ASSESSING LANDSCAPE PLANT FUNCTIONS FOR SUSTAINABLE BOTANICAL GARDEN MANAGEMENT (A CASE STUDY OF ENREKANG BOTANICAL GARDEN)

Sandri Fesly Ari[1*], Iradhatullah Rahim[2], Yunarti[3]

[1,2] Agrotechnology Study Program, Faculty of Agriculture, Animal Husbandry, and Fisheries, Universitas Muhammadiyah Parepare, Jl. Jend. Ahmad Yani Km. 6, Bukit Harapan, Soreang, Parepare, South Sulawesi, Indonesia, 91131

[3] International Business Administration Study Program, Politeknik Pertanian Negeri Pangkajene Kepulauan, Makassar - Parepare Main Road Km. 83, Mandalle, Pangkep, Pangkajene and Islands Regency, South Sulawesi 90761

*correspondent e-mail: fesly80@yahoo.com

ABSTRACT

Botanical gardens play a strategic role in integrating ecological, spatial, and socio-cultural functions within sustainable agricultural landscapes. This study assesses the functional performance of landscape plants in Enrekang Botanical Garden, focusing on Taman Monumen La Tinro and Taman Wangi, to support sustainable garden management. A mixed-method approach was employed, combining field observations, visual landscape documentation, and visitor perception surveys. Five functional variables were evaluated: ecological, shading, spatial, aesthetic, and conservation functions. The results indicate that aesthetic and spatial functions received the highest visitor ratings in both sites, reflecting effective visual organization and spatial clarity of planting design. Shading and conservation functions showed moderate performance, while ecological functions were perceived as comparatively weaker, suggesting limited recognition of ecological services by visitors. Comparative analysis reveals functional differentiation between the two gardens, influenced by layout configuration and vegetation composition. These findings highlight a functional imbalance between visual-spatial dominance and ecological-conservation roles. The study contributes novelty by integrating visitor-based functional assessment into botanical garden landscape evaluation, offering an applied framework to enhance sustainable, multifunctional landscape management in integrated agricultural systems.

ABSTRACT

Kebun raya memainkan peran strategis dalam mengintegrasikan fungsi ekologis, spasial, dan sosio-kultural dalam lanskap pertanian berkelanjutan. Studi ini menilai kinerja fungsional tanaman lanskap di Kebun Raya Enrekang, dengan fokus pada Taman Monumen La Tinro dan Taman Wangi, untuk mendukung pengelolaan kebun yang berkelanjutan. Pendekatan metode campuran digunakan, menggabungkan pengamatan lapangan, dokumentasi lanskap visual, dan survei persepsi pengunjung. Lima variabel fungsional dievaluasi: fungsi ekologis, naungan, spasial, estetika, dan konservasi. Hasil menunjukkan bahwa fungsi estetika dan spasial menerima peringkat pengunjung tertinggi di kedua lokasi, mencerminkan organisasi visual yang efektif dan kejelasan spasial dari desain penanaman. Fungsi naungan dan konservasi menunjukkan kinerja yang moderat, sementara fungsi ekologis dianggap relatif lebih lemah, menunjukkan pengakuan yang terbatas terhadap layanan ekologis oleh pengunjung. Analisis komparatif mengungkapkan diferensiasi fungsional antara kedua kebun, dipengaruhi oleh konfigurasi tata letak dan komposisi vegetasi. Temuan ini menyoroti ketidakseimbangan fungsional antara dominasi visual-spasial dan peran ekologis-konservasi. Studi ini memberikan

*kontribusi baru dengan mengintegrasikan penilaian fungsional berbasis pengunjung ke
dalam evaluasi lanskap kebun raya, menawarkan kerangka kerja terapan untuk
meningkatkan pengelolaan lanskap multifungsi yang berkelanjutan dalam sistem
pertanian terpadu.*

INTRODUCTION

Sustainable green space management has become a strategic issue in the development of integrated environmental and agricultural systems, particularly in response to increasing pressure on land resources, biodiversity, and environmental quality. Botanical gardens, as functional green spaces, serve not only as centers for plant conservation but also as ecological, educational, social, and aesthetic spaces that reflect the interconnected relationship between humans and nature (Błaszak et al., 2019; Sanders et al., 2018). In this context, landscape plants play a crucial role, as they shape spatial structure, ecological functions, and the environment's visual quality and comfort (Liu & Nijhuis, 2020; Yao et al., 2012).

Conceptually, the relationship between humans and landscapes can be understood through the perspective of Dasein, which positions humans as beings who exist within the world and continuously interact with their surroundings (Wylie, 2013; 2017). Landscapes are therefore not merely physical entities, but meaningful spaces that shape human experience, perception, and the sustainability of life (Menatti & Casado da Rocha, 2016; Vallés-Planells, 2014). Accordingly, landscape plants in botanical gardens should not be regarded solely as decorative elements, but as integral components of living systems that support the ecological and existential sustainability of green spaces (Błaszak et al., 2019; Tian, 2022). This perspective calls for management approaches that extend beyond technical considerations toward more systemic and function-based frameworks (Ossiannilsson & Ioannides, 2017).

Numerous international studies have assessed botanical gardens and urban green spaces from the perspectives of species diversity, landscape aesthetics, and conservation value (Heywood, 2017; Southon et al., 2017). However, most of these studies remain largely descriptive, focusing on vegetation inventories or visual spatial arrangements (Egerer et al., 2020; Rakow & Lee, 2015; Villagra-Islas, 2011). Research that specifically evaluates landscape plant functions as an integrated system supporting sustainable botanical garden management remains limited. Furthermore, the integration of ecological, functional–spatial, and management-oriented values within a unified analytical framework has not been sufficiently developed, particularly for botanical gardens in tropical regions.

Within the context of integrated and sustainable agricultural systems, botanical gardens occupy a strategic position as interfaces linking biodiversity conservation, environmental education, and productive landscape management (Błaszak et al., 2019; Johnson, 2012). Assessing landscape plant functions—such as ecological regulation, shading, spatial guidance, boundary definition, aesthetic enhancement, and conservation—becomes essential to ensure that vegetation composition and distribution effectively support sustainable management objectives (Dong et al., 2022; Jones et al., 2013; Solecka, 2019). Nevertheless, studies that explicitly link these functional roles to managerial implications for botanical garden management remain scarce.

Addressing this research gap, the present study offers novelty by applying a functional-based assessment of landscape plants as a foundation for sustainable botanical garden management within an integrated systems framework. Using Enrekang Botanical Garden as a case study, this research not only provides empirical insights into landscape plant functions but also proposes an evaluative model that can be replicated in other botanical gardens and comparable green spaces.

Therefore, the objective of this study was to assess the functions of landscape plants in Enrekang Botanical Garden and to analyze their implications for sustainable botanical garden management. The findings are expected to contribute to the development of function-based landscape management approaches and to strengthen the role of botanical gardens as integral components of sustainable agricultural and environmental systems.

RESEARCH METHODS

Study Area

The study was conducted at Enrekang Botanical Garden, located in South Sulawesi, Indonesia. The botanical garden represents a tropical highland environment characterized by diverse vegetation types, varied topography, and multifunctional landscape zones. The site was selected due to its role as a conservation-oriented green space that integrates ecological, educational, and recreational functions within a single landscape system.

Research Design

This research employed a descriptive–analytical approach combined with functional landscape assessment. The study focused on evaluating landscape plant functions based on direct field observations, spatial documentation, and visual analysis. The methodological framework was designed to link vegetation characteristics with their functional roles in supporting sustainable botanical garden management.

Landscape Zoning and Sampling Units

The botanical garden area was divided into functional landscape zones based on land use, spatial configuration, and management objectives, as identified in the existing site plan and field observations. Within each zone, representative sampling units were established to capture dominant plant compositions and landscape structures. Sampling locations were selected purposively to reflect variations in vegetation density, plant form, and spatial arrangement, ensuring that all major landscape functions observed in the field were adequately represented.

Assessment of Landscape Plant Functions

Landscape plant functions were assessed based on functional variables explicitly observed and presented in the Results section. The assessment framework focused on five main functional variables that emerged from field observations and visual documentation, namely ecological, shading, spatial, aesthetic, and conservation functions. These variables represent the dominant functional roles of landscape plants within the botanical garden system and form the analytical basis for the figures presented in this study. All functional variables were assessed through direct field observation and systematic photographic documentation. The photographs serve as primary visual

evidence for each functional variable and were used to support qualitative interpretation in the Results and Discussion sections.

Ecological Function

This variable refers to the role of landscape plants in supporting environmental quality, including microclimate regulation, soil protection, water infiltration, and habitat provision. Indicators used in this assessment included vegetation density, canopy layering, ground cover presence, and plant adaptability to site conditions.

Shading Function

The shading function was evaluated based on canopy width, leaf density, and spatial distribution of trees and shrubs that contribute to thermal comfort along pedestrian pathways and open spaces. This function is visually represented in the results through images showing canopy coverage and shaded circulation areas.

Spatial Function

Spatial function encompasses the role of plants in structuring space, including guidance along circulation routes, boundary definition, and enclosure of activity areas. Indicators included plant alignment, planting continuity, and spatial clarity created by vegetation arrangement.

Aesthetic Function

The aesthetic function was assessed through visual attributes such as plant form, color variation, texture, and compositional harmony within the landscape. This variable reflects the contribution of landscape plants to visual quality and visitor experience, as demonstrated in the photographic figures presented in the Results section.

Conservation Function

The conservation function was evaluated based on the presence and dominance of native, endemic, or conservation-priority plant species within the landscape. This variable highlights the role of botanical gardens in preserving plant diversity and supporting long-term ecological sustainability.

Scoring and Classification of Functional Performance

To ensure analytical consistency, each landscape plant function was evaluated using a qualitative scoring system, classifying functional performance into three levels: low, moderate, and high. The classification was based on observable indicators such as plant density, canopy structure, spatial continuity, and visual dominance within the landscape. This scoring system enabled comparative analysis among different landscape zones and functions and facilitated the interpretation of functional effectiveness presented in the graphical results.

Data Analysis and Interpretation

The collected data were analyzed descriptively and comparatively across landscape zones and functional categories. Functional scores were synthesized and visualized to support interpretation of landscape performance, forming the basis for the figures presented in the Results section. The analysis emphasized identifying dominant functions, functional overlaps, and gaps that have implications for sustainable botanical garden management.

Methodological Rigor and Reproducibility

To enhance reproducibility, all assessment criteria, functional classifications, and scoring procedures were applied consistently across observation units. Photographic documentation and zone-based analysis provide transparent evidence supporting the functional evaluations. This methodological approach allows replication in other botanical gardens or green spaces with similar landscape characteristics.

RESULTS AND DISCUSSION

Functional Performance of Landscape Plants Based on Visitor Perceptions

As shown in Figure 1, visitor perceptions indicate that landscape plant performance in both Taman Monumen La Tinro and Taman Wangi is predominantly characterized by high spatial and aesthetic functions, each exceeding 90%. This suggests that vegetation arrangement in both sites effectively structures space, enhances visual quality, and supports visitor orientation. In contrast, shading and ecological functions received moderate ratings (approximately 60–75%), while conservation function was consistently rated lowest, particularly in Taman Monumen La Tinro. This pattern indicates a design emphasis on visual comfort and spatial experience rather than explicit biodiversity conservation.

Comparatively, Taman Wangi demonstrated a relatively higher conservation score than Taman Monumen La Tinro, although it remained within the low–moderate category. This difference likely reflects variations in plant composition, vegetation density, or the presence of microhabitat-supporting elements. The consistently high spatial and aesthetic ratings across both sites indicate a shared design approach prioritizing legibility and visual appeal, reinforcing the tendency of urban landscape planning to foreground experiential qualities over ecological functionality.

These findings align with previous studies showing that visitors respond more strongly to visible spatial and aesthetic attributes than to indirect ecological functions (Belaire et al., 2015; Breiby & Slåtten, 2018; Goodness et al., 2016). Moreover, conservation roles of urban green spaces are often underrecognized without clear visual cues or interpretive elements (Rupprecht & Byrne, 2014). Overall, Figure 1 highlights a perceptual gap between ecological potential and user awareness, underscoring the need for integrated landscape management that balances aesthetic–spatial performance with ecological and conservation functions in sustainable botanical garden systems.


(a) Taman Monumen La Tinro   (b) Taman Wangi
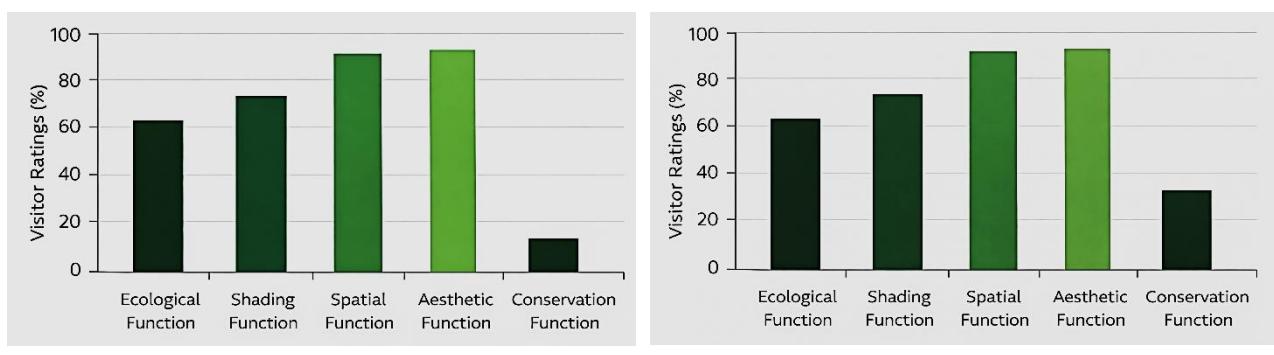
Figure 1.   Functional assessment of landscape plant performance in Taman Monumen La Tinro based on visitor perceptions.

Perceived Landscape Plant Functions as a Basis for Sustainable Garden Management

Figure 2 illustrates visitor-based assessments of the functional roles of landscape plants in Taman Monumen La Tinro and Taman Wangi. In both sites, the aesthetic function received the highest ratings (≈95%), indicating that visual quality is the most immediately perceived and valued role of landscape vegetation. This consistent dominance suggests that plant composition, color harmony, and spatial arrangement strongly shape visitors' overall impressions, reinforcing the importance of aesthetics as a primary driver of public satisfaction in botanical and urban park settings.

The spatial and shading functions were also rated highly (≈80–85%), reflecting the effectiveness of vegetation in structuring space and providing thermal comfort. These functions were perceived slightly more positively in Taman Wangi, likely due to more coherent plant zoning and canopy distribution. In contrast, the ecological function received substantially lower ratings (≈45–50%) in both parks, indicating that services such as pollution mitigation, biodiversity support, and microclimate regulation are less visible or less understood by visitors. This perception gap highlights a common challenge in landscape management, where ecological benefits are often indirect and not immediately perceptible to the public (Karimi et al., 2020; Pfund et al., 2011).
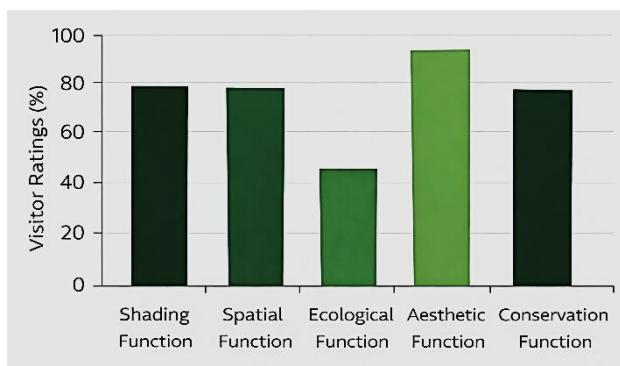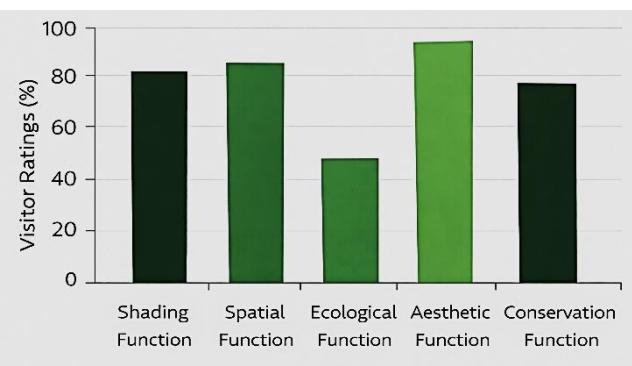

(a) Taman Monumen La Tinro   (b) Taman Wangi

Figure 2.   Perceived functional roles of landscape plants in Taman Monumen La Tinro and Taman Wangi.

(a) Taman Monumen La Tinro   (b) Taman Wangi

Figure 3.   Landscape characteristics of study sites.

The conservation function showed moderate ratings (≈75–78%), suggesting partial recognition of the role of landscape plants in preserving local plant diversity and environmental quality. These findings align with previous studies reporting that users of urban green spaces tend to prioritize

aesthetic and comfort-related functions over ecological processes, unless explicit interpretive elements or educational signage are provided (Cicerali et al., 2017). Overall, the results emphasize the need for integrated landscape strategies that not only enhance visual and spatial quality but also make ecological and conservation functions more legible to visitors, thereby strengthening the multifunctional role of botanical gardens within sustainable landscape management frameworks.

Functional-Based Evaluation Model for Botanical Garden Management

Based on the functional assessment results, this study formulates a functional-based evaluation model for botanical garden management that integrates landscape plant performance, visitor perceptions, and sustainability objectives (Figure 4). The findings from Taman Monumen La Tinro and Taman Wangi indicate that landscape plant functions are perceived unevenly, with aesthetic and spatial functions consistently dominating visitor evaluations, while ecological and conservation functions remain less visible. This pattern reflects a common tendency in public green spaces where visually legible and comfort-related attributes are more readily recognized than indirect ecological services (Fandeli, 2021). Such functional hierarchies provide an empirical basis for developing an evaluation model that moves beyond descriptive vegetation inventories toward a performance-oriented and perception-informed framework.
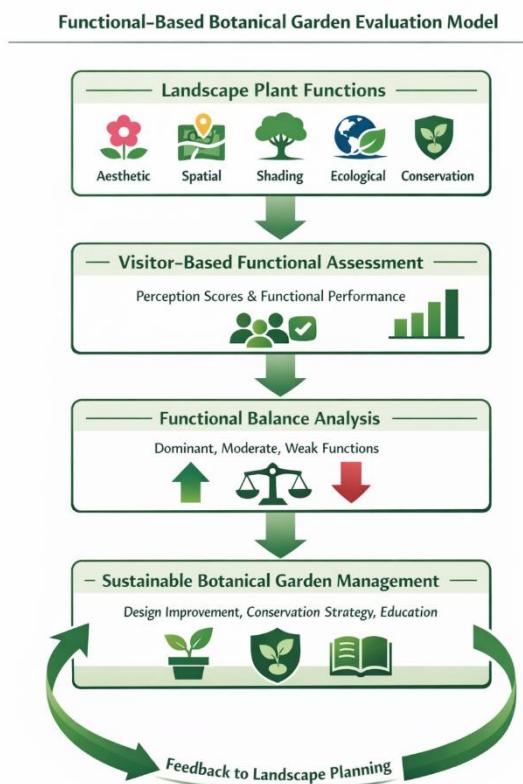
Figur 4.   Functional-based evaluation model for sustainable botanical garden management.

The proposed model conceptualizes botanical garden performance through five interrelated functional dimensions: aesthetic, spatial, shading, ecological, and conservation functions. These dimensions collectively represent the multifunctional character of botanical gardens as ecological infrastructures, cultural landscapes, and public spaces (Błaszak et al., 2019; Heywood, 2017). Within

this framework, visitor-based functional assessment serves as a diagnostic layer that identifies dominant, moderate, and weak functions. High ratings for aesthetic and spatial functions indicate effective visual organization and spatial clarity, which are critical for visitor engagement and recreational value (Liu & Nijhuis, 2020; Southon et al., 2017). Conversely, lower recognition of ecological and conservation functions highlights a perceptual gap between ecological capacity and public awareness, a challenge widely reported in studies of urban and botanical landscapes (Bele & Chakradeo, 2021; Muratet et al., 2015; Shwartz et al., 2024).

Operationally, the evaluation model follows a three-stage process: functional identification, functional balance analysis, and management response formulation. Rather than maximizing individual functions in isolation, the model emphasizes achieving functional balance and synergy, recognizing that visually dominant landscapes without ecological robustness risk long-term sustainability, while ecologically rich landscapes lacking spatial legibility may fail to attract public support (Dong et al., 2022; Jones et al., 2013). By translating functional evaluation outcomes into adaptive management strategies—such as optimizing planting composition, strengthening conservation-oriented vegetation, and enhancing ecological interpretation—the model positions landscape plants as mediators between ecological sustainability and human experience. Consequently, this functional-based evaluation model offers a replicable and applied framework for sustainable botanical garden management, particularly within integrated agricultural and environmental systems in tropical contexts (Johnson, 2012; Solecka, 2019).

CONCLUSION

This study shows that landscape plant performance in Taman Monumen La Tinro and Taman Wangi is primarily perceived through aesthetic and spatial functions, which dominate visitor evaluations and effectively support visual quality, spatial legibility, and comfort. In contrast, ecological and conservation functions are less strongly perceived, indicating a gap between the ecological potential of landscape vegetation and public awareness.

The study's key contribution lies in its functional-based assessment framework that integrates visitor perceptions with landscape plant functions to support sustainable management. The findings demonstrate that perception-driven evaluation can reveal functional imbalances overlooked by conventional assessments, emphasizing the need for integrated landscape strategies that balance aesthetic–spatial performance with enhanced ecological and conservation visibility. This approach reinforces the role of botanical gardens as multifunctional landscapes supporting sustainability, education, and long-term environmental resilience.

REFERENCE

Belaire, J. A., Westphal, L. M., Whelan, C. J., & Minor, E. S. (2015). Urban residents' perceptions of birds in the neighborhood: Biodiversity, cultural ecosystem services, and disservices. *The Condor: Ornithological Applications*, *117*(2), 192-202. https://doi.org/10.1650/CONDOR-14-128.1

Bele, A., & Chakradeo, U. (2021). Public perception of biodiversity: a literature review of its role in urban green spaces. Journal of Landscape Ecology, 14(2), 1-28. DOI: 10.2478/jlecol-2021-0008

Błaszak, M., Rybska, E., Tsivitanidou, O., & Constantinou, C. P. (2019). Botanical gardens for productive interplay between emotions and cognition. *Sustainability*, *11*(24), 7160. https://doi.org/10.3390/su11247160

Breiby, M. A., & Slåtten, T. (2018). The role of aesthetic experiential qualities for tourist satisfaction and loyalty. *International Journal of Culture, Tourism and Hospitality Research*, *12*(1), 1-14. https://doi.org/10.1108/IJCTHR-07-2017-0082

Cicerali, E. E., Kaya Cicerali, L., & Saldamlı, A. (2017). Linking psycho-environmental comfort factors to tourist satisfaction levels: Application of a psychology theory to tourism research. *Journal of Hospitality Marketing & Management*, *26*(7), 717-734. https://doi.org/10.1080/19368623.2017.1296395

Dong, J., Jiang, H., Gu, T., Liu, Y., & Peng, J. (2022). Sustainable landscape pattern: a landscape approach to serving spatial planning. *Landscape Ecology*, *37*(1), 31-42. https://doi.org/10.1007/s10980-021-01329-0

Egerer, M. H., Wagner, B., Lin, B. B., Kendal, D., & Zhu, K. (2020). New methods of spatial analysis in urban gardens inform future vegetation surveying. *Landscape Ecology*, *35*(3), 761-778. https://doi.org/10.1007/s10980-020-00974-1

Fandeli, C. (2021). *Pembangunan kota hijau*. Ugm Press.

Goodness, J., Andersson, E., Anderson, P. M., & Elmqvist, T. (2016). Exploring the links between functional traits and cultural ecosystem services to enhance urban ecosystem management. *Ecological Indicators*, *70*, 597-605. https://doi.org/10.1016/j.ecolind.2016.02.031

Heywood, V. H. (2017). The future of plant conservation and the role of botanic gardens. *Plant Diversity*, *39*(6), 309-313. https://doi.org/10.1016/j.pld.2017.12.002

Johnson, V. (2012). Identity, sustainability, and local setting at US botanical gardens. *Organization & Environment*, *25*(3), 259-285. https://doi.org/10.1177/1086026612459056

Jones, K. B., Zurlini, G., Kienast, F., Petrosillo, I., Edwards, T., Wade, T. G., ... & Zaccarelli, N. (2013). Informing landscape planning and design for sustaining ecosystem services from existing spatial patterns and knowledge. *Landscape ecology*, *28*(6), 1175-1192. https://doi.org/10.1007/s10980-012-9794-4

Karimi, A., Yazdandad, H., & Fagerholm, N. (2020). Evaluating social perceptions of ecosystem services, biodiversity, and land management: Trade-offs, synergies and implications for landscape planning and management. *Ecosystem Services*, *45*, 101188. https://doi.org/10.1016/j.ecoser.2020.101188

Liu, M., & Nijhuis, S. (2020). Mapping landscape spaces: Methods for understanding spatial-visual characteristics in landscape design. *Environmental Impact Assessment Review*, *82*, 106376. https://doi.org/10.1016/j.eiar.2020.106376

Menatti, L., & Casado da Rocha, A. (2016). Landscape and health: Connecting psychology, aesthetics, and philosophy through the concept of affordance. *Frontiers in psychology*, *7*, 571. https://doi.org/10.3389/fpsyg.2016.00571

Muratet, A., Pellegrini, P., Dufour, A. B., Arrif, T., & Chiron, F. (2015). Perception and knowledge of plant diversity among urban park users. *Landscape and Urban Planning*, *137*, 95-106. https://doi.org/10.1016/j.landurbplan.2015.01.003

Ossiannilsson, E., & Ioannides, N. (2017, October). Towards a framework and learning methodology for innovative mobile learning: A theoretical approach. In *Proceedings of the 16th World Conference on Mobile and Contextual Learning* (pp. 1-8). https://doi.org/10.1145/3136907.3136929

Pfund, J. L., Watts, J. D., Boissiere, M., Boucard, A., Bullock, R. M., Ekadinata, A., ... & Urech, Z. L. (2011). Understanding and integrating local perceptions of trees and forests into incentives for sustainable landscape management. *Environmental Management*, *48*(2), 334-349. https://doi.org/10.1007/s00267-011-9689-1

Rakow, D. A., & Lee, S. A. (2015). Western botanical gardens: history and evolution. *Horticultural Reviews: Volume 43*, 269-310. https://doi.org/10.1002/9781119107781.ch05

Rupprecht, C. D., & Byrne, J. A. (2014). Informal urban greenspace: A typology and trilingual systematic review of its role for urban residents and trends in the literature. *Urban Forestry & Urban Greening*, *13*(4), 597-611. https://doi.org/10.1016/j.ufug.2014.09.002

Sanders, D. L., Ryken, A. E., & Stewart, K. (2018). Navigating nature, culture and education in contemporary botanic gardens. *Environmental Education Research*, *24*(8), 1077-1084. DOI: 10.1080/13504622.2018.1477122

Shwartz, A., Turbé, A., Julliard, R., Simon, L., & Prévot, A. C. (2014). Outstanding challenges for urban conservation research and action. *Global environmental change*, *28*, 39-49. https://doi.org/10.1016/j.gloenvcha.2014.06.002

Solecka, I. (2019). The use of landscape value assessment in spatial planning and sustainable land management — a review. *Landscape Research*, *44*(8), 966–981. https://doi.org/10.1080/01426397.2018.1520206

Southon, G. E., Jorgensen, A., Dunnett, N., Hoyle, H., & Evans, K. L. (2017). Biodiverse perennial meadows have aesthetic value and increase residents' perceptions of site quality in urban green-space. *Landscape and urban planning*, *158*, 105-118. https://doi.org/10.1016/j.landurbplan.2016.08.003

Tian, L. (2022). Analysis of the artistic effect of garden plant landscaping in urban greening. *Computational Intelligence and Neuroscience*, *2022*(1), 2430067. https://doi.org/10.1155/2022/2430067

Vallés-Planells, M., Galiana, F., & Van Eetvelde, V. (2014). A classification of landscape services to support local landscape planning. *Ecology and Society*, *19*(1). https://www.jstor.org/stable/26269503

Villagra-Islas, P. (2011). Newer plant displays in botanical gardens: The role of design in environmental interpretation. *Landscape Research*, *36*(5), 573-597. https://doi.org/10.1080/01426397.2011.558730

Wylie, J. (2013). Landscape and phenomenology. In *The Routledge companion to landscape studies* (pp. 72-83). Routledge. DOI: 10.4324/9780203096925-11/landscape-phenomenology-john-wylie

Wylie, J. (2017). The distant: thinking toward renewed senses of landscape and distance. *Environment, Space, Place*, *9*(1), 1-20. https://doi.org/10.1353/spc.2017.a797525

Yao, Y., Zhu, X., Xu, Y., Yang, H., Wu, X., Li, Y., & Zhang, Y. (2012). Assessing the visual quality of green landscaping in rural residential areas: the case of Changzhou, China. *Environmental monitoring and assessment*, *184*(2), 951-967. https://doi.org/10.1007/s10661-011-2012-z