RESEARCH ARTICLE

Exploring the Factors Affecting Tree Removal Decisions in Malaysian Development Areas

Khalilah Hassan[1*], Wan Saiful Nizam Wan Mohamad[1], Nor Diyana Mustapa[1], Mohammad Rusdi Mohd Nasir[2], Izrahayu Che Hashim[3], Suzanah Abdullah[3], Marina Abdullah[3]

[1]Sustainability, Urban Design & Wellbeing Research Group, Faculty of Architecture & Ekistics, Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

[2]Architectural Heritage and Cultural Studies Research Group, Faculty of Architecture & Ekistics, Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

[3]Jabatan Pengajian Alam Bina dan Teknologi, Kolej Pengajian Alam Bina, UiTM Cawangan Perak, Kampus Seri Iskandar, 32610 Seri Iskandar, Perak, Malaysia

*Corresponding author: khalilah.h@umk.edu.my

Abstract

Urban development has increasingly contributed to the reduction of urban tree canopy cover, raising concerns about ecological balance and environmental quality in cities. This study aimed to explore the key factors influencing decisions to remove trees within Malaysian development areas. Understanding the underlying motivations and constraints behind these decisions was considered essential for promoting better tree preservation practices and sustainable landscape planning. Data were collected through a survey administered to registered landscape professionals from the Institute of Landscape Architects Malaysia (ILAM) using a simple random sampling method. The collected data were analyzed using exploratory factor analysis (EFA) and descriptive statistics with SPSS software. The findings revealed that institutional constraints, particularly the lack of specific legal frameworks for tree preservation were the dominant factor affecting tree removal decisions. These constraints were often compounded by limited resources and complex procedural requirements. The study emphasized that effective urban tree management depended on coordinated efforts among relevant authorities, developers, and local communities. A clearer understanding of the decision-making process surrounding tree removal can therefore serve as a foundation for enhancing policy formulation and achieving more sustainable urban development outcomes.

Keywords: *Tree removal; tree preservation; decision making; urban development*

Citation:
Hassan, K., Wan Mohamad, W. S. N., Mustapa, N. D., Mohd Nasir, M. R., Che Hashim, I., Abdullah, S., & Abdullah, M. (2025). Exploring the factors affecting tree removal decisions in Malaysian development areas. Alam Cipta, 18(3), Article 10. https://doi.org/10.47836/AC.18.3.PAPER10
Received:
07 February 2025
Accepted:
12 November 2025
Published:
December 2025

Introduction

Urban development represents a worldwide phenomenon that has a significant impact on urban forest dynamics, particularly evident in the decrease of tree canopy cover (Brunner & Cozens, 2013; Jiang et al., 2025; Nowak & Greenfield, 2020). Guo et al. (2019) demonstrate that existing trees in development areas are more likely to be cut down, while trees in non-development areas are more likely to be retained. In addition, previous studies have also indicated that since 2000, Malaysia has lost a significant amount of its tree cover (Kanniah, 2017) alongside the increase in CO2 emissions (Susskind et al., 2020). Since urban areas are the main locations experiencing environmental pollution, whose impacts can be mitigated and reduced through urban greening, most cities are proactively establishing long-term goals to enhance their respective urban green infrastructures by launching large-scale planting campaigns and retaining existing

trees (Lombardía & Gómez-Villarino, 2023). Malaysia also prioritises improving environmental quality by aligning with the Sustainable Development Goals (SDGs), particularly SDG 15 (biodiversity conservation), SDG 13 (climate change), and SDG 11 (urban habitats). In addition, initiatives and legislative tools have been established, including the Town and Country Planning Act 1976 [Act 172], the national landscape policy, and the Landscape Agenda 2050 (LAA2050), to protect and implement sustainable natural resource management within all development strategies.

Literature Review

Resource availability, including funding, expertise, equipment, staffing, and data, strongly affects urban tree removal. In Malaysia, limited arboricultural expertise, incomplete tree inventories, and insufficient resources have often led to unnecessary removals during development (Hassan et al., 2024). Inadequate diagnostic tools and lack of trained staff further contribute to removals based on uncertain assessments of tree health (Conway, 2016; Hamzah et al., 2017; Morgenroth & Östberg, 2017; Roman et al., 2022). Financial constraints and weak preservation incentives also drive developers to favour removal over retention, while municipal tree care units remain underfunded and understaffed, limiting proactive management (Clark et al., 2020; Despot & Gerhold, 2003; Ordóñez et al., 2019; Roman et al., 2013; Vogt et al., 2015).

Institutional constraints such as poor enforcement, fragmented governance, and limited public involvement also contribute to tree loss. Weak laws and low penalties enable routine removals, especially on private land (Clark et al., 2020; Martin et al., 2025). Fragmented planning and unclear agency roles result in trees being undervalued (Hassan et al., 2024; Ordóñez et al., 2019). Tree Preservation Orders (TPOs) under the Town and Country Planning Act 1976 [Act 172] are rarely enforced or systematically integrated into local plans, reducing their effectiveness. Limited jurisdiction over private land and lack of regulatory clarity enable removals of healthy trees with little oversight (Clark et al., 2020). Low institutional capacity and limited community engagement further weaken monitoring and accountability, resulting in removals often justified on liability or infrastructure damage concerns (Guo et al., 2019; Romero, 2021).

Governance limitations have been widely recognised as one of the most critical threats to sustaining urban tree canopy in Malaysia (Hassan et al., 2024; Nik Mohamed Sukri et al., 2022). To address these constraints, creative governance mechanisms and collective decision-making are increasingly necessary. Ordóñez-Barona et al. (2021) highlight the importance of integrating diverse legislative tools, fostering stakeholder coordination, and encouraging active community participation to mitigate the adverse effects of urban development on trees. Similarly, Clark et al. (2020) emphasise that effective legal frameworks should align with participatory planning approaches to strengthen urban forest protection. In the Malaysian context, Nik Mohamed Sukri et al. (2022) recommend that local authorities consider all possible alternatives before approving tree removal, ensuring that removal is treated as a last resort rather than a standard procedure.

In Singapore, the establishment of Tree Conservation Areas (TCAs) under the *Parks and Trees Act* requires written approval from the National Parks Board (NParks) before any tree exceeding one metre in girth can be removed. This framework is supported by inter-agency coordination, systematic monitoring, and strong public awareness campaigns promoting urban tree protection. In Thailand, initiatives such as the *Smart Urban Forest Initiative* in Chiang Mai integrate community-based and technology-supported approaches to tree management. These models emphasise participatory planning, geospatial mapping, and local stakeholder involvement to enhance tree preservation and urban resilience. Such regional examples

demonstrate opportunities for Malaysia to strengthen institutional capacity and adopt participatory mechanisms that balance urban development with long-term tree conservation goals.

Spatial constraints are another determinant in tree removal decisions. Trees situated close to buildings, sidewalks, or other infrastructure are more likely to be removed due to root damage, safety concerns, and liability issues during construction activities (Roman et al., 2014). Construction encroachment on root zones or canopy space often prompts pre-emptive removals to avoid future conflicts. Urban builders tend to be less willing to modify plans to protect existing trees, leading to higher removal rates near development sites (O'herrin et al., 2022). Transplanting trees in confined urban environments is challenging because limited soil volume and restricted rooting space reduce survival and growth, often causing removal due to poor health or failure to establish. Small planting spaces, such as narrow pits along sidewalks, further restrict root development, increase stress, and make trees more vulnerable to decline and removal, especially during redevelopment projects (Jim, 2019).

Human perceptions and decision biases strongly influence the removal or retention of trees during urban development. Gilbert (1996) explained that many removal decisions are based on contractors' misunderstandings of tree health and survival, while private landowners often overestimate risks associated with trees such as falling branches or root damage. Similarly, Kronenberg (2014) found that trees are sometimes perceived as nuisances, causing shade, allergies, or leaf litter, and as physical obstacles to development. These misconceptions often result in premature removals rather than mitigation or redesign efforts. Morton (2006) further argued that retention decisions should consider not only a tree's health and lifespan but also its cultural, aesthetic, and ecological value. Such findings highlight the need for more inclusive, informed, and communicative decision-making processes that involve both experts and communities.

Developers' decisions are frequently driven by financial and market pressures (Kellogg et al., 2017; O'herrin et al., 2016; Ordóñez-Barona et al., 2021). Tree removals are often justified as cost-saving measures to avoid maintenance, redesign, or project delays (Kirkpatrick et al., 2012; Papastavrou, 2019). Transplanting adds further logistical and financial burdens, making removal a more attractive option to streamline construction timelines (Hassan et al., 2024). Consequently, practical and economic considerations continue to outweigh ecological and social values in many development contexts.

Tree size, species, and health conditions also influence removal likelihood. Larger and mature trees are more likely to be retained due to their perceived value, whereas smaller or non-native species are often removed (Croeser et al., 2020; Guo et al., 2018, 2019; Morgenroth et al., 2017). However, even mature trees face removal when they are located too close to buildings, perceived as potential hazards, or show signs of declining vitality (Kirkpatrick et al., 2012, 2013; Roux et al., 2014). These suggest that biological and morphological characteristics are key determinants in professional decision-making about tree retention and removal.

Aesthetic and design objectives can also play a decisive role in tree removal. Ames and Dewald (2003) and Roman et al. (2022) emphasized that improved communication and creative design integration are necessary to protect trees within construction projects. Roman et al. (2022) reported that nearly half of tree removals at the University of Pennsylvania were linked to redevelopment and risk management processes, reflecting limited design flexibility.

Methodology

Data were gathered through a questionnaire survey involving 265 registered landscape practitioners from the Institute of Landscape Architects Malaysia (ILAM) for the 2021/2022 session. The total population comprised 829 individuals, including both Corporate and Graduate Members. The required sample size was determined using the Krejcie and Morgan (1970) formula, which indicated that 265 respondents were sufficient to accurately represent the population.

This study adopted simple random sampling, involving Institute of Landscape Architects Malaysia (ILAM) members who were directly engaged in urban tree assessment, planning, and management. The selection ensured that the respondents possessed relevant professional knowledge to evaluate the determinants influencing tree removal decisions in development areas.

A structured questionnaire consisting of 43 Likert-scale items was developed using Google Forms and distributed to the participants online. Respondents articulated their views on each statement using a five-point Likert scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Descriptive statistics and Exploratory Factor Analysis (EFA) were conducted on the survey data using SPSS Version 29.0. The overall methodological process, from population selection to data analysis, is illustrated in Figure 1.

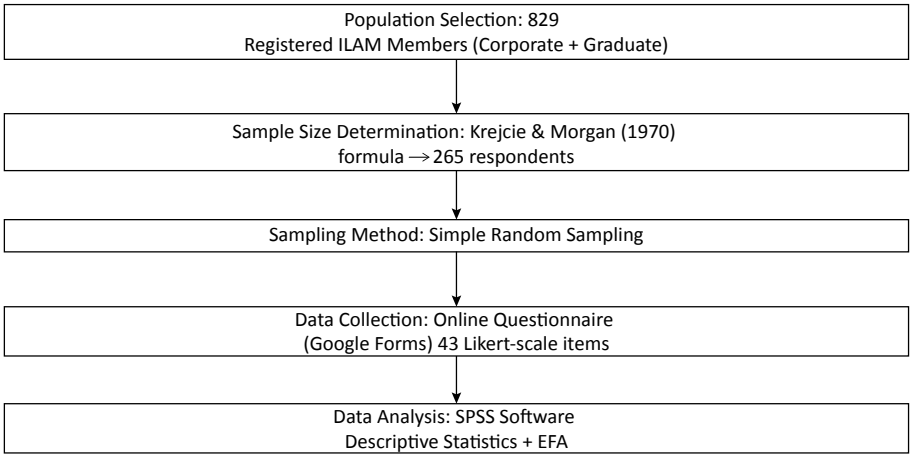

Figure 1: Methodology Flowchart

The Cronbach's alpha test indicated a score of 0.96, demonstrating that the items in the instrument exhibited strong reliability. The tree removal decision determinants variable's KMO test result of 0.90 demonstrated that there were no multicollinearity problems and confirmed the data's suitability for factor analysis. Additionally, the Bartlett's test results confirmed that the item correlations are appropriate for component analysis, with a significant result at $p < 0.05$ (see Table 1).

Table 1: Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

Test		Determinants of Tree Removal Decisions
Kaiser-Meyer-Olkin (KMO)		0.90
Bartlett	**Approx. Chi-Square**	8302.34
	df	903
	Sig.	0.00

According to the findings, the EFA was suitable for these datasets. This study uses the Principal Components procedure with the Varimax rotation method and determines that only those factors contributing significantly, with equal to or greater than 60% and an eigenvalue of 1.0 or above, are extracted as study variables.

Evaluation of the rotated component matrix table (rotated component matrix) to eliminate items is done based on the criteria used by Maskey et al. (2018), specifically focusing on loadings that are less than 0.40 and cross-loading values that are greater than 0.40.

Results and Discussion

Exploratory factor analysis

Eight separate components were identified from the rotated component matrix using the Varimax rotation process, as seen in Table 2. It can be concluded that six items need to be eliminated, and the remaining 37 items are found to be suitable for use as decision-making criteria for tree removal in development areas. Collectively, these eight factors account for 67.19% of the total variance in the "Tree Removal Determinants" variable, with Factor 1 contributing 13.91%, Factor 2 12.18%, Factor 3 11.39%, Factor 4 8.72%, Factor 5 6.95%, Factor 6 5.33%, Factor 7 4.63%, and Factor 8 4.09%.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Variance		Cumu-lative	Variance		Cumu- lative	Variance		Cumulative
	Total	%	%	Total	%	%	Total	%	%
1	15.60	36.28	36.28	15.60	36.28	36.28	5.98	13.91	13.91
2	2.94	6.84	43.12	2.94	6.84	43.12	5.24	12.18	26.09
3	2.30	5.34	48.45	2.30	5.34	48.45	4.90	11.39	37.48
4	2.18	5.06	53.51	2.18	5.06	53.51	3.75	8.72	46.20
5	1.95	4.53	58.05	1.95	4.53	58.05	2.99	6.95	53.14
6	1.58	3.67	61.71	1.58	3.67	61.71	2.29	5.33	58.47
7	1.23	2.86	64.58	1.23	2.86	64.58	1.99	4.63	63.10
8	1.13	2.62	67.19	1.13	2.62	67.19	1.76	4.09	67.19

Extraction Method: Principal Component Analysis

Factor Identification and Interpretation

Through exploratory factor analysis (EFA), this study identified eight distinct factors that influence decision-making regarding tree removal in Malaysian development areas. These factors and their corresponding loadings and mean rankings are detailed in Table 3.

Table 3: Result of Rotating Component Matrix

Factors Affecting Tree Removal Decisions	Factor loadings								Mean
	1	2	3	4	5	6	7	8	
Factor 1: Resource Availability									
Tree inventory requires experts	0.81								4.03
Absence equipment for assessing tree vitality	0.78								
Transplanting requires experts	0.76								
Insufficient incentives for tree preservation	0.75								
Insufficient funds for tree maintenance	0.75								
Lack of staff for tree monitoring	0.70								
The allocation of funds is inadequate	0.66								
Insufficient tree data	0.64								

Factors Affecting Tree Removal Decisions	Factor loadings								Mean
	1	2	3	4	5	6	7	8	
Factor 2: Institutional constraint									
Legislation enforcement is ineffective		0.77							4.11
Fines are insufficient		0.72							
Lack comprehensive plan and coordination		0.70							
Lack of involvement in planning permission process		0.70							
The replacement tree is inappropriate		0.66							
TCLM involves certain projects		0.65							
No authority to control private tree removal		0.58							
Limitations alter policy		0.56							
No gazette tree law		0.53							
Insufficient community involvement		0.42							
Factor 3: Spatial characteristics									
Proximity to structures			0.76						4.06
Space constraints for transplanting			0.76						
Space restriction (above and below the surface)			0.74						
Inappropriate planting distance			0.70						
The development site is small in size or shape			0.70						
Factor 4: Social aspect									
Lack of creative design solutions				0.71					3.92
Inaccurate inventory data				0.66					
Based on the preferences of a prominent Individual				0.66					
Constrained to the developer's wishes				0.62					
Factor 5: Cost and profit									
Removal costs are cheaper than retaining in situ					0.83				3.77
Removal costs are cheaper than transplanting					0.80				
Design changes cost more					0.74				
Prohibit removal is hindering development					0.52				
Factor 6: Tree characteristic									
Small tree diameter						0.66			3.64
Not a native tree/no special value						0.65			
To be replaced by new species						0.64			
Factor 7: Tree vitality									
Short life span							0.77		3.92
Health problem and no potential for recovery							0.68		
Factor 8: Project-theme									
Unrelated design themes								0.61	3.50

Factor 1: Resource Availability (Mean = 4.03)

Component 1 is best interpreted as resource availability, which encompasses financial, technical, and informational limitations in tree conservation. High factor loadings, such as "tree inventory requires experts" (0.81) and "absence of equipment for assessing tree vitality" (0.78), highlight critical operational deficiencies. Respondents cited the lack of dedicated funding for tree maintenance, the shortage of trained arboricultural professionals, and outdated or incomplete tree data as major barriers. These limitations hinder proactive practices such as health assessments, transplantation planning, and long-term monitoring. When resources are insufficient, the default response often becomes tree removal,

even in cases where retention or treatment might be feasible. Moreover, these resource-related limitations are closely intertwined with institutional and procedural inefficiencies. Without adequate funding, expertise, and information systems, even well-intentioned policies are difficult to implement, thereby increasing the likelihood of unnecessary tree removals in development projects.

Factor 2: Institutional Constraints (Mean = 4.11 – Highest)

This factor was rated the most significant, highlighting widespread concern over the effectiveness of institutional mechanisms in managing tree conservation. Institutional constraints refer to issues related to policies, legislation, guidelines, and procedures that govern Tree Conservation and Landscape Management (TCLM). These include the effectiveness of development order processes, inter-agency or departmental cooperation, the availability and enforcement of tree protection laws, the adequacy of penalties or tree replacement requirements, and the legal authority to regulate tree felling on private land. Most of these constraints are associated with local authorities, who often serve as the primary decision-makers but have limited in jurisdiction, especially over trees on private property. The findings also indicate that poor enforcement, lack of coordinated planning, and weak community involvement further undermine TCLM implementation.

This finding reinforces the conclusion that the absence of legally binding and enforceable tree preservation measures, such as the ineffective use of Tree Preservation Orders (TPOs) under the Town and Country Planning Act 1976 [Act 172], is the most influential determinant in tree removal decisions. Additionally, institutional challenges are further compounded by resource scarcity and procedural complexity, including lengthy bureaucratic processes and overlapping agency responsibilities. Together, these structural issues create systemic barriers to protecting trees in development areas and call for urgent institutional reform and greater stakeholder collaboration.

These findings indicate that governance and institutional limitations remain one of the most critical barriers to sustaining Malaysia's urban tree canopy. Weak enforcement, overlapping agency responsibilities, and the absence of clear legal frameworks continue to hinder effective tree preservation. To address these challenges, stronger governance mechanisms and more inclusive decision-making processes are required. Integrating diverse legislative tools, fostering inter-agency collaboration, and encouraging active community involvement can collectively mitigate the negative impacts of urban development on trees. Local authorities are also encouraged to explore all feasible alternatives before granting approval for tree removal, ensuring that removal becomes a last resort rather than a default practice.

Factor 3: Spatial Characteristics (Mean = 4.06)

This component reflects the physical constraints of the development site, including tree proximity to buildings, limited rooting space, and unsuitable plot shape or size. Factors such as proximity to structures and "space constraints for transplanting" suggest that trees are often removed to prevent interference with construction. In high-density urban environments, accommodating mature trees requires design flexibility, which is frequently avoided due to cost or space limitations. Consequently, the spatial layout of a site can be a decisive factor in whether trees are retained or removed.

Factor 4: Social Aspects (Mean = 3.92)

Social factors encompass human perceptions, preferences, and planning biases. This includes a lack of creative design solutions, reliance on inaccurate inventory

data, and decisions influenced by prominent individuals or developer preferences. The absence of inclusive decision-making and stakeholder engagement often results in tree removals that prioritise short-term interests over broader environmental and community benefits. This underscores a critical gap in participatory urban planning and the need to integrate both expert and public perspectives into development approval processes.

Factor 5: Cost and Profit Considerations (Mean = 3.77)

Cost-driven motivations strongly influence decisions to remove trees. Respondents commonly noted that the perceived cost-effectiveness of tree removal—compared to redesigning site plans or investing in tree transplantation—leads developers to choose removal. Furthermore, the belief that retaining trees can impede construction progress or increase budgets fosters a short-term financial mindset. These cost-benefit trade-offs often disregard the long-term ecosystem services and social value provided by mature urban trees.

Factor 6: Tree Characteristics (Mean = 3.64)

This factor includes the biological and morphological characteristics of trees, such as small diameter, non-native species, or a perceived lack of ecological or heritage value. Trees deemed insignificant or easily replaceable are often excluded from preservation efforts. Such decisions may reflect biases in aesthetic preferences or species selection and overlook the potential contributions of small or non-native trees to biodiversity and climate adaptation.

Factor 7: Tree Vitality (Mean = 3.92)

Tree health and expected lifespan also significantly influence decision-making. Respondents pointed out that trees showing signs of irreversible decline or limited life expectancy are frequently removed. While this is often justified on safety or viability grounds, it also reflects limited investment in health monitoring and remedial care. A more proactive and diagnostic approach could reduce unnecessary removals and extend the service life of valuable trees.

Factor 8: Project Theme Compatibility (Mean = 3.50 – Lowest)

The least influential factor, which is project-theme compatibility, refers to whether the presence of trees aligns with the intended design concept of the development. Overall, although less significant, this factor still affects decisions in projects with strong aesthetic or branding requirements, such as commercial centres and gated residential communities. In such cases, trees may be removed if perceived to conflict with the intended visual or thematic identity of the development.

Ordóñez-Barona et al. (2021) state that in order to address the impact of development on urban trees, the most creative mechanisms and collective decision-making are needed. This may be achieved by combining different legislation, stakeholder coordination, and getting support from the community (Clark et al., 2020). Nik Mohamed Sukri et al. (2022) urged local authorities to investigate all possible solutions before issuing consent for tree removal.

Research contribution

This study contributes new insights into understanding how professional decision-makers assess tree removal in Malaysian development areas. Theoretically, it extends current urban forestry research by empirically identifying eight determinants that shape removal decisions namely, resource availability, institutional constraints, spatial characteristics, social aspects, cost and profit, tree characteristics, tree vitality, and project-theme compatibility. Methodologically, the study demonstrates

the use of Exploratory Factor Analysis (EFA) to quantify complex decision-making factors, providing a structured analytical framework that can be replicated in future studies of urban tree management. The findings also contribute to the contextual understanding of Malaysian urban planning by linking institutional and procedural limitations to tree loss, thereby highlighting governance as a critical domain for reform and innovation in sustainable landscape management.

Practical contributions

Practically, the study offers evidence-based guidance for improving tree management within development areas. By identifying the main determinants influencing tree removal, the findings can assist local authorities, landscape architects, and urban planners in refining decision-making frameworks and regulatory practices. The results underscore the importance of strengthening coordination among agencies, enhancing tree assessment capacity, and promoting data-driven management. Furthermore, the insights support local authorities in updating technical guidelines, streamlining approval procedures, and encouraging more transparent, accountable, and inclusive approaches to urban tree preservation.

Conclusion

In conclusion, decisions regarding tree removal are significantly influenced by institutional constraints, particularly those related to limited resources and complex administrative procedures. These constraints affect various stakeholders involved in the decision-making process, including local authorities, landscape practitioners, urban planners, and policymakers. This study highlights the need for a robust regulatory framework, comprehensive planning, effective stakeholder coordination, and active community engagement to ensure the protection of urban trees.

To strengthen current practices, several policy measures are recommended. Enforcement mechanisms under the Town and Country Planning Act 1976 [Act 172] should be enhanced through updated local by-laws to ensure stronger implementation of Tree Preservation Orders (TPOs) within local development plans. Incentives should also be introduced for developers who retain mature trees on-site, encouraging tree-sensitive planning and sustainable site design. Additionally, mandatory tree audits during project planning stages would ensure that all significant trees are documented, assessed, and integrated into design decisions before construction begins. By implementing these actions, decision-making processes can become more transparent, consistent, and effective. These improvements are essential to achieving sustainable urban development and aligning Malaysia's landscape management practices with the Sustainable Development Goals particularly SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land).

Acknowledgement

The authors acknowledge the financial assistance from the Fundamental Research Grant Scheme (FRGS). Grant: FRGS/1/2015/WAB03/UITM/03/1.

References

Ames, B., & Dewald, S. (2003). Working Proactively with Developers to Preserve Urban Trees. *Cities*, *20*(2), 95–100. https://doi.org/10.1016/S0264-2751(02)00117-8

Brunner, J., & Cozens, P. (2013). "Where have all the Trees Gone?" Urban Consolidation and the Demise of Urban Vegetation: A Case Study from Western Australia. *Planning Practice and Research*, *28*(2), 231–255. https://doi.org/10.1080/02697459.2012.733525

Clark, C., Ordóñez, C., & Livesley, S. J. (2020). Private Tree Removal, Public Loss: Valuing and Enforcing Existing Tree Protection Mechanisms is the Key to Retaining Urban Trees on Private Land. *Landscape and Urban Planning*, *203*, 1–11. https://doi.org/10.1016/j.landurbplan.2020.103899

Conway, T. M. (2016). Tending their Urban Forest: Residents' Motivations for Tree Planting and Removal. *Urban Forestry and Urban Greening*, *17*, 23–32. https://doi.org/10.1016/j.ufug.2016.03.008

Croeser, T., Ordóñez, C., Threlfall, C., Kendal, D., van der Ree, R., Callow, D., & Livesley, S. J. (2020). Patterns of Tree Removal and Canopy Change on Public and Private Land in the City of Melbourne. *Sustainable Cities and Society*, *56*. https://doi.org/10.1016/j.scs.2020.102096

Despot, D., & Gerhold, H. (2003). Preserving Trees in Construction Projects: Identifying Incentives and Barriers. *Journal of Arboriculture*, *29*(5).

Gilbert, O. L. (1996). Retaining Trees on Construction Sites. *Arboricultural Journal*, *20*(1), 39–45. https://doi.org/10.1080/03071375.1996.9747096

Guo, T., Morgenroth, J., & Conway, T. (2018). Redeveloping the Urban Forest: The Effect of Redevelopment and Property-Scale Variables on Tree Removal and Retention. *Urban Forestry and Urban Greening*, *35*, 192–201. https://doi.org/10.1016/j.ufug.2018.08.012

Guo, T., Morgenroth, J., & Conway, T. (2019). To Plant, Remove, or Retain: Understanding Property Owner Decisions About Trees During Redevelopment. *Landscape and Urban Planning*, *190*. https://doi.org/10.1016/j.landurbplan.2019.103601

Hamzah, H., Othman, N., & Mohd Hussain, N. H. (2017). Tree Removal Application by Urban Dwellers: A Case Study of Kajang Local Authority. *Proceedings of International Conference on Architecture (ICRP-AVAN)*, 124–128.

Hassan, K., Nizam, W. S., Mohamad, W., Hasan, R., & Bahaluddin, A. (2024). Decision-Making for Tree Removal in Urban Development: Insights from Local Authorities in Malaysia. *Journal of the Malaysia Institute of Planners*, *22*(6), 196–206.

Jiang, T., Freudenberg, M., Kleinn, C., Tewari, V. P., Diwakara, B. N., & Nölke, N. (2025). Unveiling Urbanization Effects on Trees Outside Forests Along the Urban-Rural Gradient in Megacity Bengaluru. *Forest Ecosystems*, *12*. https://doi.org/10.1016/j.fecs.2024.100258

Jim, C. Y. (2019). Soil Volume Restrictions and Urban Soil Design for Trees in Confined Planting Sites. *Journal of Landscape Architecture*, *14*(1), 84–91. https://doi.org/10.1080/18626033.2019.1623552

Kanniah, K. D. (2017). Quantifying Green Cover Change for Sustainable Urban Planning: A Case of Kuala Lumpur, Malaysia. *Urban Forestry and Urban Greening*, *27*, 287–304. https://doi.org/10.1016/j.ufug.2017.08.016

Kellogg, W. A., Mikelbank, B., Laverne, R., & Hexter, K. W. (2017). The Economic Value of Tree Preservation in a Weak Land Development Market Region. *Arboriculture & Urban Forestry*, *43*(2), 55–71. https://engagedscholarship.csuohio.edu/urban_facpubhttps://engagedscholarship.csuohio.edu/urban_facpub/1461

Kirkpatrick, J. B., Davison, A., & Daniels, G. D. (2012). Resident Attitudes Towards Trees Influence the Planting and Removal of Different Types of Trees in Eastern Australian Cities. *Landscape and Urban Planning*, *107*(2), 147–158. https://doi.org/10.1016/j.landurbplan.2012.05.015

Kirkpatrick, J. B., Davison, A., & Daniels, G. D. (2013). Sinners, Scapegoats or Fashion Victims? Understanding The Deaths of Trees in the Green City. *Geoforum*, *48*, 165–176. https://doi.org/10.1016/j.geoforum.2013.04.018

Krejcie, R. V, & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, *30*, 607–610.

Kronenberg, J. (2014). Why not to Green a City? Institutional Barriers to Preserving Urban Ecosystem Services. *Ecosystem Services*, *12*, 218–227. https://doi.org/10.1016/j.ecoser.2014.07.002

Lombardía, A., & Gómez-Villarino, M. T. (2023). Green Infrastructure in Cities for the Achievement of the UN Sustainable Development Goals: A Systematic Review. *Urban Ecosyst*, *26*, 1693–1707.

Martin, A. J. F., Fleming, A., & Conway, T. M. (2025). Protecting Trees in the Urban Forest: A Systematic Review of Literature on Acts, Bylaws, Ordinances, and Regulations. *Environmental Reviews.*, *33*, 1–13.

Maskey, R., Fei, J., & Nguyen, H. O. (2018). Use of Exploratory Factor Analysis in Maritime Research. *Asian Journal of Shipping and Logistics*, *34*(2), 91–111. https://doi.org/10.1016/j.ajsl.2018.06.006

Morgenroth, J., O'Neil-Dunne, J., & Apiolaza, L. A. (2017). Redevelopment and the Urban Forest: A Study of Tree Removal and Retention During Demolition Activities. *Applied Geography*, *82*, 1–10. https://doi.org/10.1016/j.apgeog.2017.02.011

Morgenroth, J., & Östberg, J. (2017). Measuring and Monitoring Urban Trees and Urban Forests. In *Routledge Handbook of Urban Forestry*. Routledge.

Morton, A. (2006). Determining the Retention Value of Trees on Development Sites. *7th National Street Tree Symposium*, 110–123.

Nik Mohamed Sukri, N. A., Wan Ariffin, W. T., & Salim, S. (2022). Tree Preservation Order of Act 172: A Malaysian Legislation Towards Sustainable Urban Forests. In S. Maruthaveeran & Wendy. Y. Chen (Eds.), *Urban Forestry and Arboriculture in Malaysia*. Springer.

Nowak, D. J., & Greenfield, E. J. (2020). The Increase of Impervious Cover and Decrease of Tree Cover within Urban Areas Globally (2012–2017). *Urban Forestry and Urban Greening*, *49*. https://doi.org/10.1016/j.ufug.2020.126638

O'herrin, K., Hauer, R. J., Weit, W. J. Vander, & Miller, R. W. (2016). Homebuilder Practices and Perceptions of Construction on the Wooded Lot: A Quarter Century Later Follow-Up Assessment. *Arboriculture & Urban Forestry*, *42*(5).

O'herrin, K., Hauer, R., Pike, K., & Vogt, J. (2022). Homebuilder Activities and Knowledge of Tree Preservation during Construction: Comparison of Practitioners in Rural and Urban Locations. *Sustainability (Switzerland)*, *14*(5). https://doi.org/10.3390/su14052753

Ordóñez, C., Threlfall, C. G., Kendal, D., Hochuli, D. F., Davern, M., Fuller, R. A., van der Ree, R., & Livesley, S. J. (2019). Urban Forest Governance and Decision-Making: A Systematic Review and Synthesis of the Perspectives of Municipal Managers. *Landscape and Urban Planning*, *189*, 166–180. https://doi.org/10.1016/j.landurbplan.2019.04.020

Ordóñez-Barona, C., Bush, J., Hurley, J., Amati, M., Juhola, S., Frank, S., Ritchie, M., Clark, C., English, A., Hertzog, K., Caffin, M., Watt, S., & Livesley, S. J. (2021). International Approaches to Protecting and Retaining Trees on Private Urban Land. *Journal of Environmental Management*, *285*. https://doi.org/10.1016/j.jenvman.2021.112081

Papastavrou, V. (2019). Community Engagement in Urban Tree Management Decisions: The Bristol Case Study. *Arboricultural Journal*, *41*(2), 91–104. https://doi.org/10.1080/03071375.2019.1589173

Roman, L. A., Battles, J. J., & McBride, J. R. (2014). Determinants of Establishment Survival for Residential Trees in Sacramento County, CA. *Landscape and Urban Planning*, *129*, 22–31. https://doi.org/10.1016/j.landurbplan.2014.05.004

Roman, L. A., Fristensky, J., Lundgren, R., Cerwinka, C., & Lubar, J. (2022). Construction and Proactive Management Led to Tree Removals on an Urban College Campus. *Forests*, *13*(6). https://doi.org/10.3390/f13060871

Roman, L. A., McPherson, E. G., Scharenbroch, B. C., & Bartens, J. (2013). Identifying Common Practices and Challenges for Local Urban Tree Monitoring Programs Across the United States. *Arboriculture and Urban Forestry*, *39*(6), 292–299. https://doi.org/10.48044/jauf.2013.038

Romero, F. S. (2021). Logic and Effectiveness of Urban Tree Preservation: A Comparative Case Study of Charlotte and San Antonio. *State and Local Government Review*, *53*(2), 142–158.

Roux, D. S. Le, Ikin, K., Lindenmayer, D. B., Manning, A. D., & Gibbons, P. (2014). *The Future of Large Old Trees in Urban Landscapes*. *9*(6). https://doi.org/10.1371/journal.pone.0099403

Susskind, L., Chun, J., Goldberg, S., Gordon, J. A., Smith, G., & Zaerpoor, Y. (2020). Breaking Out of Carbon Lock-In: Malaysia's Path to Decarbonization. *Frontiers in Built Environment*, *6*. https://doi.org/10.3389/fbuil.2020.00021

Vogt, J., Hauer, R. J., & Fischer, B. C. (2015). The Costs of Maintaining and not Maintaining the Urban Forest: A Review of the Urban Forestry and Arboriculture Literature. *Arboriculture and Urban Forestry*, *41*(6), 293–323. https://doi.org/10.48044/jauf.2015.027