ICCAUA Proceedings Journal
Proceedings of the international conference of contemporary affairs in architecture and urbanism-ICCAUA
Volume 9 (December 2026), 2610302

Journal homepage: https://journal.iccaua.com/

DOI: https://doi.org/10.38027/ICCAUA2026EN0302

Analysis of Perception, Intensity of Utilization, and Facility Needs in Riverbank Open Spaces: A Multi-Site Survey Study

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Received: 27.04.2026
Revised: 26.06.2026
Accepted: 01.07.2026
Available online: 10.07.2026

This article has been selected and peer-reviewed for publication in this journal as part of the 9th International Conference of Contemporary Affairs in Architecture and Urbanism, held on 7–8 May 2026 in Istanbul, Türkiye.

A b s t r a c t

Riverbank open spaces in urban residential areas provide important environmental and social functions, particularly in densely populated settlements with limited access to formal public spaces. Despite growing interest in waterfront revitalisation, empirical evidence on user satisfaction in informal riverbank settlements remains limited. This study evaluates public perceptions, utilisation intensity, facility needs, and determinants of satisfaction in riverbank open spaces along the Musi River, Palembang, Indonesia. A cross-sectional multi-site survey of 499 respondents was analysed using reliability tests, descriptive statistics, the Kruskal–Wallis test, Spearman correlation, and robust regression. Results indicate high utilisation intensity but only moderate satisfaction with existing conditions. Road quality, representing accessibility, emerged as the strongest predictor of satisfaction, outweighing social cohesion variables. Respondents prioritised waste bins, seating, lighting, and shade trees. The findings provide a low-cost framework for inclusive riverbank regeneration by improving accessibility and essential amenities in emerging cities (Grabowski et al., 2023a), , (Mouratidis, 2024) (Sharifi, 2023); (Shi et al., 2025).

K e y w o r d s : open space; riverbank; public perception; utilisation; accessibility; satisfaction

1. Introduction

Urban open spaces play a crucial role in promoting environmental quality, public health, recreation, and social interaction. Well-functioning public spaces provide opportunities for informal encounters, community bonding, physical activity, and psychological restoration, while also supporting urban resilience and social equity (Grabowski et al., 2023b) (Sharifi, 2023). In residential areas with limited land availability, riverbanks frequently function as substitute public spaces where residents gather, interact, trade, relax, and conduct everyday activities.

In many developing cities, however, riverbank spaces are characterised by complex environmental and spatial challenges, including poor sanitation, flooding, unpleasant odours, inadequate maintenance, limited seating, weak lighting systems, and unsafe pedestrian access. These conditions often reduce user comfort and weaken the long-term social value of open spaces. Previous studies indicate that accessibility, environmental cleanliness, and maintenance quality are among the strongest predictors of user satisfaction in neighbourhood public spaces (Mouratidis, 2024), (Caggiano et al., 2023).

Beyond physical conditions, the social dimension of public space is equally important. Perceived safety, visibility, frequency of activity, social harmony, and neighbourhood trust can significantly shape residents' willingness to use shared environments. Public spaces with strong social meaning often become centres of everyday cohesion and informal support networks, particularly in low- and middle-income communities (Sharifi, 2023). Thus, open spaces should be evaluated not merely by their physical existence, but by the degree to which they function effectively in daily life.

River-oriented settlements in Palembang, particularly along the Musi River, provide an important context for examining these issues. The river has historically shaped settlement patterns, mobility systems, and socio-cultural life. Nevertheless, rapid urbanisation, informal growth, and uneven infrastructure provision have altered the quality and usability of many riverside open spaces. Understanding how residents perceive these spaces, how frequently they use them, and what improvements they prioritise is therefore essential for evidence-based urban planning.

This study addresses three major objectives: (1) to map utilisation patterns and respondent characteristics across several riverbank sites; (2) to assess perceived social quality, community quality, road quality, and overall satisfaction; and (3) to identify priority facility needs for future intervention. Additionally, this study examines whether significant differences exist across locations and which variables most strongly predict satisfaction. The findings contribute to contemporary discussions on inclusive waterfront planning, neighbourhood liveability, and community-based public space management.

1.1 Research Objectives and Questions

The objective of this study is to develop a quantitative understanding of community use and perceptions of riverbank open spaces and to formulate evidence-based priorities for spatial improvement.The research questions are as follows: (1) What are the characteristics of respondents across observation sites ? (2) How frequently are riverbank spaces used, and what activities dominate ? (3) How are social quality, community quality, road quality, and satisfaction assessed ? (4) Are there significant differences in perceptions between locations ? (5) Which variables are most strongly associated with satisfaction ? (6) What facilities are most prioritised by users ?

1.2 Working Hypothesis

The working (operational) hypotheses tested were: (H1) there are differences in open space satisfaction between locations; (H2) road quality (access) is positively associated with open space satisfaction; and (H3) social and community quality is positively associated with satisfaction, although its strength may be weaker than physical/access factors.

2. Material and Method

This study employed a quantitative cross-sectional survey design to examine perceptions, utilisation intensity, and facility needs in riverbank open spaces located in residential areas along the Musi River, Palembang, Indonesia. Cross-sectional surveys are widely used in urban studies to evaluate user behaviour, environmental perceptions, and satisfaction at a specific point in time, particularly when comparing multiple sites with differing contextual characteristics (Mouratidis, 2024), (Sharifi, 2023).

Primary data were collected through structured field surveys administered directly to residents and users of selected riverbank open spaces. Each completed questionnaire represented one respondent. Responses were anonymised to ensure confidentiality and to encourage accurate reporting of attitudes and experiences.

2.1 Study Area, Data Sources and Sample

The study was conducted across several riverbank open-space locations distributed along the Musi River corridor. These sites represent residential river-edge environments with differing levels of accessibility, environmental quality, settlement density, and community activity. A total of 499 respondents participated in the survey. Observation sites were coded as Location 1, Location 2, Location 3, Location 4, and Location 5. Because Locations 4 and 5 contained only a small number of responses, inferential statistical analysis primarily focused on Locations 1–3 to maintain analytical robustness and avoid instability caused by highly unequal group sizes. However, all locations were retained in descriptive reporting. The sample size is considered adequate for non-parametric comparative analysis and multivariable regression in urban perception studies (Hair et al., 2021).

2.2 Instrument Design and Variable Operationalisation

The questionnaire consisted of five major constructs measured using ordinal Likert-type scales (1–5). Composite scores were calculated as the arithmetic mean of item responses within each construct.

Measured Constructs: Procedures

1. Social Quality (27 items)
   Assessed perceptions of safety, visibility, comfort of interaction, activity liveliness, and social atmosphere.
2. Community Quality (10 items)
   Measured harmony, trust, closeness among residents, and shared neighbourhood norms.
3. Road Quality / Accessibility (8 items)
   Evaluated road condition, width, ease of movement, and access convenience.
4. Satisfaction with Existing Open Space Conditions (8 items)
   Assessed overall satisfaction with environmental and physical conditions.
5. Facility Needs (15 items)
   Measured preferences for future improvements such as seating, waste bins, lighting, parks, kiosks, and recreational facilities.

Likert-scale instruments remain one of the most common tools for measuring user perceptions in environmental behaviour and public-space studies due to their simplicity and strong psychometric adaptability (Joshi et al., 2023).

2.3 Data Cleaning and Coding Procedures

Data processing was carried out with the following steps: (a) standardizing the writing of location categories, (b) converting numeric variables (e.g., age) to numeric format, (c) coding ordinal answers to a 1–5 scale. For Likert questions, the categories “Strongly disagree”=1, “Somewhat disagree”=2, “Neutral”=3, “Agree”=4, “Strongly agree”=5. For satisfaction, “Strongly dissatisfied”=1 to “Very satisfied”=5. For frequency of use, “Never”=1 to “Every day/Every time”=5. If multiple answers appeared (e.g., 'Agree, Neutral'), the score was calculated as the average of the listed options.

2.4 Statistical Analysis

Data were analysed using descriptive and inferential statistical procedures. (1) descriptive statistics (mean, standard deviation, median, frequencies, and percentages were used to summarise respondent characteristics, usage patterns, and perception scores.), (2) Reliability Testing Internal consistency of multi-item constructs was evaluated using Cronbach’s alpha (α)**.** Values above 0.70 were considered acceptable, while values above 0.80 indicated good reliability (Hair et al., 2021), (3) Difference Testing Across Locations. Because most variables were ordinal and not assumed to be normally distributed, the Kruskal–Wallis H test was used to compare scores among Locations 1–3. Where significant differences emerged, pairwise comparisons were interpreted with conservative significance adjustment, (4) Correlation Analysis.

Spearman's rank correlation coefficient (ρ) was applied to examine associations between satisfaction and explanatory variables, including social quality, community quality, road quality, age, and utilisation frequency, (5) Multivariable Regression. To test simultaneous predictors of satisfaction**,** Ordinary Least Squares (OLS) regression with HC3 robust standard errors was employed. Robust estimation was selected to minimise bias caused by heteroskedasticity, which is common in survey-based urban datasets. The dependent variable was satisfaction with open-space conditions, independent variables included : Road quality, Social quality , Community quality, Utilisation frequency, Age, Location dummy variables.

2.5 Ethical Considerations

Participation was voluntary. Respondents were informed of the study purpose, and no personally identifying information was recorded. Data were analysed in aggregated form only. The study followed general ethical principles for social survey research involving informed consent, anonymity, and confidentiality.

3. Results

3.1 Respondent Profile and Spatial Distribution

A total of 499 respondents participated in the survey. The spatial distribution of respondents was concentrated in Location 2 (41.88%) and Location 3 (40.88%), followed by Location 1 (15.63%), while Locations 4 and 8 together represented only 1.20% of the total sample. This pattern indicates that the primary analytical representation of riverbank open-space users is strongly derived from the three major locations.Such unequal distribution is common in field surveys of public spaces, where areas with higher accessibility, population concentration, and activity density tend to generate larger respondent pools (Mouratidis, 2024).

Table 1: Distribution of respondents by location.

Location	n	(%)
Location 1	78	15.63
Location 2	209	41.88
Location 3	204	40.88
Location 4	5	1.00
Location 5	1	0.20

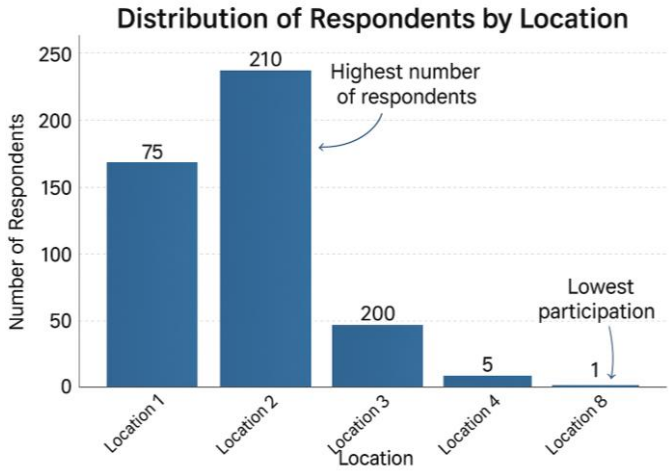

Figure 1. Distribution of respondents per location.

Demographically, respondents ranged in age from 9 to 100 years, with a mean age of 44.8 years (SD = 15.1) and a median of 45 years. The average household size was 4.99 persons, indicating relatively large family units consistent with urban neighbourhood settlement structures in Indonesia. Occupationally, the largest group consisted of housewives (64.53%), followed by traders (17.43%), labourers (5.41%), and students (5.41%). This suggests that riverbank open spaces are heavily utilised by residents whose daily routines remain strongly connected to the neighbourhood environment.

Table 2: Distribution of respondents by Occupation.

Occupation	n	(%)
Housewife	322	64.53
Trader	87	17.43
Laborer	27	5.41
Students	27	5.41
Other	14	2.81
Retired	9	1.80
Employee	7	1.40
Business Owner	6	1.20

3.2 Riverbank Utilisation Patterns

The utilisation frequency score (1–5 scale) produced a mean of 4.02 and a median of 4.00, indicating frequent use of riverbank open spaces. In practical terms, respondents generally visited these spaces several days per week to daily.This high usage level demonstrates that riverbank open spaces continue to function as everyday neighbourhood infrastructure despite moderate physical limitations. Similar patterns have been observed in informal and compact urban settlements, where proximity often outweighs environmental deficiencies (Sharifi, 2023).

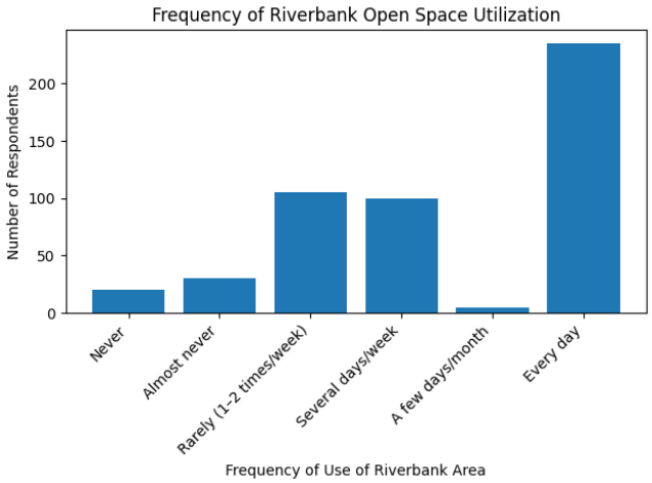

Figure 2. Frequency of riverbank utilisation.

Table 3: Ten activities most frequently carried out in open spaces.

Activity	Mean Score
Chatting	4.59
Sitting while observing	4.50
Sitting and eating/drinking	4.24
Snacking	4.24
Gathering with Neighbors	4.10
Community gathering event	4.05
Playing/exercising	3.81
Wedding events	3.72
Working informally	3.61
Waiting for a friends	3.60

The dominant activities were light social interactions rather than formal recreation. Chatting, sitting, observing, eating, and informal gatherings ranked highest, indicating that these spaces primarily function as social extensions of domestic life rather than destination parks. This finding suggests the need for design strategies centred on comfort, seating quality, shade provision, and visibility.

3.3 Construct Reliability and Descriptive Statistics of Scores

Prior to further analysis, the internal consistency of the constructs was evaluated using Cronbach's α. The results showed excellent reliability for Social Quality (α≈0.96), good reliability for Community Quality (α≈0.84), and Satisfaction with Open Space (α≈0.85), and good reliability for Facility Needs (α≈0.89). Road Quality had moderate reliability (α≈0.69), which is still acceptable for initial exploration.

Table 4: Construct reliability test (Cronbach's α).

Construct	Number of Items	Cronbach's α
Social Quality	27	0.960
Community Quality	10	0.843
Road Quality	8	0.689
Satisfaction with Open Space Conditions	8	0.853
Facility Needs	15	0.892

Table 5: Descriptive statistics of composite scores.

Variables	Average	Elementary School	Min	Max	Median
Social Quality	4.19	0.54	2.52	5.00	4.04
Community Quality	4.09	0.47	2.60	5.00	4.00
Road Quality	3.56	0.61	2.00	5.00	3.50

Satisfaction	3.11	0.60	1.00	5.00	3.00
Facility Needs	4.25	0.49	2.67	5.00	4.13
Utilisation Frequency	4.02	1.14	1.00	5.00	4.00

Respondents rated social and community quality relatively highly, indicating positive neighbourhood social conditions. However, overall satisfaction with open-space conditions was only moderate (Mean = 3.11), suggesting that positive social environments do not automatically compensate for weaker physical conditions.

3.4 Satisfaction by Environmental Aspect

Table 6: Average satisfaction per aspect of open space conditions.

Aspect	Mean
Air Quality	3.40
No Noise	3.26
Spatial extent	3.23
Shade	3.19
Cleanliness	3.04
Beauty/aesthetics	3.03
Smell/odour	2.91
Puddle Condition	2.79

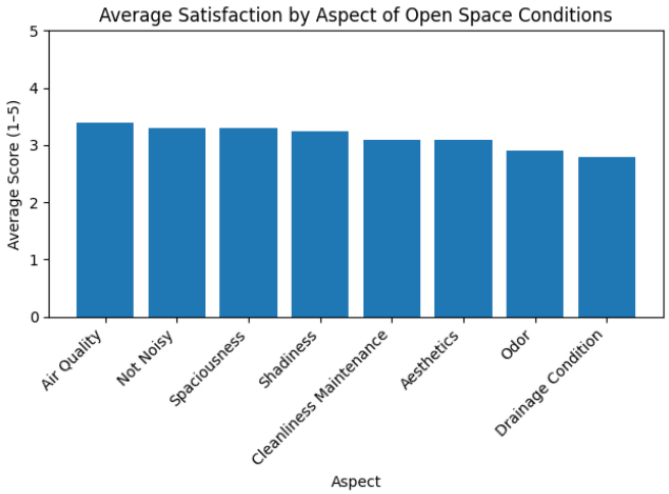

Figure 3. Average satisfaction per aspect.

The highest-rated aspect was air quality, whereas puddles and odour received the lowest scores. These results suggest that drainage management, stagnant water control, and sanitation are critical deficiencies limiting user satisfaction. Similar evidence in waterfront settlements indicates that environmental discomfort substantially reduces perceived liveability (Grabowski et al., 2023b).

3.5 Differences Between Locations

The Kruskal–Wallis test at Locations 1–3 showed significant differences in several constructs. The strongest differences were seen in Satisfaction with Open Space ($p<0.001$), followed by Road Quality ($p<0.001$), Social Quality ($p<0.001$), Community Quality ($p<0.01$), and frequency of riverbank use ($p<0.001$). Conversely, facility needs did not differ significantly between locations ($p\approx0.59$), indicating that facility preferences were relatively consistent across locations.

Table 7: Summary of differences in scores between locations (Kruskal–Wallis).

Variables	p-value	Location 1_Median(IQR)	Location 2_Median(IQR)	Location 3_Median(IQR)
Social Quality	0.000057	4.00 (3.75-4.09)	4.37 (3.96-4.81)	4.07 (3.93-4.67)
Community Quality	0.000499	3.80 (3.70-4.17)	4.30 (3.80-4.60)	4.00 (3.80-4.50)
Road Quality	0.000000	3.12 (2.88-3.50)	3.50 (3.12-4.00)	3.62 (3.25-4.00)
Satisfaction	0.000000	3.00 (2.41-3.00)	3.00 (2.62-3.25)	3.25 (3.00-3.66)
Utilisation Frequency	0.000222	5.00 (4.00-5.00)	4.00 (3.00-5.00)	4.00 (3.00-5.00)

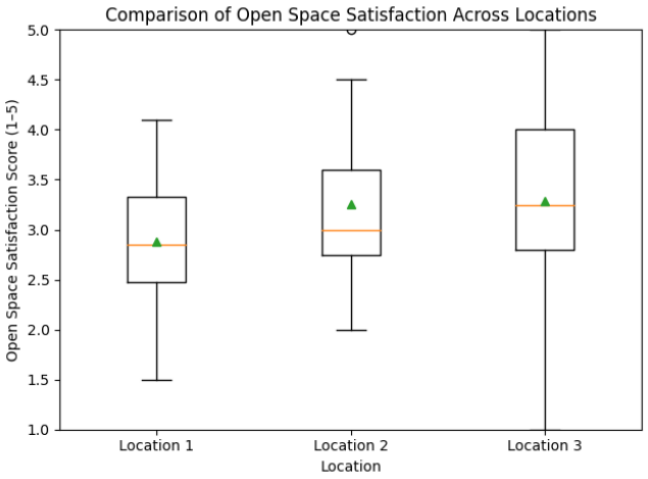

Figure 4. Boxplot of open space satisfaction (Locations 1–3).

The strongest differences emerged in satisfaction and road quality, indicating that local spatial conditions vary substantially between sites. In contrast, facility preferences were relatively consistent across locations, suggesting common user priorities regardless of neighbourhood context.

3.6 Correlation Between Variables.

Spearman's correlation showed that satisfaction with open space was moderately positively related to road quality ($\rho \approx 0.31$; $p < 0.001$). Meanwhile, the correlation between satisfaction and social and community quality tended to be weak and insignificant. These results indicate that perceived access/infrastructure plays a more significant role in satisfaction than social factors in the context of this dataset.

Table 8: Spearman Correlation with Satisfaction.

Variables	Spearman ρ	p-value
Social Quality	0.064	0.155
Community Quality	0.058	0.197
Road Quality	0.313	0.000
Facility Needs	-0.034	0.446
Utilisation Frequency	0.030	0.509
Age	-0.037	0.409

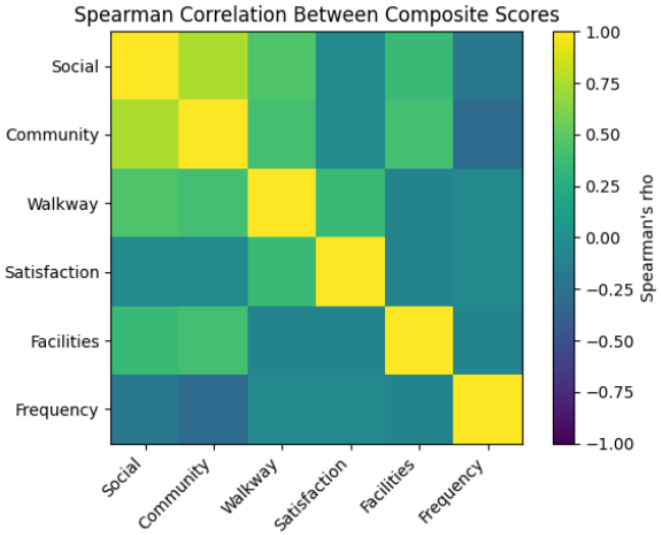

Figure 5. Heatmap of correlation between composite scores.

To test the simultaneous effect, a linear regression was conducted with satisfaction as the dependent variable and road quality, social quality, community quality, frequency of riverbank use, age, and a location dummy as predictors. The model explained approximately 16.7% of the variation in satisfaction ($R^2 \approx 0.167$). The regression results showed that road quality was positively and significantly associated with satisfaction ($\beta \approx 0.22$; $p < 0.001$). Compared to Location 1 (reference), Location 2 and especially Location 3 had higher satisfaction scores after controlling for other predictors.

Road quality demonstrated the only meaningful positive association with satisfaction. Social and community variables were positive but weak and statistically non-significant.This suggests that users may appreciate social cohesion in the neighbourhood while still judging space quality primarily through accessibility and physical convenience.

3.7 Regression Analysis

OLS regression with HC3 robust standard errors explained approximately 16.7% of variance in satisfaction ($R^2 = 0.167$).

Table 9 : OLS regression (SE robust HC3): predictors of open space satisfaction.

Variables	Coefficient	SE (robust)	p-value	CI 2.5%	CI 97.5%
Constant	2,051	0.333	0.000	1,398	2,703
Road Quality	0.217	0.061	0.000	0.098	0.337
Social Quality	-0.002	0.068	0.975	-0.136	0.131
Community Quality	-0.017	0.089	0.849	-0.191	0.157
Utilisation Frequency	0.008	0.024	0.720	-0.038	0.055
Age	0.001	0.002	0.506	-0.003	0.005
Location 2	0.164	0.080	0.040	0.008	0.320
Location 3	0.482	0.083	0.000	0.320	0.644

Road quality remained the strongest predictor after controlling for all variables. Compared with Location 1, Locations 2 and 3 reported significantly higher satisfaction levels.

3.8 Priority Facilitiey Needs

Facility preferences showed high consistency (mean facility needs score ≈4.25). The highest priority facilities were trash cans (96.79% agree/strongly agree), seating (96.19%), lighting (92.18%), and shade trees (89.98%).

Table 10 : Summary of facility requirements (15 items).

Facility	Average Score (1-5)	% Agree/Strongly agree
Rubbish bin	4.59	96.79
Seat	4.48	96.19
Lighting	4.47	92.18
shade tree	4.45	89.98
Gazebo seating	4.33	85.37
Stall/kiosk	4.30	89.78
Information boards	4.28	82.16
Guardrail	4.27	82.16
Play facilities for children	4.26	83.77
Field	4.22	80.16
Park	4.22	79.36
Parking area	4.09	72.75
Sports facilities	4.06	70.94
Dock	4.03	74.15
Fishing spot	3.67	53.91

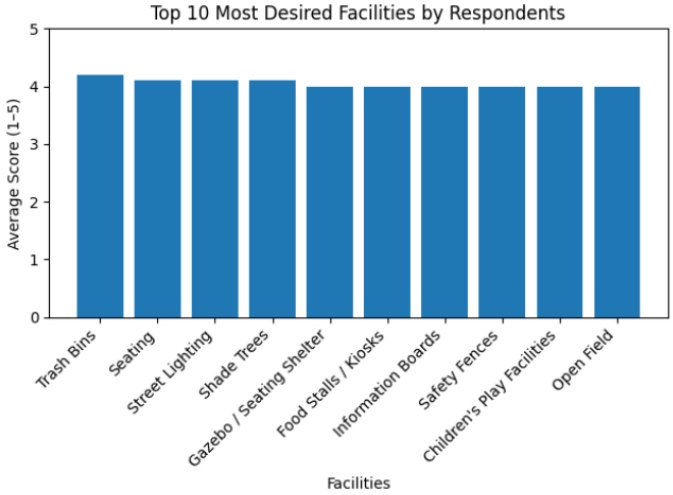

Figure 6. Ten most desired facilities.

Residents clearly prioritised basic, functional, low-cost improvements over specialised recreational amenities. This indicates that immediate upgrades should focus on cleanliness, comfort, and safety before more capital-intensive interventions.

4. Discussion

The findings reveal a notable paradox: riverbank open spaces are intensively utilised despite only moderate levels of user satisfaction. This indicates that continued use is driven less by high environmental quality and more by proximity, necessity, and the absence of alternative public spaces. In compact urban settlements, nearby informal open spaces often remain socially valuable even when physical conditions are suboptimal(Mouratidis, 2024), (Sharifi, 2023).

The high frequency of everyday use suggests that these riverbank areas function as essential neighbourhood infrastructure rather than optional recreational amenities. Residents use them for chatting, sitting, eating, observing, and community gatherings—activities strongly associated with routine social life. This reinforces previous evidence that local public spaces support informal cohesion, weak-tie social networks, and neighbourhood resilience when formal civic spaces are limited (Grabowski et al., 2023b).

However, satisfaction levels remained moderate, and specific environmental problems—particularly puddles, odours, and cleanliness—received the lowest ratings. These findings indicate that while users tolerate environmental deficiencies, such conditions still constrain comfort and perceived quality. In river-oriented settlements, drainage failure, unmanaged waste, and poor sanitation commonly reduce the liveability of public open spaces and weaken long-term usability (Caggiano et al., 2023).

One of the most significant findings is that road quality emerged as the strongest and most consistent predictor of satisfaction. Both correlation and regression analyses confirmed that better access conditions were associated with higher overall evaluations. This suggests that users may first judge open spaces through the ease, safety, and comfort of reaching them. In practical terms, pedestrian routes, surface quality, path width, and movement continuity may matter more than aesthetic improvements alone. Similar trends have been identified in contemporary urban liveability research, where accessibility strongly shapes place attachment and public-space use (Mouratidis, 2024).

Interestingly, social quality and community quality were rated positively but did not significantly predict satisfaction. A plausible explanation is that these factors already exist at relatively stable levels across locations and therefore operate as baseline social conditions rather than differentiating variables. In other words, users may appreciate neighbourhood harmony, but variation in satisfaction is more strongly determined by tangible physical conditions.

The significant differences observed between locations further indicate that contextual characteristics remain important. Even after controlling for key predictors, some locations showed higher satisfaction scores than others. This implies the presence of unmeasured local influences such as settlement density, riverbank morphology, cleanliness regimes, management quality, or microclimatic comfort. Future studies should therefore integrate spatial metrics, environmental audits, and GIS-based indicators to complement perception surveys.

From a planning perspective, the facility-priority results provide clear guidance. Residents overwhelmingly prioritised waste bins, seating, lighting, and shade trees. These are relatively low-cost, high-impact interventions capable of improving comfort, safety, and environmental order simultaneously. Rather than pursuing expensive landmark redevelopment, incremental neighbourhood-scale upgrading may generate stronger everyday benefits.

Overall, the findings support a human-centred approach to waterfront revitalisation, where modest physical improvements, reliable maintenance, and inclusive access can substantially enhance the social performance of riverbank spaces.

5. Conclusions

This study examined public perceptions, utilisation intensity, and facility needs in riverbank open spaces along the Musi River through a multi-site survey of 499 respondents. The results demonstrate that these spaces are highly utilised despite only moderate satisfaction levels, confirming their importance as everyday neighbourhood social infrastructure.

The most common uses were light social activities such as chatting, gathering, observing, and informal relaxation. Among the explanatory variables tested, road quality and accessibility emerged as the strongest determinants of satisfaction**,** while social and community quality showed weaker direct effects. This indicates that users place considerable importance on ease of access and basic physical functionality.

Facility preferences were highly consistent across locations. Waste bins, seating, lighting, and shade trees were identified as the most urgent priorities, followed by basic amenities that support comfort and safety.

The practical implication is that riverbank open-space improvement should prioritise access infrastructure, environmental cleanliness, drainage maintenance, and simple user-oriented facilities**.** Such targeted interventions may substantially improve user experience without requiring large-scale redevelopment.

Research Limitations

Several limitations should be acknowledged. First, the survey used self-reported perception data, which may be influenced by subjective bias. Second, some locations had smaller sample sizes, limiting comparative precision. Third, objective spatial indicators such as path width, vegetation cover, distance to housing, and flood frequency were not included.

Future Research Directions

Future studies should combine survey data with GIS analysis, behavioural observation, environmental measurement, and longitudinal evaluation to better understand how riverbank open spaces evolve over time and how physical interventions influence social outcomes.

In conclusion, riverbank open spaces remain valuable urban assets. With strategic and community-responsive improvements, they can become more inclusive, healthier, and socially productive environments for waterfront residents.

Acknowledgements

The authors gratefully acknowledge the residents and community members living along the Musi River riverbank areas in Palembang for their willingness to participate in this survey. Appreciation is also extended to colleagues and field assistants who supported data collection, questionnaire distribution, and logistical coordination during the study.

Funding

This research received **no specific grant** from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Data are provided in anonymised form to protect respondent confidentiality.

Institutional Review Board Statement

This study involved voluntary participation through an anonymous social survey. All respondents were informed of the purpose of the study, and consent was obtained prior to participation. No personally identifiable information was collected. The research was conducted in accordance with general ethical principles for human-participant social research and the Declaration of Helsinki.

CRediT Author Statement

Endang Sri Lestari: Conceptualisation, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Visualisation.

Maya Fitri Oktarini: Supervision, Validation, Writing – review & editing, Methodology refinement, Project administration.

All authors have read and approved the final manuscript.

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