

Relationships between tree characteristics and perceived value dimensions in urban tree preservation

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ABSTRACT

Urban tree preservation presents an ongoing challenge in rapidly developing cities, where decisions are frequently shaped by structural safety and risk considerations rather than by a comprehensive evaluation of ecological, cultural, and experiential benefits. Although the multifunctional roles of urban trees are widely acknowledged, there remains limited empirical understanding of how professional arborists weigh objective tree characteristics against different value dimensions when making retention decisions. This study examined the relationships between measurable tree attributes and four perceived value dimensions - utility, design relevance, sensory contribution, and symbolic significance - drawing on assessments from 20 certified arborists in Malaysia. Data were collected using a structured questionnaire based on a five-point Likert scale. Respondents evaluated key characteristics, including life expectancy, health condition, growth habit, tree dimensions, species origin, aesthetic qualities, and tree category. Descriptive statistics were first used to summarise overall trends, followed by Spearman's rank correlation analysis to explore associations between tree characteristics and perceived value dimensions. The results indicate that biological condition and projected longevity play a central role in professional judgment. Life expectancy demonstrated a strong positive relationship with perceived utility ($r_s = 0.870$, $p < 0.01$), while health condition was positively associated with both utility and sensory value. In contrast, aesthetic qualities showed a strong negative correlation with symbolic significance ($r_s = -0.979$, $p < 0.01$), suggesting that visual attractiveness and cultural meaning may operate as distinct evaluative lenses in professional assessment. Native and evergreen species were more strongly associated with utility and symbolic values, whereas introduced species tended to be linked with design relevance. Overall, the findings suggest that functional durability remains the primary driver of expert-led preservation decisions, yet important tensions exist between ecological performance, aesthetic preference, and cultural significance. These insights point to the need for a more integrated, multi-criteria framework capable of balancing technical evaluation with the broader social values attached to urban trees.

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1. INTRODUCTION

Urban development has increasingly led to the loss of trees in cities, even though retaining existing trees offers greater ecological and social returns than planting new ones, which may take decades to mature and deliver comparable services. In many development projects, mature trees are removed to make space for infrastructure and buildings, resulting in fragmented green spaces and a decline in biodiversity (Liu et al., 2025). Trees, especially mature ones, are vital components of urban ecosystems, offering services such as air purification, temperature regulation, carbon storage, and wildlife habitat support (Nowak & Crane, 2002). Beyond these ecological contributions, trees enhance urban aesthetics and hold significant cultural and symbolic

meanings, serving as historical landmarks, memorials, and representations of local identity (Ferguson, 2023). Preserved trees have also been linked to improved mental health outcomes, providing psychological comfort and a sense of place (Kaplan et al., 2023).

In the Malaysian context, rapid urban expansion has intensified the pressure on urban trees, with development-driven tree removal becoming a common issue across various regions (Hassan et al., 2023). These benefits are especially crucial in densely populated areas, where access to restorative green spaces is limited. Numerous studies have demonstrated that retaining existing trees yields significantly greater ecological and social benefits than planting new ones, which may take decades to mature and provide comparable

services (Coleman et al., 2022). Despite these well-established benefits, tree removal continues in cities, disrupting ecological systems and reducing the quality of life for urban residents and is often made using limited criteria, with a focus on structural condition and risk, rather than incorporating holistic assessments that include social, aesthetic, and cultural values. In light of climate resilience goals and growing awareness of environmental justice, there is an urgent need for multidisciplinary frameworks that integrate expert judgment with diverse valuation dimensions.

Urban tree preservation is a growing priority in sustainable urban planning, as trees serve multifunctional roles within city environments. Ecologically, trees reduce urban heat islands, filter pollutants, manage stormwater, and support biodiversity, with mature trees delivering greater ecosystem services due to their well-developed canopies and root systems (Coleman et al., 2022; Liu et al., 2025; Nowak & Crane, 2002). Retaining older trees has been shown to offer long-term economic and environmental benefits, including enhanced property values and reduced infrastructure costs (Ordóñez-Barona et al., 2021). To guide these decisions, several structured assessment models have been developed, including the Safe Useful Life Expectancy (SULE) method (Barrell, 1993), TreeAZ (Barrell, 2009), the Sustainable Retention Index Value (SRIV), and the Significance of a Tree Assessment Rating System (STARS) (IACA, 2010a, 2010b). These frameworks emphasise measurable criteria such as health, structure, and life expectancy when determining a tree's value and preservation potential. However, such models often fall short in capturing subjective values that reflect social or cultural relevance.

Recent scholars have called for a broader understanding of tree value that incorporates intangible elements such as emotional attachment, cultural symbolism, and sensory experience (Blicharska & Mikusiński, 2014; Gómez-Baggethun & Barton, 2013). For instance, trees contribute to place identity and community cohesion by acting as cultural symbols or historical references (Ferguson, 2023; Kaplan et al., 2023). Visual characteristics, species familiarity, and spatial context all influence public and professional perceptions of a tree's worth. Despite these advancements, there is a limited amount of empirical research examining how professionals, such as certified arborists, balance diverse value dimensions in practice. This issue is especially pertinent in Malaysia, where rapid urbanisation has intensified the pressure on urban trees, with development-driven tree removal becoming a common issue across various regions. However, empirical studies investigating how Malaysian professionals integrate both biological traits and perceived values into their assessments of trees remain scarce.

While there is growing policy interest in green infrastructure, tree preservation during development is still often deprioritised due to a lack of integrated assessment tools and weak enforcement (Nik Mohamed Sukri et al., 2022). Hassan et al. (2023) further highlight that arborists in Malaysia face complex decision-making environments where ecological, regulatory, and symbolic factors intersect, but are seldom formally captured in existing valuation models. Therefore, there remains a clear need to better understand how professional arborists evaluate and prioritise different tree characteristics within multiple value dimensions.

As cities seek sustainable development strategies, there is a growing need for comprehensive assessment frameworks that capture both the tangible and intangible contributions of urban trees. This study addresses this gap by investigating how certified arborists evaluate a range of tree characteristics—including health condition, life expectancy, dimensions, and symbolic attributes—within four perceived value dimensions: utility, design, sensory, and symbolic.

2. MATERIALS AND METHODS

2.1 Participants and sampling procedure

This study employed a purposive sampling method to recruit 20 certified arborists through established professional arboriculture networks across Malaysia. Purposive sampling, a widely used non-probability technique in qualitative studies, allows researchers to deliberately select individuals who possess specific expertise relevant to the research question (Palinkas et al., 2015). This approach was deemed appropriate given the need for informed, experience-based insights in evaluating urban trees from a professional perspective. The selected participants were certified arborists with recognised qualifications and active involvement in the field of urban landscape planning and tree risk assessment. Inclusion criteria required a minimum of five years' experience in urban tree evaluation, particularly in the context of development or construction projects. Furthermore, participants had to have been directly involved in tree preservation decision-making, ensuring their capacity to assess both the technical and contextual aspects of tree valuation. By focusing on this expert group, the study aimed to capture reliable judgments that reflect real-world practices in the arboriculture and landscape industries.

2.2 Data collection

Data collection was conducted through a structured, self-administered questionnaire tailored to capture expert perceptions of key tree characteristics and their associated perceived values. It included items evaluating various biological and morphological attributes—namely, aesthetic

qualities of plant parts, tree dimensions, growth habit, health condition, life expectancy, species origin, and tree category. The instrument also measured perceived values associated with each tree, categorised into four dimensions: utility (environmental, aesthetic, and economic functions such as air purification, shade provision, and property value enhancement); design relevance (contribution to spatial quality, place identity, and landscape aesthetics); sensory contribution (stimulation of sensory experience and emotional response, including healing and psychological comfort); and symbolic significance (association with religion, mythology, cultural identity, and collective memory).

The questionnaire was distributed in person to participants during a scheduled arborist program, ensuring a controlled environment for data collection. A brief explanation of the study's objectives and procedures was provided both verbally and in writing to ensure informed participation. Respondents were given one hour to complete the assessment independently, without discussion or external influence. They were instructed to evaluate the importance of each tree characteristic and its perceived value across the specified dimensions using a five-point Likert scale, ranging from 0 ("Not Important at All") to 4 ("Absolutely Essential"). This approach facilitated consistent, expert-informed data reflective of individual professional judgment in real-world decision-making contexts.

2.3 Data analysis

Data were analysed using IBM SPSS Statistics (Version 25) to ensure systematic and reliable statistical processing. Descriptive statistics were first calculated to provide an overview of the respondents' ratings, summarising central tendencies (mean values) and dispersion (standard deviations) for each tree characteristic and value dimension. It was followed by Spearman's rank correlation analysis, which was selected to assess monotonic relationships between the ordinal variables, given the Likert-scale nature of the responses. A significance threshold of $p < 0.05$ was used to determine the statistical relevance of each correlation. The analysis aimed to identify consistent patterns in how expert evaluations of tree characteristics aligned with perceived value dimensions, thereby uncovering potential priorities and preferences in professional tree preservation assessments.

3. RESULT AND DISCUSSION

3.1 Descriptive statistics of tree characteristics

Descriptive statistics were calculated to summarise respondents' evaluations of the importance of various tree characteristics. As presented in Table 1, *life expectancy* received the highest mean rating ($M = 3.55$, $SD = 0.686$),

followed closely by health condition ($M = 3.45$, $SD = 0.324$) and tree dimension ($M = 3.16$, $SD = 0.575$). These findings suggest that respondents prioritise tree attributes that reflect biological vitality, physical stability, and the tree's capacity for long-term survival, which are often critical in the context of urban development pressures. It aligns with the view of Morton (2006), who emphasised that a tree's survivability—strongly influenced by its health condition and structural integrity—plays a central role in determining whether it should be retained or removed in development areas. The high rating for *life expectancy* in particular may reflect a professional concern for trees that can provide ongoing ecological and amenity benefits, such as shade, improved air quality, and landscape continuity over time.

Table 1: Descriptive statistics of tree characteristics

Parameters	Mean	Std. Deviation
Life expectancy	3.55	0.686
Health condition	3.45	0.32363
Tree dimension	3.16	0.57511
Growth habit	2.75	0.910
Aesthetic part of plant	2.58	0.35448
Species origin	2.55	0.826
Tree category	2.00	1.414

Conversely, the tree's category had the lowest mean rating ($M = 2.00$, $SD = 1.414$), indicating a broader range of opinions on its importance. The species origin, growth habit, and aesthetic quality of plant parts fell within a moderate range of importance, with mean scores ranging from 2.55 to 2.75. Overall, the standard deviations indicate relatively consistent responses, with greater variability observed for the tree's category compared to other characteristics. These results reinforce the notion that functional longevity and health are the primary drivers of preservation decisions among arboricultural professionals.

3.2 Descriptive statistics of perceived value dimensions

In addition to tree characteristics, the study evaluated the importance of four distinct value dimensions. As presented in Table 2, utility received the highest mean rating ($M = 3.20$, $SD = 0.58$). It indicates that arborists primarily prioritise the functional performance of trees - such as pollution mitigation, shading, and safety - over intangible qualities. It aligns with the earlier finding that life expectancy and health condition were the top-rated tree characteristics, as these biological traits are prerequisites for sustained ecosystem service delivery. Symbolic significance was the second most important dimension ($M = 2.87$); however, it notably exhibited the highest standard deviation ($SD = 0.71$) among all dimensions. This higher variability suggests a divergence of opinion among professionals regarding the weight of cultural, religious, or mythological associations in tree assessment. At

the same time, some arborists view cultural heritage as critical, while others may consider it secondary to safety and function. Design relevance ($M = 2.52$, $SD = 0.31$) and Sensory contribution ($M = 2.20$, $SD = 0.57$) received moderate-to-low ratings. Interestingly, Design Relevance displayed the lowest standard deviation, indicating a high level of consensus among respondents regarding the aesthetic contribution of trees to spatial quality, even if it is not their top priority in preservation decisions.

Table 2: Descriptive statistics of perceived value dimensions

Value Dimension	Mean	Std. Deviation
Utility	3.20	0.579
Symbolic significance	2.87	0.706
Design relevance	2.52	0.310
Sensory contribution	2.20	0.565

3.3 Correlation analysis between tree characteristics and value dimensions

Spearman's rank correlation coefficients revealed several statistically significant relationships between tree characteristics and their perceived value dimensions. A complete summary of correlation results is provided in Figure 1. Notably, a robust positive correlation was found between life expectancy and utility value ($r_s = 0.870$, $p < 0.01$), indicating that trees expected to live longer are perceived as more useful, especially in development areas where long-term ecological function and economic benefit are critical.

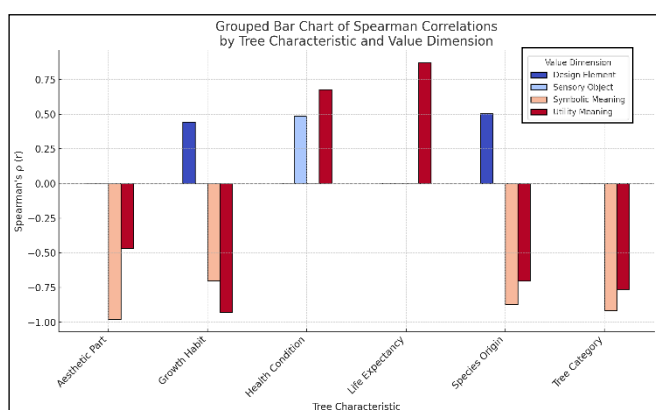


Figure 1: Summary of correlation by tree characteristic and value dimension

This finding highlights the importance of durability and ongoing service provision in urban forestry decision-making. It aligns closely with established tree assessment models—Safe Useful Life Expectancy (SULE) (Barrell, 1993), TreeAZ (Barrell, 2009), Sustainable Retention Index Value (SRIV) (IACA, 2010b), and the Significance of a Tree Assessment Rating System (STARS) (IACA, 2010a) which all emphasise life expectancy as a central criterion in determining preservation value. These models evaluate a tree's ability to remain structurally sound and environmentally beneficial over

time, providing arborists with a structured method to classify trees based on their viability and contribution. Trees that exhibit strong health and long-life potential are thus more likely to be prioritised, as they represent a more sustainable return on investment in terms of shade provision, pollution mitigation, biodiversity support, and cost-effectiveness in maintenance. In essence, these models and the current findings both underscore that utility is not merely a short-term measure, but rather an outcome of a tree's capacity to perform and endure within its urban context over time.

In contrast, a robust negative correlation emerged between aesthetic value and symbolic meaning ($r_s = -0.979$, $p < 0.01$), revealing an inverse relationship where trees rated highest for visual attractiveness were consistently rated lowest for cultural, religious, or mythological significance. This counterintuitive finding challenges conventional assumptions in urban design that aesthetically pleasing trees automatically acquire symbolic importance, instead suggesting that these value dimensions may represent distinct, even competing, valuation frameworks in professional assessment (Kirkpatrick et al., 2012). The results align with established findings within cultural ecosystem services research, demonstrating that aesthetic and symbolic values often derive from different tree attributes and social processes (Gómez-Baggethun & Barton, 2013). Urban forestry studies increasingly recognise this dichotomy, noting that while ornamental characteristics (e.g., floral displays, symmetrical canopies) strongly influence visual preference surveys (Hoyle et al., 2019), they contribute minimally to a tree's capacity to embody collective memory or spiritual meaning (Jones & Cloke, 2002).

As Blicharska and Mikusiński (2014) substantiate through cross-cultural analysis, extensive, visually striking trees frequently serve aesthetic functions in urban landscapes. However, their enduring cultural significance predominantly stems from historical longevity (century-old specimens), ecological rarity (last remnants of native vegetation), or association with transformative community events (memorial plantings) rather than conventional beauty metrics. Ferguson (2023) provides further ethnographic insight into this phenomenon, demonstrating that ordinary street trees often acquire symbolic meaning through long-term human interaction. These cultural associations typically arise from trees witnessing neighbourhood changes, serving as informal gathering places, or surviving significant events—developments that are unrelated to their visual appearance. It aligns with heritage tree research, which shows that community-nominated "significant trees" are frequently described in narrative terms (stories, traditions) rather than visual descriptors (Schmied & Pillmann, 2003). The observed strong negative correlation may reflect fundamental

differences in assessment methodologies between symbolic and aesthetic valuation processes. When evaluating symbolic significance, arborists systematically reference documented historical associations, ethnobotanical traditions, and species-specific cultural knowledge - as exemplified by *Ficus religiosa*'s sacred status in Buddhism (Ormsby, 2013). Conversely, aesthetic assessments predominantly engage immediate sensory perception and visual design principles (Hoyle et al., 2019).

Species origin (coded as 1 = Native, 2 = Introduced) demonstrated distinct associations with perceived values. A strong negative correlation was found with both utility ($r_s = -0.704$, $p = 0.001$) and symbolic values ($r_s = -0.873$, $p < 0.001$). Since native species were coded as the lower value (1), this negative correlation indicates that native species were rated significantly higher than introduced species in terms of ecological usefulness and cultural significance. It aligns with urban forestry research, which shows that native flora is often prioritised for ecosystem services (Arcos-LeBert et al., 2021) and place identity (Kaplan et al., 2023). Conversely, species origin showed a moderate positive correlation with design value ($r_s = 0.503$, $p = 0.024$). This positive relationship suggests that introduced species were perceived as making a greater contribution to landscape aesthetics. These findings reveal a functional divergence: while arborists prioritise native species for environmental and symbolic roles, introduced species are still valued for their specific architectural or ornamental contributions to landscape design. Similarly, Tree category (coded as 1 = Evergreen, 2 = Deciduous) showed a robust negative correlation with utility ($r_s = -0.762$, $p < 0.001$) and symbolic value ($r_s = -0.917$, $p < 0.001$). The negative coefficient here indicates that Evergreen trees (coded 1) were rated more favorably than Deciduous trees (coded 2) in both functional and cultural aspects. This preference aligns with the literature, which demonstrates that evergreen species provide consistent year-round ecosystem services, such as canopy cover and pollution removal, whereas these services are seasonally diminished in deciduous species (Liu et al., 2025; Nowak & Greenfield, 2012).

Similarly, the growth habit showed a strong negative correlation with both utility ($r = -0.930$, $p = 0.000$) and symbolic values ($r = -0.701$, $p = 0.001$), and a moderate positive correlation with design value ($r = 0.445$, $p = 0.049$). It suggests that growth rate is a significant attribute in expert assessments, influencing how trees are perceived in terms of functionality, cultural meaning, and aesthetic presence. Growth rate is a key functional trait that affects canopy development, carbon sequestration, and structural stability—critical components of ecosystem services in urban forests (Rötzer et al., 2023). Faster-growing species may be favoured

in landscape design due to their ability to establish visual structure and shading benefits more rapidly. However, slower-growing species are often associated with greater structural integrity, longer life spans, and enduring cultural significance, particularly in contexts where heritage, symbolism, or long-term ecological resilience are valued. This trade-off reflects a deeper tension between short-term landscape needs and long-term sustainability goals, suggesting that growth habit is not only a biological characteristic but also a value-laden attribute in professional judgment.

Meanwhile, health condition was positively correlated with utility ($r_s = 0.679$, $p = 0.001$) and sensory values ($r_s = 0.488$, $p = 0.029$), indicating that healthier trees were perceived as more functional and sensorially valuable. It aligns with research indicating that tree vitality enhances ecosystem service delivery, including improved air quality, thermal regulation, and aesthetic enjoyment (Coleman et al., 2022). Healthy trees are also more likely to survive construction disturbances, respond well to maintenance, and maintain their structural and ecological functions over time. In design contexts, trees in better health contribute to a sense of vibrancy and comfort, supporting human psychological and sensory well-being. These findings underscore the importance of incorporating tree health and growth habits into preservation frameworks to ensure both functional and experiential outcomes in urban environments.

These results can guide arborists and planners in prioritising tree preservation based on ecological function and service duration. Moreover, the data underscores the importance of integrating expert judgment with objective tree characteristics in decision-making processes. Practically, these correlations provide empirical support for updating existing urban design and preservation frameworks. For instance, the strong correlation between Life Expectancy and Utility suggests that formal assessment tools, such as the Safe, Useful, Life Expectancy (SULE) rating system, should be given significant weight in municipal preservation ordinances. Furthermore, the identified divergence—where Native species are preferred for utility/symbolism but not design—suggests a need for urban planting models that intentionally integrate both functional native species and aesthetically preferred, non-invasive introduced species to meet both ecological and design goals.

Incorporating both perceptual and scientific evaluations may help reconcile diverse stakeholder interests in urban development projects. Additionally, the interplay between tree characteristics and value perceptions reflects the broader shift in landscape planning toward multifunctionality and cultural sustainability. Understanding these relationships enables decision-makers to balance

performance-based assessments with intangible benefits, such as a sense of place, identity, and well-being. Given that urban trees increasingly serve as interfaces between natural and built environments, integrating both objective traits and perceptual insights becomes essential for resilient urban ecosystems.

4. CONCLUSION

This study highlights the nuanced relationships between tree characteristics and perceived value dimensions among urban forestry professionals. The strong, significant correlations found suggest that both biological traits and subjective perceptions play crucial roles in the preservation of trees. These preliminary findings lay the groundwork for more comprehensive studies that can lead to the development of integrated assessment tools for tree conservation planning in urban environments. Future research should focus explicitly on integrating community perspectives (e.g., on symbolic and sensory values) with expert judgment (on health and utility) to construct a holistic, multi-criteria tree valuation framework. Longitudinal case studies and larger sample sizes are also needed to validate and expand upon these results across different urban contexts. Notably, the study demonstrates that expert judgment incorporates more than just quantifiable data—it also reflects contextual and cultural understandings of tree value. Incorporating these multiple dimensions into policy and planning could help bridge the gap between scientific evaluation and community expectations. Findings from this research can inform municipal guidelines and urban greening strategies, particularly in rapidly developing countries like Malaysia, where the integration of sustainable development and biodiversity conservation is crucial.

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