0.61) as 'low perceived safety', and the interquartile range as 'moderate perceived safety'. This data-driven approach ensures the categories reflect the actual distribution of user perceptions in the study area..

Inferential statistics were used to examine the correlations between variables. Chi-square tests were employed to test the associations among landscape design variables and perceived safety. Exploratory Factor Analysis (Principal Component Analysis and Varimax rotation) was used to determine the latent dimensions of the study variables. In alignment with the cross-sectional study design, all results were strictly viewed as associative correlations.

IV. RESULTS AND DISCUSSION

A. Physical Landscape Characteristics and Security Performance

According to the results presented in Table 1, CPTED strategies in Lagos recreational parks are not effective due to single design factors, but to the combination of spatial planning, maintenance, and proactive management. The effect of the interventions on the physical design of the parks is significantly enhanced by the management coherence, which implies that the performance of the parks managed privately (ORP and AAP) is typically much higher than that of the government-managed parks on all dimensions. This helps in arguing that recreational parks security is a design-management interaction process, as opposed to design presence.

Considering the Design Integration dimension of the ILSF, the visibility related variables, spatial organisation related variables and user activity pattern variables come out as major predictors of security outcomes. Lighting sufficiency, entrance brightness, and spatial distribution of activity areas are the key factors in improving natural surveillance and presence of users. This is in line with literature that has emphasized the significance of visibility in the formation of safety outcomes (El-Metwally *et al*., 2021; Sezavar *et al*., 2023), and builds on studies that have also identified the influence of spatial configuration in enabling surveillance (Dizdaroglu, 2022; Mak and Jim, 2022). Nonetheless, the findings indicate that such correlations are very situational. Specifically, vegetation displays a dual nature: on the one hand, it helps to improve the quality of the environment; on the other hand, ill-maintained vegetation makes sightlines shorter, and creates the opportunity to hide. This result opposes traditional CPTED implementations that focus on permeability and greenery without considering the visibility trade-offs (Lee, 2022; Yoade *et al*., 2023). The Maintenance and Lighting dimension comes out as a prevailing security performance determinant. Lighting reliability, cleanliness and vegetation management are not merely physical conditions, they also serve as indicators of governance and territorial control. This observation builds on the current literature by showing that lighting is not an indicator of institutional effectiveness and management presence but functions outside a visibility mechanism. Parks that are maintained regularly have greater perceived safety, which substantiates the claim that environmental maintenance enhances territoriality and decreases crime chances (Badiora *et al*., 2021). On the other hand, environments that are not well maintained indicate lack of attention, and user confidence is diminished as well as informal surveillance becomes weak. The findings are highly supportive of the ILSF since they establish the fact that Design Integration and Maintenance and Lighting are dependent dimensions.

Table 1 Physical Landscape Characteristics and Security Performance

CPTED Dimension	**Key Metrics**	**Overall Mean**	**Top-Performing Parks**	**Low-Performing Parks**	**Critical Influencing Variable**
Natural Surveillance	Lighting adequacy; viewscapes/sightlines; seating visibility; vegetation height and density; noise level; signage/wayfinding	3.13 (Fair)	ORP (4.0); AAP (3.8)	NKP (2.5); RJP (2.8)	Lighting adequacy (3.14) and vegetation management (2.96)
Territorial Reinforcement	Formal entrances/gateways; signage/branding; edge definition; civic symbols/public art; stewardship/ownership; management presence	3.20 (Moderate)	ORP (4.12); AAP (3.80)	NKP (2.58); RJP (2.85)	Management presence (3.08) and stewardship (3.11)
Access Control	Defined entry points; perimeter fencing; security at gates; lighting at entrances; CCTV; pedestrian–vehicular segregation; emergency access	3.44 (Fair–Good)	ORP (4.54); AAP (4.29)	BRP (2.86); RJP (2.96)	Security presence at gates (3.42) and lighting at entrances (3.47)
Target Hardening	Perimeter fencing quality; security lighting; guardrails/bollards; vandal-resistant fixtures; CCTV; lighting maintenance	3.22 (Moderate)	ORP (4.47); AAP (4.15)	BRP (2.70); NKP (2.63)	Security lighting (3.42) and lighting maintenance (3.36)
Maintenance and Management	Cleanliness; vegetation height and density; tree canopy management; structures (benches, toilets, fences); sustainability features	3.30 (Fair–Good)	ORP (4.10); MOP (3.70)	NKP (2.60); RJP (2.90)	Vegetation management (3.20) and cleanliness (3.40)
Activity Support	Recreational facilities; water features; microclimate areas; park size and spatial distribution; topography; event/social zones	3.40 (Moderate)	ORP (4.30); AAP (4.10)	NKP (2.80); BRP (2.90)	Park size and spatial distribution (3.60) and event zones (3.50)

Source: Field Survey (2025); F = Frequency, % = Percentage; S = Significant (p < 0.05); NS = Not Significant. Park Codes: NKP – Ndubuisi Kanu Park; DOAFP – Dr. Oluyomi Abayomi Finnih Park; MOP – Muri Okunola Park; SP – Skate Park; RJP – Rafiu Jafojo Park; GFP – Gani Fawehinmi Park; BRP – Badagry Recreational Park; AAP – Apapa Amusement Park; ORP – Omu Resort Park.

B. *Crime Incidence and Safety Indices*

Crime incidence analysis (Table 2a) indicates that social disorder and property related crimes prevail in the Lagos recreational parks security environment with violent crimes being low. The most common incidents become verbal abuse, pick pocketing and theft, which means that in this kind of environment crime is mostly opportunistic and interaction-based and not violent. The trend is consistent with the results that areas with high pedestrian traffic and poor coverage have a higher probability of low-level but frequent crimes (Lee, 2022; Yoade *et al*., 2023).

Regarding the security outcomes, the park-level indices (Table 2b) are based on an apparent hierarchy of safety performance. The two parks that have the highest WCSI scores are ORP and NKP, whereas AAP has the lowest, which proves that ownership structure is not the sole factor that determines safety performance. Rather, the differences are a manifestation of differences in the integration of the design, maintenance and management systems and support the primary reasoning of the ILSF. The negative correlation existing between Mean Crime Perception (MCP) and WCSI proves the fact that fear of crime is more or less consistent with the apparent state of the environment, but it is not entirely subjective.

Parks that have low MCP values always have higher WCSI scores which implies that the better the environmental quality and management, the lower the perceived and actual experience of crime events. Crime incidence distribution shows the importance of Design Integration in organizing opportunity. Pick pocketing and theft are high frequency crimes that are concentrated in the environment where movement is less controlled and surveillance is not regular. This helps the concepts of opportunity reduction whereby spatial arrangement contributes to the probability of crime occurrence. In parks that have a more well-defined territoriality and structure to activity areas, there is less exposure to those incidents, which supports the relevance of access control and spatial legibility in determining the outcome of security.

The difference in the scores of WCSI also highlights the importance of Maintenance and Lighting as operational determinants of safety. Parks with above moderate levels of safety have a high degree of consistency in terms of environmental maintenance, control of vegetation as well as reliable lighting facilities whereas low performing parks are those that lack maintenance deficiencies as well as poor environmental control. This reinforces the thesis that maintenance is a governance cue, which affects user trust and perception of offenders (Badiora *et al*., 2021). The Lagos results add to the current literature by showing that vegetation management is a mediating variable of great importance. Although greenery positively affects the quality of the environment, uncontrolled vegetation destroys visibility and offers hiding places, which confirms the results of Mak and Jim (2022) and Widya Putra *et al*. (2023).

Table 2a Crime Incidence Means and Rankings Across Recreational Parks

Nature of Crime	Mean	SD	Rank
Social/Disorder Crimes			
Verbal Abuse	3.91	0.09	1
Pickpocketing	3.80	0.12	2
Underage Drinking	3.45	0.11	3
Theft	3.44	0.16	4
Larceny	3.21	0.13	5
Motor Vehicle Theft	3.05	0.13	6
Burglary	2.82	0.11	7
Bullying	2.60	0.11	8
Robbery	2.43	0.13	9
Aggravated Assault	2.22	0.10	10
Child Abuse	1.94	0.07	11
Rape	1.54	0.07	12
Arson	1.43	0.06	13
Criminal Homicide	1.31	0.05	14
Human Trafficking	1.30	0.06	15
Murder	0.00	0.00	16

Table 2b Park Safety Indices and Dominant Crime Patterns

Park	MCP	WCSI	Rank	Safety Category	Dominant Crimes
ORP	2.35	**0.71**	**1st**	High Safety	Verbal abuse; underage drinking
NKP	2.48	**0.70**	**2nd**	Moderate Safety	Theft; pickpocketing; verbal abuse
RJP	2.60	0.68	3rd	Moderate Safety	Larceny; verbal abuse; burglary
MOP	2.75	0.67	4th	Moderate Safety	Pickpocketing; verbal abuse
DOAFP	2.91	0.64	5th	Moderate Risk	Theft; underage drinking
GFP	2.95	0.63	6th	Moderate Risk	Theft; pickpocketing
SP	3.05	0.61	7th	Low Safety	Theft; bullying
BRP	3.10	0.60	8th	Low Safety	Pickpocketing; theft
AAP	3.20	**0.58**	**9th**	Low Safety	Theft; robbery; bullying

Source: Field Survey (2025); *F = Frequency, % = Percentage; S = Significant ($p < 0.05$); NS = Not Significant.* **Park Codes:** NKP – Ndubuisi Kanu Park; DOAFP – Dr. Oluyomi Abayomi Finnih Park; MOP – Muri Okunola Park; SP – Skate Park; RJP – Rafiu Jafojo Park; GFP – Gani Fawehinmi Park; BRP – Badagry Recreational Park; AAP – Apapa Amusement Park; ORP – Omu Resort Park. and Figures in parenthesis are percentage

Socio-Economic Determinants of Safety Perception

The analysis in Table 3 shows that socio-economic attributes do not work in isolation, but they interact with environmental factors to influence the outcome of security, which result in varied patterns of park utilization in Lagos recreational areas. There is a statistically significant difference in age, gender, education, income and proximity across parks thus there is a regular association between the various user groups and specific park situations. The population of middle-aged users is the most active in parks, which is related to the increased level of safety concern and the family-based nature of recreation, in line with Levinger *et al*. (2022) and Kimic and Polko (2022). Gender differences also show that female users are less represented in parks with low-quality surveillance and lighting, which supports the results by Kimic and Polko (2022) and Ajayi *et al*. (2020) on gendered safety perception.

Education and income become the important structuring variables. Better-maintained parks have a higher concentration of higher-educated and higher-income users and, consequently, endorse Odufuwa *et al*. (2019), Austin *et al*. (2021), and Bottero *et al*. (2022). It means that access to safer recreational spaces is not distributed equally but is related to socio-economic capacity, which expands Ajayi *et al*. (2020) and Kimic and Polko (2022).

One such critical result is the development of spatial sorting, whereby users individually volunteer to attend parks depending on their perceptions of safety and environmental quality. Proximity analysis demonstrates that users will be ready to travel further to visit safer parks, which confirms Powers *et al*. (2022) and expands Badiora *et al*. (2021) by identifying a proximity-security trade-off. On the other hand, low-income and unemployed users are clustered in parks of weaker safety conditions, meaning that they are constrained in their choice but not preference. This trend indicates that security consequences are socially distributed, so population groups that are vulnerable are more likely to be exposed to less effective CPTED ecosystems.

Occupation and visit frequency do not show a statistically significant difference but when they are distributed, they depict significant behavioral dynamics. The higher-safety parks are concentrated with frequent users, whereas lower-safety locations are concentrated with infrequent users, indicating that park usage is an adaptive behavior, where perceived risk affects behavioral response and not an apathetic behavioral pattern. This agrees with Badiora and others (2021) who emphasize behavioral adaptation to environmental insecurity, and builds on Powers *et al*. (2022) and Levinger *et al*. (2022) by showing that occupational status affects exposure to various safety environments.

C. Design-Safety Relationships

In Table 4, the chi-square test shows that all the five elements of CPTED design were significantly related with perceived safety ($p < 0.05$), which indicates that environmental configuration is systematically related to user security assessment in Lagos recreational parks.

Natural surveillance is the predictor of perceived safety and the most powerful, which supports its primary role in determining both visibility and user confidence. This supports Kimic and Polko (2022) who state that unobstructed sightlines are the key factor in augmenting the risk of offender detection, and builds upon Levinger *et al*. (2022) by showing that openness not only lowers the risk of opportunity but also provides a sense of psychological comfort in the area where formal surveillance is constrained.

The second most effective is the access control, which emphasizes the significance of the organized entry points and boundary delineation to control the movement and improve spatial legibility. This confirms Ajayi *et al*. (2020) and Odufuwa *et al*. (2019) and indicates that well-defined access systems are powerful predictors of safety outcomes in high-density settings. Markedly, its comparative power in comparison with territorial reinforcement suggests that physical controls might be more directly practical than symbolic ownership indicators in high-user-turnover situations.

Territorial reinforcement demonstrates a strong yet relatively less effective connection with perceived safety, implying that signage, spatial definition, and ownership cues play a role in informal control, but their performance is enhanced by combining physical design and active control. This is in line with Austin *et al*. (2021) and further advances Bottero *et al*. (2022) by stating that territoriality is a relational process and not a strictly physical intervention. Lighting and maintenance also show strong relationships with perceived safety, although their relatively low effect indicates that they are operational facilitators, but not primary predictors. This confirms Powers *et al*. (2022) and Badiora *et al*. (2021), who suggest that illumination and maintenance contribute to the improvement of safety conditions, but only in case of an already effective spatial setup.

In general, the chain of associations: Natural Surveillance > Access Control > Territorial Reinforcement > Lighting > Maintenance proves that spatial configuration is the basis of safety results, and maintenance and lighting are the boosters in the ILSF framework..

Table 3 Distribution of socio-economic characteristics

Variable	Category	NKP	DOAFP	MOP	SP	RJP	GFP	BRP	AAP	ORP	Pooled (%)	Statistical Test
Age (Years)	<19	2.4	5.1	5.9	10.4	3.8	6.4	11.8	8.2	4.7	6.6	χ^2 = 28.642, p = 0.041 (S)
	20–30	14.3	20.5	21.6	25.0	18.9	19.1	25.5	24.5	16.3	20.8	
	31–40	40.5	28.2	25.5	18.8	28.3	27.7	21.6	26.5	20.9	26.3	
	41–50	26.2	23.1	27.5	20.8	26.4	25.5	21.6	20.4	20.9	23.6	
	51–60	16.6	23.1	19.6	25.0	22.6	21.3	19.6	20.4	18.6	20.8	
Gender	Male	54.8	51.3	51.0	64.6	56.6	57.4	62.7	67.3	55.8	58.2	χ^2 = 12.486, p = 0.023 (S)
	Female	45.2	48.7	49.0	35.4	43.4	42.6	37.3	32.7	44.2	41.8	
Education	No formal	0.0	2.6	0.0	2.1	1.9	0.0	3.9	2.0	0.0	1.4	χ^2 = 45.892, p = 0.011 (S)
	Primary	2.4	5.1	5.9	4.2	3.8	6.4	5.9	4.1	2.3	4.5	
	Secondary	16.7	15.4	19.6	16.7	17.0	17.0	17.6	14.3	13.9	16.5	
	ND/NCE	19.0	20.5	19.6	18.8	18.9	19.1	17.6	18.4	16.3	18.7	
	BSc/HND	45.2	46.1	41.2	41.7	43.4	46.8	39.2	46.9	41.9	43.5	
	MSc/PhD	16.7	10.3	13.7	16.7	15.1	10.6	15.7	14.3	18.6	14.7	
Distance (km)	<1	23.8	20.5	21.6	20.8	22.6	21.3	17.6	22.4	18.6	21.0	χ^2 = 16.885, p = 0.032 (S)
	2–3	16.7	15.4	13.7	14.6	15.1	14.9	15.7	12.2	14.0	14.7	
	4–6	11.9	10.3	9.8	10.4	9.4	8.5	7.8	8.2	7.0	9.2	
	>7	4.8	5.1	3.9	4.2	5.7	4.3	5.9	4.1	4.7	5.0	
Income (₦)	<100k	28.6	25.6	25.5	22.9	24.5	21.3	21.6	24.5	23.3	24.1	χ^2 = 18.462, p = 0.021 (S)
	100–200k	21.4	17.9	17.6	16.7	17.0	17.0	15.7	18.4	18.6	17.7	
	200–300k	14.3	12.8	9.8	10.4	9.4	8.5	9.8	8.2	7.0	9.9	
	300–400k	7.1	7.7	5.9	6.3	5.7	6.4	5.9	6.1	4.7	6.1	
	>400k	4.8	2.6	3.9	2.1	3.8	2.1	3.9	2.0	2.3	3.1	
Occupation	Professional	14.3	12.8	15.7	14.6	11.3	10.6	11.8	10.2	9.3	12.3	χ^2 = 34.125, p = 0.610 (NS)
	Civil Servant	19.0	15.4	17.6	16.7	17.0	14.9	15.7	14.3	14.0	16.1	
	Business	16.7	15.4	15.7	14.6	15.1	12.8	13.7	12.2	14.0	14.4	
	Artisan	11.9	10.3	9.8	10.4	11.3	10.6	9.8	10.2	9.3	10.4	
	Student	23.8	23.1	21.6	20.8	22.6	21.3	21.6	20.4	20.9	21.8	
	Unemployed	14.3	23.1	19.6	22.9	22.6	29.8	27.5	32.7	32.6	25.0	
Visit Frequency	Rarely	33.3	33.3	31.4	31.3	32.1	31.9	31.4	30.6	32.6	31.9	χ^2 = 13.838, p = 0.123 (NS)
	Occasionally	38.1	35.9	37.3	37.5	37.7	38.3	37.3	36.7	37.2	37.4	
	Frequently	28.6	30.8	31.4	31.3	30.2	29.8	31.4	32.7	30.2	32.1	

Source: Field Survey (2025); F = Frequency, % = Percentage; S = Significant (p < 0.05); NS = Not Significant.

Park Codes: NKP – Ndubuisi Kanu Park; DOAFP – Dr. Oluyomi Abayomi Finnih Park; MOP – Muri Okunola Park; SP – Skate Park; RJP – Rafiu Jafojo Park; GFP – Gani Fawehinmi Park; BRP – Badagry Recreational Park; AAP – Apapa Amusement Park; ORP – Omu Resort Park.

Table 4 Chi-square matrix of design variables vs. perceived safety

Design Element	Highly Effective F(%)	Effective F(%)	Moderately Effective F(%)	Ineffective F(%)	Not Effective F(%)	Mean	SD	χ^2	p-value	Remark
Natural Surveillance (visibility, openness, sightlines)	173 (41.0)	137 (32.3)	73 (17.3)	27 (6.3)	13 (3.0)	4.02	0.89	12.327	0.032	S
Access Control (entry points, fencing, pathways)	143 (33.7)	158 (37.3)	76 (18.0)	30 (7.0)	17 (4.0)	3.89	0.94	14.229	0.027	S
Territorial Reinforcement (signage, space definition, ownership cues)	126 (29.7)	166 (39.3)	80 (19.0)	33 (7.7)	18 (4.3)	3.83	0.91	11.452	0.041	S
Lighting Adequacy (illumination, visibility at night)	151 (35.7)	144 (34.0)	76 (18.0)	33 (7.7)	18 (4.3)	3.89	0.95	10.834	0.035	S
Maintenance Quality (cleanliness, repair, landscape care)	159 (37.7)	152 (36.0)	68 (16.0)	30 (7.0)	13 (3.0)	3.98	0.90	9.214	0.041	S
Total (N = 423)										

Source: Field Survey, 2025. **S = Significant, NS = Not Significant at p < 0.0**

D. Factor Analysis and Integrated Landscape–Security Framework

The factorability diagnostics confirm that the dataset is good to be reduced to dimensions. Table 5 reveals that both Kaiser-Meyer-Olkin (KMO) measure and Bartlett Test of Sphericity pass the necessary levels, meaning that the correlation is not random and that enough shared variance exists between the variables. This aids in the derivation of latent dimensions behind security results and confirms Arabi *et al*. (2020), who determine that high KMO values represent sufficient sampling merit. The finding also confirms Lee (2022) about the significance of preliminary validation in CPTED research and agrees with El-Metwally *et al*. (2021), who prove that landscape-security interactions are characterized by coherent structural organization.

The extraction of the factors as shown in Table 6 depicts a definite two-dimensional format which means that the effectiveness of CPTED in the recreational parks of Lagos is structured around distinct yet related factors. Such dimensions represent spatial and functional elements of park settings, which validate Odufuwa *et al*. (2019), who reveal that CPTED variables accumulate into discrete elements. The finding supplements Badiora *et al*. (2021) by separating design-related and operational determinants of security outcomes and refutes unitaristic interpretations of CPTED by determining that security outcomes are determined by interaction between spatial configuration and maintenance conditions, and not individual-factor design compliance.

Additional rotation of the component matrix in Table 7 reveals a clean and theoretically sound structure with strong loadings and low cross-loading among the variables. The first one, which can be interpreted as Design Integration, combines natural surveillance, access control, and territorial reinforcement, and it is confirmed that the three work as an integrated system of opportunity reduction. Notably, the perceived safety of users loads more on this aspect, which means that perceived safety is more aligned with the spatial configuration, and not the operational conditions per se. The finding supports Lee (2022) and El-Metwally *et al*. (2021), who highlight the primacy of the environmental design in the formation of the perception of safety, and expands on the works by showing that, in the Lagos context, the concept of design integration has a dual effect on crime (as an event) and fear of crime (as a perception).

The second variable, which is interpreted as Maintenance and Lighting also separates the operational variables to ensure that these two variables are independent but complementary determinants of security outcomes. This confirms Badiora *et al*. (2021) that the factor of maintenance is critical to environmental safety and goes a step further to show that lighting and maintenance do not co-occur with the variables of spatial design. The difference between these factors suggests that design integration offers structural base to crime reduction opportunities, but maintenance and lighting are operational amplifiers that determine user confidence and fear of crime.

Based on the empirical framework based on Tables 5-7, the concept of Integrated Landscape-Security Framework (ILSF) views the park safety as a two-dimensional system that combines the design and operational dynamics.

Table 5 KMO and Bartlett's Test

Test Parameter	Value	Threshold Criterion
Kaiser-Meyer-Olkin (KMO) Measure	0.812	≥ 0.60 (Acceptable)
Bartlett's Test of Sphericity χ^2	312.476	
Degrees of Freedom (df)	15	
Significance (p-value)	0.000	≤ 0.05 (Significant)

Source: Field Survey, 2025.

Table 6 Total Variance Explained

Component	Initial Eigenvalue	% of Variance	Cumulative %	Extraction Sums of Squared Loadings (Rotation Varimax)
Factor 1	2.784	46.4	46.4	2.412
Factor 2	1.224	20.4	66.8	1.168
Factor 3	0.627	10.4	77.2	
Factor 4	0.525	8.7	85.9	
Factor 5	0.441	7.4	93.3	
Factor 6	0.401	6.7	100.0	

Extraction Method: Principal Component Analysis. **Rotation Method:** Varimax with Kaiser Normalization. **Source:** Field Survey, 2025.

Table 7 Rotated Component Matrix

Landscape Design Variables	Factor 1 (Design Integration)	Factor 2 (Maintenance and Lighting)	Communalities
Natural Surveillance	0.812	0.122	0.693
Access Control	0.785	0.155	0.647
Territorial Reinforcement	0.763	0.194	0.616
Lighting Adequacy	0.184	0.853	0.752
Maintenance Quality	0.212	0.821	0.708
User Safety Perception	0.694	0.332	0.573

Source: Field Survey, 2025

The framework, as shown in Figure 2, operationalizes six interconnected strategies, which include improving visibility and sightlines, establishing access and circulation paths, reinforcing territorial ownership, providing sufficient lighting, maintaining regular maintenance, and empowering management and community engagement. These results support El-Metwally *et al*. (2021) and Arabi *et al*. (2020) on primacy of visibility in crime deterrence, Mak and Jim (2022) on the importance of consistency of maintenance, and Navarrete-Hernandez *et al*. (2023) on the role of spatial legibility and territorial definition.

On the whole, the ILSF shows that the results of security development are a product of the synchronization of spatial planning and operational management. The main ways through which design integration decreases opportunities of crime include structuring of visibility and access, and maintenance and lighting affect fear of crime by indicating institutional control and environmental order. Management and community participation is a bridging mechanism that maintains the two dimensions in the long run. That makes the ILSF a context-aware extension of CPTED, especially appropriate in environments where maintenance regularity and administrative capability are dynamics.

E. Expert Validation of the Integrated Landscape–Security Framework

The expert judgement offered in Table 8 shows that there is a great deal of agreement about the applicability of the Integrated Landscape–Security Framework (ILSF) design strategies, which validates the content validity of the framework in the Lagos recreational park setting. The consensus of the reviewed strategies is above the accepted levels, which proves that the framework is theoretically based and practically implementable. This strengthens the effectiveness of the ILSF as a context-sensitive model of enhancing perceived safety outcomes and security results. One of the most noticeable trends that came out of the validation is the focus on the surveillance-related interventions, specifically the combination of active management (CCTV and the presence of personnel) and visibility-oriented design. Professionals have always found these measures to be the most applicable, which shows that positive safety perceptions are based on the integration of formal guardianship and environmental presence, and not on passive design alone.

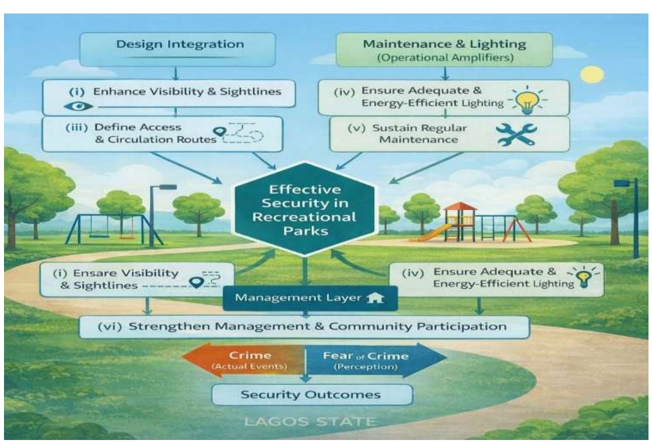

Figure 2 The Integrated Landscape-Security Framework (ILSF) Diagram

This observation supports El-Metwally *et al*. (2021) and Arabi *et al*. (2020), who highlight that visibility is the core of crime prevention but goes further to show that technology-aided surveillance in Lagos is in co-determination with natural surveillance in fostering perceived safety. Vegetation control is also confirmed as the fundamental part of the framework as it can play a dual role of facilitating or hindering surveillance based on the quality of management. This backs Mak and Jim (2022), who emphasize the significance of landscape regulation based on maintenance and helps to support the thesis that unregulated greenery can make people more afraid of crime because it provides an opportunity to hide, whereas controlled vegetation improves visibility and makes users less intimidated by crime.

Conversely, spatial organization techniques like specified routes and sitting patterns although rated positively, are perceived by scholars to be enabling, but not determining factors of security. This is consistent with the findings of Navarrete-Hernandez *et al*. (2023), which pinpointed spatial legibility and circulation as relevant to user direction and movement, but proposes that deterrence-oriented interventions prevail over amenity-oriented design in security-constrained space like Lagos. These aspects thus play a more indirect role in organizing movement and facilitating surveillance, and not necessarily as independent security measures.

Notably, the validation findings support the overall idea that the ILSF has, which is that security outcomes are generated by the combination of design, management, and maintenance systems. Although design integration diminishes crime opportunities (events), lighting, maintenance and active management are the main operational strategies that affect fear of crime (perception) by cueing control, order and institutional presence. The consensus among professionals is high enough to suggest that neither of the two dimensions is effective on its own; instead, the combination of the two defines overall performance.

The fact that the expert opinion has converged, despite the difference in discipline background, is another indication that confirms that the ILSF is applicable and not biased towards any discipline. This forms the framework as a plausible foundation of evidence-based planning of perceived park security, especially in settings where there is high user density and unstable governance capacity. In this respect, the ILSF expands the traditional CPTED uses by instituting a hybridized model of active and passive surveillance, in which technological systems, environmental design and management practices are synergistic elements of security provision.

Table 8 Expert Consensus Assessment of ILSF Design Strategies (n=12)

Design Strategy	Very Relevant %	Relevant %	Moderately Relevant %	Not Relevant %	Mean	SD	I-CVI	S-CVI/UA	Consensus Level
CCTV and park management presence	50.0 (6)	33.3 (4)	8.3 (1)	8.3 (1)	4.25	0.87	0.83	0.92	Excellent
Improved lighting and visibility	50.0 (6)	33.3 (4)	8.3 (1)	8.3 (1)	4.25	0.87	0.83	0.92	Excellent
Vegetation control for clear sightlines	41.7 (5)	41.7 (5)	8.3 (1)	8.3 (1)	4.17	0.83	0.83	0.92	Excellent
Defined pedestrian pathways and entry zones	41.7 (5)	33.3 (4)	16.7 (2)	8.3 (1)	4.08	0.90	0.75	0.83	Good
Strategic seating and gathering areas	33.3 (4)	41.7 (5)	16.7 (2)	8.3 (1)	4.00	0.84	0.75	0.83	Good

Expert Composition: Park Managers (5), LASPARK Officials (3), Urban Planners (2), Security Consultants (2) **Rating Scale:** 4=Very Relevant, 3=Relevant, 2=Moderately Relevant, 1=Not Relevant **I-CVI (Item Content Validity Index):** Proportion of experts rating ≥3 (Relevant or above); **S-CVI/UA (Scale Content Validity Index/Universal Agreement):** Average I-CVI across all items. **Source:** Field Expert Survey, 2025.

V. CONCLUSION

The research establishes that landscape design and maintenance together significantly correlate with perceived safety outcomes in recreational parks, leading to the creation of the Integrated Landscape–Security Framework (ILSF). This framework functions as an evidence-based, context-sensitive model for assessing and enhancing perceived safety in urban parks. The framework demonstrates that Design Integration (encompassing natural surveillance, access control, and territorial reinforcement) establishes the structural conditions that reduce the perception of crime opportunities, while Maintenance and Lighting serve as operational systems that sustain perceived security and build user trust over time. The validation of this two-dimensional structure established that perceived safety outcomes are generated through the synergy of spatial design and continuous management practices, rather than through isolated design interventions.

The ILSF offers practical implementation tools that extend beyond its theoretical scope. It serves as a diagnostic tool for park managers to prioritize interventions based on anticipated impacts on perceived safety. For instance, areas with poor visibility should be prioritized for vegetation management and lighting improvements, as these elements yield stronger perceived safety benefits than purely aesthetic upgrades (e.g., surface finishes and decorative elements). Furthermore, maintenance schedules should prioritize surveillance efficiency rather than aesthetics as the sole basis for decision-making.

For urban planners, the ILSF provides a design review system applicable to both new park construction and the enhancement of existing parks. Design teams must establish spatial elements such as sightlines, access points, and boundary definitions, early in the project approval process. Crucially, maintenance planning must be integrated as a fundamental requirement, ensuring that operational capacity supports design intentions rather than being treated as an afterthought. The framework also enables policymakers to optimize resource allocation by distinguishing between capital investment needs (Design Integration) and ongoing operational costs (Maintenance and Lighting). This distinction mitigates the common practice of building infrastructure without planning for future maintenance, which can severely compromise perceived public safety. Municipal authorities can utilize the framework to support evidence-based decision-making, directing funding toward safety improvements in high-risk areas that require enhanced visibility, access control, and maintenance.

Despite its significant contributions, this study has key limitations that must be acknowledged. First, the analysis relies on perceived crime and safety data, capturing how users experience fear of crime rather than measuring actual rates of criminal activity. Consequently, the findings should be understood as indicators of perceived security, not as reflections of objective crime statistics. Second, the cross-sectional research design restricts the study to identifying associations and patterns; it cannot reveal causal relationships or direct temporal effects (i.e., it cannot definitively prove that specific design changes cause a reduction in actual crime).

Future research could employ specific, testable designs to build upon these findings. Longitudinal studies are necessary to determine whether enhancements in ILSF indicators (e.g., improved lighting and vegetation management) result in sustained improvements in perceived safety indices and increased user diversity over time. Additionally, the framework requires validation through comparative studies across different Global South cities to identify which components require contextual adaptation. Future research should also investigate how smart lighting systems and community-based monitoring tools can be integrated with digital solutions to optimize environmental design and management. Ultimately, the ILSF promotes effective park safety design by emphasizing the ongoing relationship between physical planning, operational management, and user perception, thereby fostering environments where the public feels secure.

AUTHOR CONTRIBUTIONS

O. A. Adebayo served as the main author and student researcher, responsible for conceptualization, methodology development, data collection, formal analysis, writing of the original draft, and visualization. **P. Ayuba, I. B. Muhammad**, and **A. D. Isah** served as supervisors, guiding theoretical framework development, methodology review, data validation, and critical review and editing of the manuscript. All authors have read and agreed to the published version of the manuscript.

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REFERENCES

Aboah, A., **Wang, B.**, **Bagci, U.**, & **Adu-Gyamfi, Y.** (**2023**). Real-time multi-class helmet violation detection using few-shot data sampling technique and YOLOv8. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 5349–5357).

Ajayi, A. O., **Atanda, C.**, & **Ajayi, A. O.** (**2020**). Evaluation of crime and safety in Lagos metropolitan parks. *UNIOSUN Journal of Engineering and Environmental Sciences*, 2(2), 78–86.

Arabi, M., **Naseri, T. S.**, & **Jahdi, R.** (**2020**). Use of all generations of CPTED for designing urban historical fabric: Case study of Tehran. *Ain Shams Engineering Journal*, 11(2), 519–533. https://doi.org/10.1016/j.asej.2019.11.001

Atoyebi, O. S. (**2023**). Landscape design and crime prevention mechanisms in residential areas of Ikeja, Nigeria. *FUOYE Planning Journal*, 6(2), 76–99.

Babamboni, A. S., **Ogunleye, V. T.**, **Ajayi, O. O.**, & **Dare-Abel, O. A.** (**2025**). Urban parks and user well-being in Lagos State. *African Journal of Environmental Sciences and Renewable Energy*, 18(1), 138–153. https://doi.org/10.62154/ajesre.2025.018.010696

Badiora, A. I., **Dada, O. T.**, & **Adebara, T. M.** (**2021**). Environmental design correlates of crime in tourist sites. *Journal of Outdoor Recreation and Tourism*, 35, 100392. https://doi.org/10.1016/j.jort.2021.100392

Bahriny, F., & **Bell, S.** (**2020**). Patterns of urban park use and quality factors. *Sustainability*, 12(4), 1560. https://doi.org/10.3390/su12041560

Bottero, M., **Caprioli, C.**, **Foth, M.**, **Mitchell, P.**, **Rittenbruch, M.**, & **Santangelo, M.** (**2022**). Urban parks and green gentrification. *Urban Forestry & Urban Greening*, 74, 127618. https://doi.org/10.1016/j.ufug.2022.127618

Chen, S., **Sleipness, O.**, **Xu, Y.**, **Park, K.**, & **Christensen, K.** (**2020**). Evaluating non-spatial dimensions of urban parks. *Urban Forestry & Urban Greening*, 53, 126718. https://doi.org/10.1016/j.ufug.2020.126718

Chen, X., & **Marzbali, H. M.** (**2024**). Urban park features and perceived safety. *Cities*, 153, 105272. https://doi.org/10.1016/j.cities.2024.105272

Choi, W., **Na, J.**, & **Lee, S.** (**2024**). Intelligent CPTED systems. *Applied Sciences*, 14(15), 6581. https://doi.org/10.3390/app14156581

Cozens, P., **Babb, C.**, & **Stefani, D.** (**2023**). CPTED audits as an iterative process. *Crime Prevention and Community Safety*, 25, 1–19. https://doi.org/10.1057/s41300-022-00170-0

Dizdaroglu, D. (**2022**). Sustainable urban park design criteria. *Journal of Contemporary Urban Affairs*, 6(1), 69–81.

El-Metwally, Y., **Khalifa, M.**, & **Elshater, A.** (**2021**). Prospect-refuge theory and perceived safety. *Ain Shams Engineering Journal*, 12(4), 4247–4260. https://doi.org/10.1016/j.asej.2021.02.015

Jennings, V., & **Bamkole, O.** (**2022**). Social cohesion and urban green space. *International Journal of Environmental Research and Public Health*, 19(3), 1325. https://doi.org/10.3390/ijerph19031325

Kennedy, L. W., **Caplan, J. M.**, & **Drawve, G.** (**2022**). Data-informed crime prevention. *Police Practice and Research*, 23(2), 125–142. https://doi.org/10.1080/15614263.2022.2038412

Kimic, K., & **Polko, P.** (**2022**). Urban parks and perceived security. *International Journal of Environmental Research and Public Health*, 19(7), 4184. https://doi.org/10.3390/ijerph19074184

Kyaagba, A. J., *et al*. (**2024**). Environmental design strategies in Nigeria. *Path of Science*, 10(12). https://doi.org/10.22178/pos.112-3

Lee, S. (**2022**). Urban design and safety of public spaces. *Journal of Urbanism*, 15(2), 222–240.

Levinger, P., **Cerin, E.**, **Milner, C.**, & **Hill, K. D.** (**2022**). Older people and nature. *International Journal of Environmental Health Research*, 32(6), 1329–1336.

Lis, A., & **Iwankowski, P.** (**2021**). Visual relationships and park safety. *Journal of Environmental Psychology*, 73, 101532. https://doi.org/10.1016/j.jenvp.2020.101532

Mak, B. K., & **Jim, C. Y.** (**2022**). Safety perception in urban parks. *Security Journal*. https://doi.org/10.1057/s41284-022-00351-0

Marzbali, M. H., *et al*. (**2021**). CPTED and urban safety review. *Sustainable Cities and Society*, 68, 102776. https://doi.org/10.1016/j.scs.2021.102776

Mullenbach, L. (**2022**). Defensible space in parks. *Journal of Urban Design and Planning*, 15(3), 215–233.

Navarrete-Hernandez, P., *et al*. (**2023**). Public space regeneration and safety. *Landscape and Urban Planning*, 237, 104809. https://doi.org/10.1016/j.landurbplan.2023.104809

Newman, O. (**1973**). *Defensible space: Crime prevention through urban design*. Macmillan.

Odufuwa, B., *et al*. (**2019**). Perceived personal safety in recreation sites. *Journal of Outdoor Recreation and Tourism*, 25, 24–35. https://doi.org/10.1016/j.jort.2019.03.004

Powers, S. L., *et al*. (**2022**). Intergroup contact in urban parks. *Journal of Leisure Research*, 53(3), 426–449.

Rigolon, A., & **Németh, J.** (**2023**). Green gentrification and equity. *Urban Studies*, 60(5), 987–1005. https://doi.org/10.1177/00420980221134777

Sezavar, N., *et al*. (**2023**). Vegetation and safety perception. *Journal of Cleaner Production*, 403, 136768. https://doi.org/10.1016/j.jclepro.2023.136768

Talal, M. L., & **Santelmann, M. V.** (**2023**). Vegetation management in parks. *Ecological Applications*, 30(4), e02079. https://doi.org/10.1002/eap.2079

Todd, R. (**2023**). Environmental risk and offender behavior. *International Journal of Environmental Research and Public Health*, 20(2), 1045. https://doi.org/10.3390/ijerph20021045

Torabi, F., *et al*. (**2020**). Socio-cultural perceptions of crime. *Journal of Comparative Sociology*, 61(4), 289–306. https://doi.org/10.1177/0020715220904721

UN-Habitat (**2022**). *World Cities Report 2022*. United Nations.

Widya Putra, D., *et al*. (**2023**). Spatial configuration and insecurity. *Frontiers in Built Environment*, 9, 1114968. https://doi.org/10.3389/fbuil.2023.1114968

World Health Organization (**2021**). *Urban green spaces and health: A review of evidence*. WHO Regional Office for Europe. https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/

Yoade, A., **Atoro, T.**, & **Atoyebi, O.** (**2023**). Landscape design and crime prevention in Nigeria. *FUOYE Planning Journal*, 1(2), 463–476.