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İÇİNDEKİLER

ENVIRONMENTAL MANAGEMENT IN CITIES: CONCEPTUAL APPROACHES AND A SYSTEMATIC EVALUATION OF THE LITERATURE 1

DUYGU AKYOL KUYUMCUOĞLU

PATCHSCAPE: A NEW URBAN REPAIR PARADIGM INSPIRED BY THE PHILOSOPHY OF KINTSUGI 19

CİHAD BİLGE, ALİ CAN KUZULUGİL, BAŞAK AYTATLI

PROPOSAL FOR THE LAZ VILLAGE MODEL:A MODELLING APPROACH FOR THE CONSERVATION OF THE DISAPPEARING LAZ CULTURE; THE CASE OF ARHAVI 43

HİLAL SURAT

ARTIFICIAL INTELLIGENCE AND PLANTING DESIGN: EXPECTATIONS AND LIMITATIONS 78

AHMET BENLİAY, MEHMET KIVANÇ AK

LAND SURFACE TEMPERATURE AND EVAPOTRANSPIRATION IN LANDSCAPE ARCHITECTURE 93

HAKAN OGUZ

BÖLÜM 1

ENVIRONMENTAL MANAGEMENT IN CITIES: CONCEPTUAL APPROACHES AND A SYSTEMATIC EVALUATION OF THE LITERATURE

1. Duygu AKYOL KUYUMCUOĞLU[1]

Introduction

Today, cities have become areas where environmental pressures are felt most intensely as a result of population growth, spatial concentration, and the centralization of economic activities. Rapid and often unplanned urbanization processes bring with them multifaceted problems such as overuse of natural resources, disruption of ecosystem integrity, increased waste production, and loss of environmental quality. In this context, the emergence of environmental problems is considered not only as an ecological issue but also as a complex urbanization problem with social, economic, and administrative dimensions. The relationship that cities establish with environmental systems is at the center of sustainability discussions. In particular, global environmental problems such as

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climate change, biodiversity loss, and depletion of natural resources increase the importance of decisions taken at the local level and make cities the main application areas of environmental management policies. This situation reveals that environmental management requires a holistic approach that is not limited only to technical regulations and legal frameworks; it includes elements such as planning, governance, participation, and institutional capacity.

The concept of environmental management encompasses policies, strategies, and practices developed in line with the protection of environmental values and the sustainable use of natural resources. Urban-scale environmental management necessitates a re-evaluation of this general framework in light of the city's specific dynamics, actors, and spatial structure (Aydın, 2011). Local governments stand out in this process as both implementers of environmental policies and decisive actors in improving the quality of urban life. However, the literature frequently emphasizes significant discrepancies between the theoretical foundations and practical applications of environmental management in cities. Academic studies on environmental management in cities have been shaped within the framework of different disciplines and approaches. Theoretical approaches such as sustainable city, ecological modernization, integrated environmental management, and participatory governance offer different perspectives on solving environmental problems. However, how these approaches are applied at the city scale, under what institutional and managerial conditions they are effective, and to what extent they find resonance in local contexts remain a controversial area in the literature. This situation necessitates a systematic evaluation of the existing literature and a comparative examination of conceptual approaches. The main aim of this book chapter is to address conceptual approaches to environmental management in cities within a holistic framework and to systematically evaluate the existing literature. This section first explains the concept of environmental management and its implications at the urban scale; then, it discusses the main theoretical approaches that guide environmental management in cities. Following this, international and Turkey-focused academic studies are examined from a thematic perspective, and prominent trends, gaps, and problem areas in the literature are revealed. Finally, the relationship between theoretical approaches and practical applications is discussed, and assessments are presented regarding the development of environmental management within the context of local governments. In this framework, the section aims not only to describe the literature on environmental management in cities but also to offer a conceptual synthesis and to provide a theoretical foundation for future studies.

The Concept and Scope of Environmental Management in Cities

Environmental management in cities refers to the entirety of policies, strategies, and practices developed to control environmental problems arising from accelerating urbanization processes, protect natural resources, and improve the quality of urban life (Antrop, 2005; Ian McHarg, 1969). This concept encompasses not only technical interventions aimed at reducing environmental damage but also a multi-layered structure including managerial, institutional, and social dimensions. At the city scale, environmental management is of particular importance in areas where environmental problems are spatially concentrated, due to the complexity of decision-making processes and the multi-actor nature of the system (Henri Lefebvre, 1991).

The Concept of Environmental Management

Environmental management encompasses the planning, implementation, and monitoring processes carried out in line with the protection, development, and sustainable use of the natural and built environment (Antrop, 2005). These processes require a balanced approach that combines the protection of environmental values with economic development and social welfare goals. In this respect, environmental management is based on a management approach that prioritizes preventive and holistic approaches rather than producing reactive solutions to environmental problems.

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Environmental Management at the Urban Scale

Cities are places where environmental pressures are observed most intensely in terms of energy consumption, waste production, and natural resource use (Michael Batty, 2013). Therefore, urban environmental management is considered a special management area that aims to regulate the relationship that cities establish with natural systems and to reduce environmental risks. Urban environmental management encompasses numerous components such as air quality, water resources, waste management, green areas, and energy use. Each of these components directly affects the quality of urban life and plays a decisive role in ensuring environmental sustainability (Forman, 1995). However, the effectiveness of policies developed in these areas depends not only on technical solutions but also on institutional structure and managerial capacity.

Urban Environment Components and Management Areas

The urban environment is a dynamic system formed as a result of the interaction between the natural environment and the built environment. In this system, water, soil, air, and biodiversity stand out as basic natural components; Transportation infrastructure, residential areas, and industrial zones constitute the built environment (Antrop, 2005). Environmental management requires a holistic approach that takes into account the relationships between these components.

Areas of application of urban environmental management include waste management, water and sewerage services, control of air and noise pollution, and planning of urban green spaces. Policies developed for these areas are considered among the fundamental elements determining the environmental performance of the city (Batty, 2013).

The Relationship Between Sustainability and Urban Environmental Management

The concept of sustainability forms the theoretical basis of urban environmental management. The sustainable city approach aims to protect environmental resources, ensure social justice, and maintain balanced economic development (United Nations, 2015). In this context, urban environmental management focuses on long-term strategic goals rather than short-term solutions. Sustainable urban environmental management requires the integration of environmental decisions into planning processes and the achievement of harmony between spatial scales. This approach prioritizes an integrated management understanding instead of fragmented and sectoral policies (McHarg, 1969).

Limitations and Challenges of Environmental Management in Cities

Environmental management practices in cities face various challenges due to reasons such as uncertainties in the sharing of institutional authority, insufficient financial resources, and limited participation mechanisms (John W. R. Whitehand, 2001). This situation shows that environmental management is not only a technical regulatory field; it is also a governance and planning problem. This incompatibility between theoretical approaches and practical applications limits the effectiveness of environmental management and makes it difficult to achieve sustainability goals (Lefebvre, 1991). In this context, the need arises to address the theoretical approaches guiding environmental management in cities in more detail.

Theoretical Approaches to Environmental Management in Cities

Environmental management in cities is addressed within the framework of different theoretical approaches due to the complex and multi-dimensional nature of environmental problems. These approaches evaluate the causes, solutions, and management methods of environmental problems from different perspectives; and offer various models on how environmental management should be structured at the urban scale. The sustainable city approach, ecological modernization theory, integrated environmental management, and participatory governance approaches, which stand out in the literature, are considered as the main frameworks that form the theoretical basis of environmental management in cities (Antrop, 2005; Michael Batty, 2013).

Sustainable City Approach

The sustainable city approach is based on a holistic understanding of urbanization that prioritizes the balanced consideration of environmental, social, and economic dimensions. This approach opposes the evaluation of cities solely through economic growth and spatial expansion, positioning the protection of natural resources and the improvement of quality of life as fundamental goals (Şahin, 2014). In the sustainable city approach, environmental management is considered an integral part of urban planning processes. The holistic evaluation of the environmental impacts of urban policies such as land use, transportation, energy, and green space planning is among the basic principles of this approach. In this context, environmental management ceases to be a sectoral field of activity and becomes a governance tool integrated into strategic planning processes (Ian McHarg, 1969).

However, the literature also emphasizes that the sustainable city approach has various limitations at the application level. In particular, the abstract and broad nature of the sustainability concept makes it difficult for local governments to transform this approach into concrete policies; sustainability goals often remain at the discourse level (Antrop, 2005).

Ecological Modernization Approach

The ecological modernization approach offers a theoretical framework that emphasizes the importance of technological innovations, institutional transformation, and economic tools in solving environmental problems. This approach argues that environmental protection and economic development do not have to be contradictory; that these two goals can be achieved together through appropriate policies and technologies (Arthur P. J. Mol). Cities stand out as one of the main spatial contexts where the ecological modernization approach is applied. Waste recycling systems, energy efficiency practices, and smart city technologies are among the reflections of this approach on urban environmental management. In this context, local governments play an important role in the implementation and dissemination of environmental innovations (Batty, 2013). However, the ecological modernization approach is criticized for not adequately considering the structural and social dimensions of environmental problems. In particular, social inequalities and lack of participation can cause this approach to be limited in urban environmental management (Henri Lefebvre, 1991).

Integrated Environmental Management Approach

The integrated environmental management approach is based on the assumption that environmental problems cannot be solved with sectoral and fragmented policies. This approach requires the simultaneous consideration of different components and spatial scales of environmental management; It aims to ensure integrity between planning, implementation, and monitoring processes

(Forman, 1995). Integrated environmental management at the urban scale requires the joint assessment of the relationships between land use, transportation, infrastructure, and ecological systems. This approach envisages that environmental decisions should not be limited solely to environmental policies; they should be directly integrated into urban development and planning processes (McHarg, 1969).

While the integrated environmental management approach is considered a powerful tool in achieving environmental sustainability in the literature, it presents various challenges in practice due to the high level of institutional coordination and technical capacity it requires. In particular, institutional fragmentation in local governments is among the main factors limiting the effective implementation of this approach (Whitehand, 2001).

Participatory Governance and Local Governments

The participatory governance approach argues that decision-making processes in environmental management should not be limited solely to public institutions. This approach envisages the active participation of civil society organizations, the private sector, and urban residents in environmental management processes (Terry G. McGee). Environmental management in cities offers a suitable ground for participatory governance because it involves decisions that directly affect the living environment at the local level. Strengthening participation mechanisms, increasing environmental awareness, and including local knowledge in decision-making processes are considered elements that increase the effectiveness of environmental management (Eraydın, 2010).

However, the literature also emphasizes that participatory governance practices often remain at a symbolic level and cannot truly influence decision-making processes. This situation shows that unless participation is supported by institutional structures and a legal framework, it cannot bring about the expected transformation in environmental management (Batty, 2013).

Systematic Evaluation of the Literature on Environmental Management in Cities

The literature on environmental management in cities has gained an interdisciplinary structure in parallel with the increasing complexity of environmental problems and has diversified around different theoretical approaches. This literature has developed at the intersection of fields such as planning, environmental sciences, public administration, sociology, and geography; it has addressed environmental problems not only as a technical issue but also as an administrative and social phenomenon (Antrop, 2005; Michael Batty, 2013). In this section, studies on environmental management in cities are evaluated within a systematic framework; prominent themes, trends, and gaps in the literature are revealed.

Literature Review Approach and Evaluation Framework

In the evaluation of the literature on environmental management in cities, international and Turkey-focused academic studies have been considered together. In the literature review, studies focusing on the concepts of environmental management, sustainable city, local governments, and governance have been prioritized. Within this framework, the literature has been classified with a thematic approach and analyzed through the main issues on which the studies focus. A systematic review of the literature aims not only to provide a chronological or descriptive summary of the studies, but also to reveal the relationships between theoretical approaches, methodological trends, and application practices. This approach allows for the identification of recurring themes and neglected areas in the literature (Richard T. T. Forman, 1995).

Environmental Management in Cities in the International Literature

Studies on environmental management in cities in the international literature have largely been shaped around sustainability and climate change. These studies address the local-scale reflections of environmental problems, positioning cities as key actors in sustainable transformation (United Nations, 2015). Particularly in the literature centered on Europe and North America, the role and institutional capacity of local governments in environmental policies are highlighted. Studies in this context emphasize that environmental management should be linked to strategic planning and governance processes rather than technical tools. Waste management, energy efficiency, and green infrastructure applications are among the themes frequently addressed in the international literature (Batty, 2013). However, most of these studies present examples based on the institutional and economic conditions of developed countries; they struggle to produce generalizable conclusions for different socio-economic contexts.

Environmental Management Literature Focused on Turkey

Academic studies on environmental management in cities in Turkey largely focus on legislation, institutional structure, and the areas of authority of local governments. These studies show that environmental management is addressed within the framework of the sharing of authority between central and local governments (John W. R. Whitehand). Metropolitan municipalities, in particular, are considered as the main actors in the provision of environmental services.

Another prominent theme in the Turkish literature is the institutional fragmentation and coordination problems in environmental management practices. Studies reveal that conflicts of authority and lack of coordination between different institutions limit the effectiveness of environmental management. However, it is observed that participatory governance and social participation issues are addressed to a limited extent in the Turkish-focused literature; environmental management is mostly evaluated within an administrative and legal framework.

Thematic Analysis of the Literature

When the environmental management literature in cities is examined thematically, it is grouped under four main headings. The first of these is studies focusing on waste management and environmental infrastructure services. These studies highlight technical solutions and service delivery processes; The first theme addresses environmental management as a practical field of activity. The second theme revolves around water management and ecosystem-based approaches. Studies in this area emphasize the protection of urban ecosystems and the sustainable use of natural resources (Forman, 1995). The third theme consists of studies addressing the relationships between institutional structure, legislation, and governance. These studies reveal that the success of environmental management is largely related to institutional capacity and managerial integrity.

Finally, studies addressing education, awareness, and participation occupy a more limited space in the literature. This indicates that the social dimension of environmental management has not been sufficiently addressed in depth in the literature (Henri Lefebvre).

Gaps in the Literature and Critical Evaluation

A general evaluation of the literature shows that studies on environmental management in cities are mostly addressed either theoretically or practically; the relationship between these two areas is not sufficiently established. The failure to link theoretical approaches with practical applications makes it difficult to understand why environmental management has shown limited success in the urban context. In addition, it is observed that comparative studies that take into account the specificity of local contexts are limited in the literature. This situation leads to an insufficient answer to the question of why universal models of environmental management produce different results in different cities (Batty, 2013). In this context, there is a need for a more in-depth discussion of the relationship between theoretical approaches and practical applications of environmental management in cities.

Environmental Management in Turkish Cities: Institutional and Legal Framework

Environmental management in Turkish cities is shaped within the framework of shared authority and responsibilities between central and local governments. This structure creates a multi-layered administrative system in the determination and implementation of environmental policies; it defines environmental management as both an administrative and legal field. However, this multi-actor structure, while increasing the effectiveness of environmental management, can also bring about institutional coordination problems (Antrop, 2005).

The Role and Powers of the Central Government

In Turkey, the central government is the primary determining actor in the determination of environmental policies. National environmental policies and strategies are largely created by the central administration; the legal and institutional framework is shaped accordingly. This structure offers a significant advantage in terms of ensuring standardization in environmental management throughout the country.

However, the centralized structure can lead to a loss of flexibility in solving environmental problems specific to local conditions. The literature frequently emphasizes that the dominance of central decisions in the implementation of environmental policies at the local level narrows the scope of initiative for local governments (John W. R. Whitehand).

The Position of Local Governments in Environmental Management

Local governments play a critical role as implementing actors in environmental management in cities. Waste management, drinking water and sewerage services, planning of urban green spaces, and environmental monitoring activities are largely the responsibility of municipalities (Çevik, 2010). This shows that the success of environmental management depends significantly on the institutional and technical capacity of local governments (Michael Batty).

However, in the context of Turkey, the environmental management capacity of local governments shows significant differences among municipalities. In particular, insufficient financial resources and a shortage of expert personnel are among the main problems limiting the sustainability of environmental management practices.

Legal Legislation and Implementation Problems

In Turkey, environmental management is carried out within a comprehensive legal framework. While environmental laws and regulations clearly define environmental protection objectives, various problems are encountered during the implementation phase. The fact that legislation assigns tasks to numerous institutions and actors can lead to conflicts of authority and ambiguities in responsibilities (Antrop, 2005). This situation causes environmental management to be implemented in a fragmented structure; making it difficult to implement integrated and holistic approaches. The literature emphasizes that the existence of legislation alone is not sufficient, and that institutional coordination and governance mechanisms need to be strengthened for effective environmental management.

Institutional Coordination Problems

One of the most important structural problems faced by environmental management in cities in Turkey is the lack of institutional coordination. The lack of clarity in the sharing of authority between central and local governments reduces the effectiveness of the provision of environmental services. This clearly shows that environmental management is not only a technical but also an administrative problem area (Lefebvre, 1991).

The Relationship Between Theoretical Approaches and Practice: A Discussion

Theoretical approaches to environmental management in cities offer comprehensive and holistic models for solving environmental problems. However, the literature shows that these models are reflected in urban applications to a limited extent. While sustainable city, ecological modernization, integrated environmental management, and participatory governance approaches offer strong frameworks at the theoretical level, they encounter various structural obstacles in the implementation process (Batty, 2013). In the case of Turkey, it is observed that environmental management practices are mostly carried out with a focus on legislation and service delivery; the holistic and participatory structure envisioned by theoretical approaches is not sufficiently implemented. In particular, the weakness of participatory governance mechanisms causes the social dimension of environmental management to be neglected (Lefebvre, 1991). This incompatibility between theoretical approaches and practical applications is one of the main factors limiting the effectiveness of environmental management. The literature emphasizes that the success of environmental management depends not only on technical solutions but also on considering institutional capacity, governance structure, and local contexts (Forman, 1995).

In this context, the need to adapt theoretical frameworks regarding environmental management in cities to local practices emerges. Strengthening the relationship between theory and practice will ensure that environmental management produces concrete results not only in policy documents but also in urban spaces. This discussion provides an important basis for assessments and recommendations regarding the future of environmental management.

Conclusion

The analyses conducted within the scope of this study show that environmental management is increasingly occupying a central position within urban studies. The literature covers a wide range of topics, from technical issues such as water and waste management to governance and participation. In recent years, themes such as green infrastructure, climate adaptation, and nature-based solutions have formed the new direction of the literature. Not only academic discussions, but also the processes that determine the environmental performance of cities are expanding the scope of environmental management. Therefore, the future of the environmental management literature will be shaped by the strengthening of interdisciplinary approaches and the widespread adoption of data-driven models.

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BÖLÜM 2

PATCHSCAPE: A NEW URBAN REPAİR PARADİGM INSPİRED BY THE PHİLOSOPHY OF KİNTSUGİ

CİHAD BİLGE[1]
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Introduction

A New Ontology of Broken Urban Fabrics

Urban spaces, by their very nature, sustain their existence through continuous transformation and flow. Within this dynamic process, structures as physical manifestations of historical layers undergo partial destruction due to the erosive effects of time, natural disasters, socio-economic degeneration, or political interventions, resulting in the emergence of both physical and semantic voids within urban memory (Yoon & Lee, 2019; Foster, 2020). At a global scale, the accelerating processes of urbanization cause a significant portion of the existing building stock to lose its function or deteriorate physically, thereby posing substantial challenges for both the conservation of cultural heritage and the pursuit of urban sustainability.

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Traditional conservation paradigms are often grounded in the approach of anastylosis, which aims to return structures to their original and idealized states. However, financial, technical, and ethical constraints frequently render this restoration utopia unattainable (Plevoets & Van Cleempoel, 2019). As a result, it is observed that fragments of ruins having lost their function and integrity, remaining “unrepaired” and “silent” have become permanent features within the morphological structure of cities (DeSilvey, 2017). These fragments are interpreted not merely as zones of physical decay, but also as symbols of ruptures in the continuity of collective memory and of the loss of spatial and temporal coherence. While traditional conservation approaches predominantly advocate either the complete restoration of damaged structures or their demolition and replacement, recent years have increasingly emphasized the necessity of developing alternative strategies (Pintossi et al., 2023). In the face of this impasse, the act of repair must be reconsidered not merely as a technical intervention, but as an aesthetic and ethical practice that generates meaning, identity, and continuity. The conceptual foundation of this shift can be found in the Japanese aesthetic tradition of Kintsugi. Kintsugi is a practice in which broken ceramic pieces are reassembled using lacquer mixed with gold powder, making the traces of repair deliberately visible rather than concealed (Juniper, 2003; Kemske, 2021). Within this approach, the aim is not to eliminate the flaw, but to render the object’s fragility, lived history, and capacity for renewed existence visible (Santini, 2021; Krishnamoorthy, 2024). In this way, the break itself becomes an inseparable component of the object’s new identity and value. Kintsugi is rooted in the philosophy of wabi-sabi, which values not perfectionism but impermanence, simplicity, and the authenticity that emerges from the cyclical processes of nature (Juniper, 2003). In an architectural context, the aesthetics of Kintsugi encourage viewing ruins not merely as remnants of the past, but as symbols of continuity and rebirth. This perspective converges with the concept of the “aesthetics of ruins.” Ruins emerge as tangible expressions of the dialectic between human-made forms and the transformative power of natüre (Girot, 2021; Horvat & Šerman, 2023).

As noted by Simmel, ruins represent the visible manifestations of the struggle between human-made form and nature’s power to return matter to itself, thereby creating a moment of philosophical pause. (Woodward, 2001; Horvat & Šerman, 2023).

Today, Kintsugi is being reinterpreted not only within the realms of craft or art, but also across disciplines such as architecture and landscape architecture. Repair is no longer understood solely as a technical intervention; rather, it is conceived as a nature-aligned, co-creative practice that renders the history, identity, and continuity of place visible (Ingold, 2011). At the architectural scale, the philosophy of Kintsugi influences approaches to restoration and reinterpretation by foregrounding traces of spatial continuity in post-damage or post-destruction interventions (Plevoets & Van Cleempoel, 2019). Carlo Scarpa’s layered restoration practices, Daniel Libeskind’s “wounded city” metaphor, and representations of repair in contemporary Japanese architecture all resonate with the aesthetics of Kintsugi, transforming post-destruction rebirth and sustainable spatial transformation into a poetic expression.

Architectural adaptations of Kintsugi are particularly evident in adaptive reuse projects, where the integration of ruins with new interventions enables buildings to acquire a renewed identity (Figure 1). The Menokin Glass House Project by Machado Silvetti Architects and the Mill City Museum by MSR Design constitute striking examples of the yobitsugi (calling together) approach, in which original structural fragments are combined with contemporary materials (Keulemans, 2016; TenBerke, 2024).).

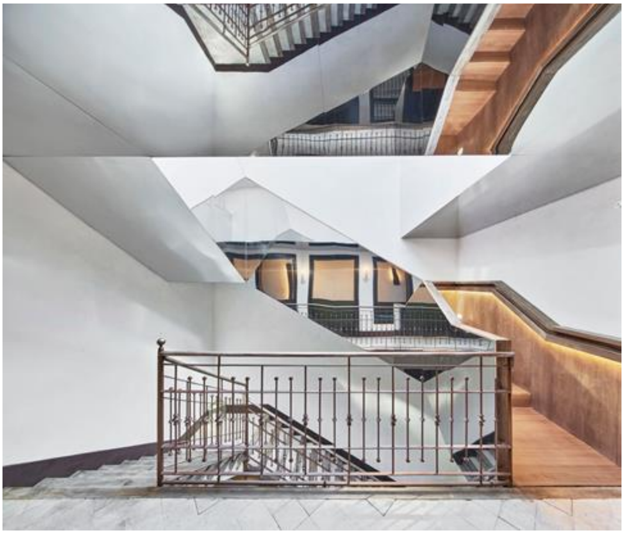

Figure 1. Kintsugi-inspired design of a garden hotel in Mallorca (URL-1)

These projects go beyond the mere functional restoration of damaged structures; by rendering historical layers visible and expressing new interventions with transparency, they establish a temporal dialogue (Figure 2).

Figure 2. Aesthetic repair of buildings influenced by Kintsugi (Source: URL-2)

Nevertheless, the existing literature and practices remain limited in systematically employing nature itself particularly plant materials and living landscape processes as an active agent of repair within this philosophy (Maselli et al., 2024). The deterioration of historic structures and urban landscapes over time can, in fact, be understood as a natural and inevitable process, constituting an organic component of a building's life cycle. However, the majority of current studies focus primarily on interior transformations or structural reinforcement, while the integration of landscape elements and the role of plant material in the repair process remain insufficiently addressed (Pintossi et al., 2023; Maselli et al., 2024).

The discipline of landscape architecture occupies an ideal position to fill this gap. Rather than producing static solutions, plants can be understood as dynamic, living stitches that change over time, adapt, and sustain their own life cycles (Francis, 2020; Cho, 2022). The restorative and integrative potential of urban green infrastructure has been demonstrated through numerous recent studies. Nature-based Solutions (NbS) possess the capacity to enhance ecological connectivity in urban areas, restore ecosystem functions, and provide habitats for diverse flora and fauna (Cohen-Shacham et al., 2016; Liu & Russo, 2021) (Figure 3).

Figure 3. Patchscape applications in landscape elements (URL-3)

From this perspective, this study proposes a new conceptual and design framework termed “Patchscape.” Derived from the combination of the words patch and scape, the term describes the process of repairing and re-signifying broken, fractured, and eroded areas within the urban fabric through plant-based and other natural materials, much like the precious seams of Kintsugi. The Patchscape approach is not merely an aesthetic intervention; rather, it emerges as a multifunctional strategy capable of addressing contemporary challenges such as the climate crisis, the urban heat island effect, and ecological degradation (Figure 4).

URL-4 URL-5 URL-6

Figure 4. Examples of Patchscape

The Patchscape concept is developed as an approach inspired by the philosophy of Kintsugi, translating the restorative power of plant material and landscape interventions into the spatial realm. Here, plants are not merely decorative elements; they function at times as “living stitches” that bind the wounds of a structure, and at other times as elements that deliberately accentuate them. This stitching represents both a physical and a spiritual integration. By rendering the fractures of a structure visible, nature reanimates it, and the act of repair no longer seeks to eliminate absence, but rather to embrace a new state of being that emerges from it (Corner, 1999; DeSilvey, 2017).

This approach embodies a spatial continuity in which the past is rewritten without being erased commonly referred to as a palimpsest landscape (Figure 5).

Figure 5. The Patchscape effect of water in urban design (URL-7)

Adaptive reuse and urban repair strategies have attracted increasing attention in the disciplines of architecture and landscape architecture over the past two decades (Gravagnuolo et al., 2021). Particularly in the post-2020 period, the growing emphasis on sustainability and circular economy principles has rendered the re-evaluation of existing building stock and urban infrastructure critically important. The literature indicates that the adaptive reuse of historic buildings can reduce carbon emissions by between 4% and 46%, offering significant environmental advantages compared to new construction (Preservation Green Lab, 2011; De Wolf et al., 2020).

Figure 6. The Patchscape effect in the garden design of a residential site in Berlin (URL-8)

Spontaneous Pavement Vegetation (SPV) and self-established plant growth in urban grey areas have become major focal points in recent landscape architecture research. De Jong's (2024) extensive study in Southern Ontario based on 420 km of walking surveys and the analysis of over 2,700 photographs demonstrates the potential of resilient plants emerging in pavement cracks and edge spaces to enhance urban biodiversity (Figure 7). Perceptual assessments conducted by Bonthoux et al. (2019b) reveal that pavements hosting spontaneous vegetation are perceived as "less maintained but more beautiful and less monotonous." These findings indicate a growing recognition of the aesthetic value of imperfection and self-organizing natural processes within urban landscapes.

Figure 7. Example of spontaneous pavement vegetation (URL-9)

The Patchscape approach proposes the deliberate integration of plants into broken pavements, deteriorated walls, and collapsed building elements by interpreting spontaneous vegetation dynamics within a structured design methodology (Bonthoux et al., 2019a). This approach offers not only aesthetic improvement but also functional benefits, including stormwater management, the creation of biodiversity corridors, and the enhancement of urban permeability. Permeable paving systems and green sidewalk designs increase water infiltration while supporting plant growth, thereby delivering multiple co-benefits such as improved urban biodiversity, enhanced air quality, and the mitigation of the urban heat island effect.

Urban ruins and abandoned industrial sites have, in recent years, been re-evaluated as areas offering significant opportunities for landscape architecture and urban design. The Landschaftspark Duisburg-Nord project in Germany's Ruhr region exemplifies the integration of a former iron and steel plant with green infrastructure, simultaneously preserving industrial heritage and achieving ecological rehabilitation (Ling et al., 2007). Similarly, the study conducted by Ai et al. (2025) at the Henrichshütte steelworks highlights the critical role of plant communities in thermal regulation and demonstrates the capacity of green infrastructure to improve microclimatic conditions (Figure 8).


URL-10


URL-11

Figure 8. Contemporary images of Landschaftspark Duisburg-Nord (URL-9) and the Henrichshütte steelworks

Conceptual Foundations

Interdisciplinary Roots of Patchscape and the Translation of Kintsugi Philosophy into Landscape Architecture

The conceptual foundation of the Patchscape approach is informed not only by the discipline of architecture, but also by aesthetics, ecology, philosophy, and art theory. This multilayered structure extends the notion of "reassembling" the fragmented parts of the city beyond a purely physical act of repair, interpreting it instead as a reconstruction of meaning (Juniper, 2003; DeSilvey, 2017). Within this context, the philosophy of Kintsugi emerging from the Japanese aesthetic tradition becomes one of the key metaphorical and operational pillars of Patchscape.

Philosophical Foundations of Kintsugi: Imperfection, Continuity, and Rebirth

Kintsugi is a repair tradition that emerged in 15th-century Japanese culture, aiming to reassemble broken ceramic vessels using lacquer mixed with gold or silver powder. This act represents not only a physical repair, but also a philosophical stance that honors the object's history, fragility, and rebirth (Juniper, 2003; Kemske, 2021). The wabi-sabi aesthetic at the core of Kintsugi emphasizes the beauty of imperfection and impermanence, celebrating the "perfection of the imperfect" (Santini, 2021). In this respect, it offers an alternative aesthetic paradigm to the Western modernist pursuit of symmetry, completeness, and permanence.

In Kintsugi, the break is not a flaw to be concealed; rather, it is a visible trace of the object's life story. This approach suggests that repair is not a "return" to a previous state, but a form of "progress" (Krishnamoorthy, 2024). Accordingly, the repaired object does not revert to its former condition; on the contrary, it attains a higher aesthetic and emotional value. From this perspective, Kintsugi is not merely an artistic practice, but also an ontological mode of thinking about life, continuity, and change.

At the core of Kintsugi philosophy lie two fundamental principles of Japanese aesthetic thought: mottainai (avoidance of waste and respect for value) and mushin (freedom from mental attachment) (Juniper, 2003). The concept of mottainai recognizes the intrinsic value of objects and emphasizes the responsibility to repair and reuse them rather than discard them. This notion aligns closely with contemporary paradigms of the circular economy and sustainability (Foster, 2020). Mushin, on the other hand, represents the ability to accept repair and embrace fragility, resonating with a dynamic understanding of conservation that acknowledges the built environment as being in constant flux and transformation.

Translating Kintsugi into Landscape Architecture: Theoretical Framework and Principles of Practice

Kintsugi'nin temel ilkeleri —kırığın kabulü, onarımın görünürlüğü

The core principles of Kintsugi acceptance of fracture, visibility of repair, and the aesthetics of rebirth provide a profound conceptual foundation for the discipline of landscape architecture. Landscape is inherently a dynamic system, existing in a state of continual evolution through cycles of growth, decay, renewal, and transformation (Corner, 1999). In this respect, Kintsugi's life-cycle-based mode of thinking closely aligns with the transient, mutable, and self-healing nature of landscapes (Francis, 2020).

Traumatic processes in urban landscapes such as destruction, fires, floods, or abandoned industrial sites leave enduring scars within the urban fabric. These wounds are often erased through strategies of "clearing" and "rebuilding"; however, a Kintsugi perspective advocates for the transformation of such traces without their elimination (Plevoets & Van Cleempoel, 2019). Landscape architecture is uniquely positioned to realize this transformation, as it possesses both ecological and aesthetic tools.

Within this framework, Patchscape offers an approach that translates the principles of Kintsugi into soil, vegetation, water, and microclimatic processes. Plants function not as gold powder, but as "living tissue" within fractured grounds; their root systems form living bonds that reunite eroded soils (Cho, 2022). In this sense, each plant is understood as both a medium of repair and a carrier of continuity analogous to the golden seams of Kintsugi. As Ingold (2011) argues, repair operates as a process of "co-creation," blurring the boundaries between nature and humans and giving rise to a dynamic relationality in which both act as active participants.

The Kintsugi Approach in Landscape Architecture Is Explained Across Three Fundamental Levels

1. Ecological Level:

Physical restoration through plants including erosion control, carbon sequestration, water recycling, and habitat creation processes.

Studies by Norton et al. (2015) and Gill et al. (2021) demonstrate that green infrastructure provides critical ecosystem services for urban resilience. Plant-based restoration creates microhabitats that support biodiversity, provides corridors for pollinator species, and strengthens the connectivity of urban ecological networks (Bonthoux et al., 2019a).

2. Aesthetic Level:

The representation of repair traces in a visible manner, without concealment, transforms into an aesthetic narrative through material contrasts, plant color transitions, and seasonal transformations.

The aesthetic value of the gold lines in Kintsugi is achieved in Patchscape through the texture, color, and form of plants. Perceptual studies by Bonthoux et al. (2019b) reveal that spontaneous plant growth in urban areas is associated with “naturalness” and “vitality” by users. These findings indicate that intentional botanical interventions also carry similar aesthetic potential.

3. Ethical Level:

It emphasizes that restoration should be seen as an act of “respect” and ‘acceptance’ rather than “recovery.” Traces of the past are carried into the future without being erased, creating an ethical understanding of restoration.

Waterton and Watson's (2021) “emotional repair landscapes” approach demonstrates that physical repair processes are also related to communities' processes of processing and making sense of their collective traumas. Kintsugi's philosophy of making the break visible adds a therapeutic dimension to spatial repair processes (Kemske, 2021; Krishnamoorthy, 2024).

Interdisciplinary Bridge: From Aesthetics to Ecology

The application of Kintsugi to landscape architecture blurs the boundaries between art, philosophy, and ecology. This approach requires a redefinition of humanity's relationship with nature. Repair is no longer seen as an act of human domination over nature; it is now viewed as a process of establishing a symbiotic partnership with nature (Yoon & Lee, 2019).

Girot (2021) argues that the relationship between memory and matter is reshaped in the landscape through processes of decay and deterioration. This perspective forms one of the theoretical foundations of the Patchscape approach: decay is not merely a loss; it represents the potential for a new beginning. Woodward's (2001) comprehensive study on ruins analyzes the representations of ruins in art, history, and literature, emphasizing the importance of fracture in cultural meaning-making processes.

Imani et al. (2022) explore the potential of botanical strategies for “biocultural restoration” in post-industrial landscapes. The authors reveal that plants not only provide ecological functions but also serve as symbolic agents that enable communities to reconnect with their traumatic pasts. This approach represents a socially scaled version of Kintsugi's philosophy of “valuing the crack.”

In this sense, Patchscape offers an ethically grounded restoration aesthetic for both the repurposing of post-industrial spaces and post-disaster rehabilitation processes. It aims to create a collective “topography of healing” by emphasizing rather than concealing fractures, and making past traumas visible rather than suppressing them (Foster, 2020). Oke et al. (2017), while examining urban climate dynamics, emphasize the role of green infrastructure in microclimate regulation and highlight the importance of the cumulative effects of such interventions at the city scale.

As a result, the transfer of Kintsugi to landscape architecture creates a new conceptual framework in which plant material acquires a symbolic value equivalent to gold, adds aesthetic depth to restoration, and makes the fracture an integral part of the life cycle. In this context, Patchscape proposes a new synthesis between nature and the man-made environment: Nature is no longer a passive decorative element; it manifests itself as an active, restorative, and transformative subject. This paradigm shift has the potential to re-examine and redefine the fundamental assumptions of both conservation practice and the discipline of urban design.

Patchscape Design Principles and Implementation Strategies

The Patchscape approach views fractures in the urban fabric not merely as physical deficiencies, but also as areas where new spatial possibilities emerge. This approach aims not to conceal repairs, but to transform them into an aesthetic part of the urban landscape. The design process is based on a holistic strategy that activates nature's own repair capacity and prioritizes material continuity and ecological function (Francis, 2020; Cho, 2022).

3.1. Design Principles

Patchscape designs are based on three fundamental principles:

(1) Visibility of Repair,

(2) Cooperation with Natural Processes, and

(3) Acceptance of Temporality.

3.1.1. Visibility of the Repair

Like kintsugi aesthetics, Patchscape also aims to make repairs visible. The reinterpretation of cracks on surfaces, crumbling walls, or lost layers of landscape is central to the design. Plant material acts as a kind of golden dust, serving as both a living and aesthetic “stitch” on the city's surface (Kemske, 2021). Therefore, the plants used are selected to emphasize the memory and texture of the place.

3.1.2. Cooperation with Natural Processes

Patchscape advocates that designers establish an interactive partnership with nature rather than seeking absolute control over it (Yoon & Lee, 2019). In this context, the design process is not static but open-ended. Plants grow, die, and sprout again; this cycle determines the aesthetic continuity of the design. Thus, a dynamic balance is established between the man-made order and the natural cycle (Debele et al., 2024).

3.1.3. Acceptance of Temporality

Landscape, by its very nature, is a temporal environment. Just as the gold veins in Kintsugi become dull or darken over time, the repair elements in Patchscape designs are also open to transformation. Moss-covered stone surfaces, yellowing leaf textures, or oxidized metal parts reveal the traces of time, enabling the landscape to behave like a living entity (DeSilvey, 2017). Thus, time becomes not an element of destruction, but a co-creator.

3.2. Implementation Strategies

Patchscape offers a flexible repair system that can be applied at different spatial scales from the micro level to the urban scale. Application strategies are grouped under four main headings:

3.2.1. Micro-Yama Strategy: Sprouting from Within the Crack

This strategy involves filling small-scale cracks, voids, and boundary areas with plant patches. Cracks between paving stones, wall voids, or drainage channels within the city are considered micro-ecotones that harbor water and seeds; micro-plant communities identical to these areas are placed in them (Manso et al., 2021). Thus, the surface transforms into a biological fabric; the fracture acts as an interface that carries life.

3.2.2. Macro Patch Strategy: Resilient Transformation of Gaps

Abandoned industrial sites, post-fire gaps, or disaster zones constitute Patchscape's macro-scale application areas. In these areas, natural succession processes are supported, and plant restoration allows the soil to breathe again (Gill et al., 2021). Rather than completely "rebuilding" the gaps, the goal is a gradual ecological transformation.

3.2.3. Material Layering and Transparency

In Patchscape designs, material selection is made in a way that supports the visibility of the repair. Transparent materials (glass, resin, plexiglass, etc.) added to old walls or floors both preserve traces of the past and make the ecological meaning of the new layer visible (TenBerke, 2024). Thus, the design acquires a multi-layered structure, both physically and semantically.

3.2.4. Plant Color Palette and Seasonal Cycles

The golden tones of Kintsugi are represented in Patchscape through seasonal color transitions. Plant species are selected based on their leaf cycle, flowering color, and textural contrasts. Species in shades of yellow, amber, rust, and copper such as Carex buchananii, Miscanthus sinensis, and Rudbeckia hirta reproduce the golden vein effect throughout the seasonal cycles. This creates a natural Kintsugi palette (Santini, 2021).

3.3. Ecological and Social Impacts

Patchscape is not merely an aesthetic repair tool, but also an ecological and social healing space. Plant patches enrich microhabitats in the city and provide living space for pollinator species (Norton et al., 2015). At the same time, it encourages the discovery of the “beauty of the crack” in urban areas by transforming the user experience. As city dwellers pass through these patches, which change over time, they develop a kind of “restorative awareness” (Foster, 2020). This process establishes a strong link between individual psychological healing and the reestablishment of collective spatial memory. In this sense, Patchscape becomes a therapeutic method for the city, an act of healing for the space, and a practice of awareness for humans (Plevoets & Van Cleempoel, 2019).

Conclusion and Evaluation

The Future of Patchscape and the Urban Repair Paradigm

21st-century cities face multi-layered crises such as climate change, spatial fragmentation, erosion of cultural heritage, and depletion of natural resources. These crises require remediation not only at the environmental level, but also at the aesthetic, ethical, and socio-psychological levels. In this context, the act of “remediation” has become more than a technical intervention; it is now a process of spatial, ecological, and emotional reinterpretation (Waterton & Watson, 2021).

The Patchscape approach stands out as an interdisciplinary repair paradigm that responds to this multidimensional need for repair. This paradigm conceptualizes the broken surfaces of cities not merely as “defects to be repaired,” but as “potential for rebirth,” by integrating the aesthetic principles of Kintsugi philosophy with the ecological processes of landscape architecture.

4.1. Ontological Transformation: The New Value of Imperfection

One of Patchscape's fundamental contributions is the revaluation of defects. In traditional urban planning, damaged, destroyed, or dysfunctional surfaces were generally viewed as “errors awaiting repair.” However, Patchscape redefines these surfaces as active components of renewal. This transformation represents not only an aesthetic shift but also a philosophical change in perspective (Juniper, 2003; Krishnamoorthy, 2024).

The city is no longer seen as a whole that is constantly striving to be completed; it is viewed as an organism that lives, learns, and evolves with its fractures. A fracture, deficiency, or wound is not an end, but the potential for a new beginning. In this context, Patchscape constructs not a “fracture ontology,” but an ontology of resilient continuity.

4.2. Contribution to Ecological Restoration and Climate Adaptation

Patchscape contributes to improving the urban ecosystem by blending the nature-based solutions (NbS) approach with aesthetic and cultural dimensions (Cohen-Shacham et al., 2016). Plant patches not only repair fractures aesthetically, but also increase carbon sequestration, regulate microclimate, and support biodiversity (Gill et al., 2021; Debele et al., 2024).

This system enables water to re-infiltrate into the soil by transforming impermeable surfaces. It also reduces the urban heat island effect and directly contributes to the city's microclimate balance (Oke et al., 2017; Balany et al., 2020). Thus, Patchscape is not only a tool for cultural restoration but also a strategic tool in building climate-resilient cities.

4.3. Social and Emotional Repair: Engaging in Dialogue with the Broken

The relationship between city dwellers and their surroundings is often based on an unnoticed emotional continuity. Ruins, voids, and broken surfaces carry the weight of the past as much as they are spaces for imagining the future (DeSilvey, 2017). Patchscape establishes an emotional repair mechanism in these areas: it teaches us to confront brokenness, to live with it, and to transform it.

The idea of “repairing the fracture with gold” also symbolically transforms the individual's relationship with their traumatic past. The patches in the city represent the manifestation of healing in the individual's subconscious. In this sense, Patchscape is considered not merely a design method but a psychogeographic healing practice (Waterton & Watson, 2021).

4.4. Application Potential and Future Trends

The Patchscape methodology is a flexible, locally adaptable, and cross-scale approach. It can be applied in various contexts, ranging from a sidewalk crack at the micro level to an abandoned industrial area at the macro scale. This flexibility makes it particularly appealing for urban fabrics exposed to the effects of the climate crisis.

In terms of future research directions, Patchscape is expected to be expanded through its integration with biotechnological materials (e.g., photosynthetic coatings, biofilm surfaces), its interaction with AI-supported landscape monitoring systems, and its social participation-based repair protocols (Ai et al., 2025). These developments could transform Patchscape from merely a design concept into a new paradigm for urban ecosystem management.

4.5. Result: The Poetic Ecology of Fracture

Patchscape defines the new ontology of cities by combining the poetic value of fracture with nature's restorative potential. This approach bridges architecture, landscape architecture, ecology, art, and philosophy, demonstrating that restoration is both an aesthetic and an ethical act.

The fracture is no longer a deficiency, but a trace that underscores resilience.

Cracks filled with plant roots represent not destruction, but the veins through which life sprouts anew.

By allowing these veins to spread throughout the city, Patchscape transforms fractured urban fabrics into resilient, sustainable, and meaningful ecosystems.

Ultimately, Patchscape is not a design method but a philosophy of life: It proposes not merely repairing cities but growing alongside them, not hiding flaws but proudly displaying them, and reconnecting with nature.

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BÖLÜM 3

PROPOSAL FOR THE LAZ VILLAGE MODEL:A MODELLING APPROACH FOR THE CONSERVATION OF THE DISAPPEARING LAZ CULTURE; THE CASE OF ARHAVİ

1. Hilal SURAT[1]

Introduction

The Eastern Black Sea geography has, throughout history, produced a distinctive living environment that has functioned not merely as a settlement area, but as a carrier of culture, an organization of production, and a laboratory of ecological adaptation (Braudel, 1996; Sauer, 1963; Cosgrove, 2008). This geography constitutes a cultural landscape in which human settlement has been shaped directly by natural imperatives such as topography, climate, vegetation, water resources, and slope, and where space, production, and social organization have evolved together (UNESCO, 2012; Antrop, 2005). With its historical roots extending to the Colchis region located in the southeastern Black Sea, the Laz community represents one of the most prominent cultural veins of this living

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environment (Hann & Beller-Hann, 2001; Aksoylu, 2009; Öztürk, 2013).

Today, the Laz population in Turkey—spatially confined primarily to the coastal belt of Artvin and Rize—constitutes one of Anatolia's most distinctive local cultural groups (Andrews, 1992; Özkan, 2015). Laz culture is not merely a linguistic identity; rather, it represents a holistic living system adapted to the ecological and social structure of the Black Sea region through its spatial organization, social structure, modes of production, architectural practices, garden-use strategies, botanical knowledge, food culture, rituals, and place–memory relations (Pelkmans, 2006; Ingold, 2000; Rapoport, 1990). This living system can be read more clearly in micro-geographies that preserve strong cultural traces, such as Arhavi (Yılmaz, 2017; Uysal, 2020).

However, many components of Laz culture today face the risk of losing their visibility to a great extent due to globalization processes, modernization, rural-to-urban migration, monocrop agricultural policies, industrial modes of production, the widespread adoption of modern housing typologies, and the weakening of social rituals (Harvey, 2005; Escobar, 2008; Kaya, 2014). Especially the accelerated out-migration after the 1980s, the changing construction patterns of the 2000s, and increasing urbanization pressure have profoundly shaken not only individual dwellings, but also collective memory, production relations, ecological cycles, and mechanisms of cultural transmission (Tekeli, 2011; Şen, 2018).

As observed throughout Turkey, population loss in the rural Eastern Black Sea region, abandoned houses, idle agricultural lands, and neglected garden systems have disrupted traditional life cycles and forced the dissolution of a production-based way of life founded on the house–garden–animal triangle (Marsden, 2003; Woods, 2011). In rural Arhavi, this dissolution has manifested spatially and socially through the distancing of the house from its production focus, the transformation of gardens into symbolic spaces, the decline of animal husbandry, and the fragmentation of community-based production (Öztürk & Demir, 2019).

In this context, the preservation of traditional buildings or architectural examples alone is insufficient. Spatial, ecological, social, and economic systems that act as carriers of culture must be addressed together (Smith, 2006; Waterton & Smith, 2010). Traditional housing fabrics and the garden-use culture associated with them represent, within historical continuity, a way of life constructed not only through shelter, but also through production, socio-economic organization, identity formation, and spatial commons (Oliver, 1997; Rapoport, 2005).

The rural landscape of the Eastern Black Sea is defined in the literature as a "cultural landscape compatible with topography" (Antrop, 2005; Fairclough, 2012). This approach reveals that spatial decisions—such as houses aligned parallel to slopes, wooden structures seated on stone foundations, terraced gardens, the spatial prioritization of water, and the positioning of animal shelters according to wind direction—have been shaped by ecological necessities (Kuban, 1995; Aran, 2000).

The primary aim of this study is to re-evaluate, in the specific context of Arhavi, the traditional life pattern of Laz culture, its spatial logic, social practices, and ecological knowledge within a holistic framework, and based on this framework to propose a structural and cultural conservation–reproduction model referred to as the Laz Village Model (LVM) (Pretty, 2011; Berkes, 2012).

The Laz Village Model encompasses a multidimensional set of applications including architectural restoration, garden rehabilitation, the reactivation of production–consumption cycles, conservation of local plant species, digital cultural archiving, community-based education programs, cooperativization, language and culture workshops for youth, branding of local products, and ecotourism routes (OECD, 2018; UNDP, 2020).

The theoretical framework of the study is built upon questions concerning how ethno-geographic continuity can be read through housing and garden typologies, how garden-use patterns in rural Arhavi relate to family structure and seasonal–ecological cycles, and whether the traditional house–garden model can be transformed into an accessible living system aligned with contemporary sustainability principles (Ingold, 2000; Berkes & Folke, 1998).

In conclusion, the study demonstrates that the traditional house–garden–animal cycle in Arhavi is not merely a spatial construct belonging to the past, but a distinctive living system that simultaneously generates cultural continuity, ecological harmony, and community resilience. Reactivating this system is considered a strategic necessity not only for the preservation of Laz culture but also for a sustainable rural future.

Theoretical Framework and Literature

The re-evaluation of rural cultural landscapes within the context of sustainability has become one of the central areas of debate over the past two decades at the intersection of architecture, landscape architecture, anthropology, ecology, and rural development literature. Studies that address biocultural diversity, ethno-ecological memory, traditional knowledge systems, and spatial typology analyses together reveal that cultural continuity must be considered not only through tangible architectural conservation approaches, but also alongside social organization forms, production practices, ritual cycles, and processes of ecological adaptation (Pretty et al., 2009; Maffi, 2010; Berkes, 2012).

Within this context, the present research focusing on Laz culture is grounded in a multilayered theoretical basis positioned at the intersection of anthropology, architecture, cultural landscape theory, ethnobotany, and ecological design. Treating the cultural landscape as a living system necessitates incorporating into analysis not only buildings, but also everyday life practices, production relations, and mechanisms of knowledge transmission that take place within and around these structures (Smith, 2006; Waterton & Smith, 2010; Taylor, 2014).

This section addresses holistically three main approaches forming the conceptual and theoretical foundation of the study:

I. the cultural landscape approach,

II. the relationship between ethno-geographic continuity and architectural typology,

III. spatial production cycles and the ethnobotanical perspective in rural ecosystems.

These approaches play a decisive role both in the historical–spatial analysis of Laz culture and in the theoretical grounding of the Laz Village Model (Berkes & Folke, 1998; Antrop, 2005).

Cultural Landscape Approach: The Unity of Space, Society, and Nature

The concept of cultural landscape is defined by UNESCO as a mixed heritage category encompassing the traces left in space by the long-term, reciprocal, and transformative relationship between humans and nature (UNESCO, 1992; UNESCO, 2011). This definition necessitates a holistic perspective that considers culture not only at the scale of buildings, but together with settlement patterns, production systems, rituals, collective memory, and ecological cycles.

In this regard, the Eastern Black Sea geography is regarded as one of the strongest examples of the cultural landscape approach. Here, housing architecture, garden layout, animal husbandry practices, water management, plant selection, and settlement organization have been shaped not only by technical and climatic necessities, but also by social norms and cultural codes (Tunçel, 2009; Özkan & Yılmaz, 2016).

The core components of the cultural landscape approach are defined in the literature along four main axes:

I. spatial continuity,
II. nature–culture unity,
III. social organization,
IV. ritual and memory relations (Antrop, 2005; Fairclough, 2012).

Spatial continuity refers to the lasting traces left in space by cultural practices over long periods of time. Nature–culture unity is defined by the formation of a process in which human intervention does not destroy nature, but develops together with it while maintaining sustainability. Social organization includes the direct reflection of family structures, forms of solidarity, and production relations in spatial organization. Ritual and memory enable the continuous cultural reproduction of space through oral traditions, seasonal cycles, and everyday practices (Connerton, 1989; Ingold, 2000).

In rural Arhavi, the cultural landscape becomes visible not only in the physical forms of houses and gardens, but also in behavioral and social dimensions such as how these spaces are used, by whom they are appropriated, and how seasonal time organizes space (Öztürk, 2013; Aksoylu, 2009). For this reason, the study conceptualizes culture not as a frozen historical heritage, but as a living system continuously reproduced through space (Smith, 2006).

Ethno-Geographic Continuity: The Relationship Between Cultural Forms and Topography

Ethno-geography is an analytical field that examines the spatial character of cultural forms together with historical, social, and environmental factors (Jordan, 1993; Crang, 1998). This approach argues that, particularly in traditional societies, cultural production is directly related to environmental conditions (Steward, 1955; Netting, 1993). The Eastern Black Sea geography is one of the rare regions where topography decisively shapes culture (Doğanay, 1997; Tümertekin & Özgüç, 2011). Slope, rainfall regime, abundance of water resources, balance of solar exposure, and dense forest cover are fundamental factors determining house plans, garden layouts, production calendars, and even forms of social division of labor (Gülersoy & Yılmaz, 2015; Kaymaz, 2018).

The spatial production practices of Laz culture provide strong examples of ethno-geographic continuity (Hann & Beller-Hann, 2001; Aksoylu, 2009). Wooden frame systems seated on stone foundations ensure structural durability and indoor comfort under high humidity conditions, while also offering earthquake resistance and material flexibility (Can, 2014; Yıldırım, 2016). The necessity of storing products in elevated structures has made serender and storage buildings integral components of the cultural landscape (Özkan, 2011; Bekar, 2017). Terraced gardens created to render slopes suitable for agriculture represent the spatial outcome of long-term collective labor (Brookfield & Padoch, 1994; Altınbaş, 2004). The guiding role of water in settlement has determined the spatial sequencing of houses, gardens, animal husbandry, and agricultural production areas (Molle & Mollinga, 2003).

In this context, ethno-geographic continuity reveals that Laz culture is not merely an abstract identity, but a presence concretized in space (Öztürk, 2013; Ingold, 2000). Housing typologies, garden-use patterns, and production practices are the result of a long-term adaptation to the region's natural conditions. This forms the fundamental premise of the Laz Village Model: culture cannot be conceived independently of geography (Rapoport, 1982; Berkes, 2012).

Architectural Typology, Cultural Memory, and Threshold Space

Architectural typology is an analytical tool that materializes a society's spatial habits, modes of production, social relations, and relationship with the environment (Rossi, 1982; Moudon, 1994). From an ethno-geographic perspective, typology functions not merely as a classification of buildings, but as a "place memory" encoding climatic adaptation, economic regimes, social hierarchy, and ritual practices (Norberg-Schulz, 1980; Assmann, 2011). Therefore, typological analysis is a central method in identifying and preserving ethno-geographic continuity (Caniggia & Maffei, 2001).

Arhavi houses can be evaluated across three fundamental typological planes: structural, functional, and threshold-related (Aksoy, 2010; Yılmaz, 2015). On the structural plane, the wooden frame seated on a stone foundation, the raised floor system, infill wall technique, and wide-eaved roof are characteristic (Can, 2014). On the functional plane, the use of the ground floor as an animal shelter or storage space, the middle floor as the living area, and the upper floor for sleeping and storage is prominent, along with the presence of permeable semi-open spaces between the house and the garden (Rapoport, 1969; Bekar, 2017). On the threshold plane, transitional areas between garden–house–nature, the spatial organization of production and storage cycles, architectural counterparts of ritual spaces, and the reflection of intra-family hierarchy in space come to the fore (Van Gennep, 1960; Turner, 1969).

The notion that "the house is not merely a plan, but a cultural spatial threshold" defines the house not as a result, but as a spatial coding field where social, economic, and ecological relations originate (Lefebvre, 1991; Rapoport, 1982). In this context, the concept of threshold refers to the ensemble of spatial decisions that organize production, social norms, environmental adaptation, and ritual–memory dimensions together (Turner, 1969; Ingold, 2000). When thresholds disappear, typology survives only formally, while cultural continuity is disrupted (Waterton & Smith, 2010).

Garden Use Patterns, Ethnobotany, and Ecological Functionality

In ethnobotanical and ecological research, rural gardens are evaluated not only as food production areas, but as functional extensions of household structure, economic strategies, cultural identity, and spatial memory (Nazarea, 1999; Toledo & Barrera-Bassols, 2008; Barthel, Crumley & Svedin, 2013). The literature demonstrates a strong relationship between plant species selection, family structure, and seasonal cycles, sustained through intergenerational knowledge transmission (Howard, 2003; Agnoletti, 2014). In this context, gardens are defined as micro-ecological laboratories where both production and ecosystem health are jointly regulated, and where biocultural diversity becomes tangible (Pretty et al., 2009; Barthel et al., 2010).

In rural Arhavi, garden use has been shaped along the axes of food production, microclimate management, ritual plants, and ecosystem services (Aksoylu, 2009; Öztürk, 2013). Plant species have been selected with consideration for soil health, shading, wind control, and water retention capacity, and these selections have been encoded into garden space as practical manifestations of local ecological knowledge (Altieri, 2004; Toledo & Barrera-Bassols, 2008). Seasonal succession supports the biological renewal of the soil, while the processing, drying, and storage of products allow the ecological temporality of the garden to continue within domestic space (Howard, 2006; Nazarea, 2013).

When garden-use patterns become unsustainable, not only production capacity but also cultural continuity, local knowledge systems, and community resilience are weakened (Pretty, 2002; Barthel et al., 2013). Therefore, the Laz Village Model aims to treat gardens not as passive landscape elements, but as ecological, cultural, and pedagogical spaces that must be reactivated (Agnoletti & Rotherham, 2015).

Re-Accessibility from a Sustainability Perspective

The traditional house–garden model is defined as a living system with low input requirements and high adaptive capacity, in which cultural continuity and ecological functions are intertwined (Altieri, 2004; Pretty et al., 2009). The concept of re-accessibility refers to rendering this system applicable again under contemporary conditions through stages of conservation, transmission, adaptation, systematization, and modularization (Agnoletti, 2014; Harrison, 2015). The literature emphasizes that merely preserving traditional rural models physically is insufficient; they must be reproduced through adaptation together with their social, cultural, and ecological dimensions (Waterton & Smith, 2010; Fairclough, 2012).

In this context, the traditional house–garden model offers a transferable living prototype for the future along the axes of ecological adaptation, community-based production, and spatial sustainability (Pretty, 2002; Barthel et al., 2010). What is required is not to replicate the past exactly, but to reinterpret and reproduce historical–ecological principles in line with contemporary needs (Smith, 2006; Harrison, 2015). In this way, the traditional house–garden model ceases to be a frozen remnant of the past and becomes a functional, living, and transformable system for a sustainable rural future (Agnoletti & Rotherham, 2015).

Cultural Stratification and Spatial Memory in Arhavi

The Eastern Black Sea coastal belt has historically been shaped not merely as a settlement area, but as a threshold geography where different cultures, modes of production, and spatial organization regimes have overlapped and accumulated (Braudel, 1980; Lowenthal, 1998; Öztürk, 2013). Due to its compressed topography between high mountain ridges and the Black Sea coastal strip, the Arhavi basin is one of the areas where this threshold quality can be observed most intensely (Darkot & Tuncel, 1981; Erinç, 2001). This geographical compression has historically both necessitated intercultural transition and produced a multilayered cultural landscape in which different communities superimposed their spatial codes without completely erasing one another (Hann & Beller-Hann, 2001; Smith, 2006).

The settlement history of Arhavi should be read not as a narrative of successive “relocations,” but through the reinterpretation and refunctionalization of the same space across different periods (Cosgrove, 1998; Waterton & Smith, 2010).

Laz, Georgian, Pontic Greek, Ottoman-Turkish, and partly Hemshin communities developed different models of production, habitation, and social organization on the same topography at different times, without entirely eliminating the spatial traces they established (Aksoylu, 2009; Öztürk, 2013; Bryer, 2014). This has made Arhavi one of the rare basins in the Eastern Black Sea where cultural continuity and transformation can be read simultaneously (Lowenthal, 1998; Rapoport, 2005).

In this context, the cultural stratification of Arhavi can be addressed across three fundamental planes:

I. ethnic and linguistic multilayeredness,

II. spatial and property regime transformations from the Ottoman period to the Republic,

III. enduring traces of ecological and social memory in space (Smith, 2006; Waterton & Smith, 2010).

Historically, Arhavi has functioned as a border and transition zone (Hann & Beller-Hann, 2001; Braudel, 1980). Micro trade routes linking coastal trade colonies with the inland hinterland during the Hellenistic and Roman periods demonstrate that the region was a space of circulation and interaction from an early period (Bryer, 2014; Darkot & Tuncel, 1981). The cultural structure shaped by Lazika, Tao-Klarjeti, and Byzantine influences in the Middle Ages acquired a new administrative and social organizational form during the Ottoman period, rendering ethnic and cultural diversity even more pronounced (Aksoylu, 2009; Öztürk, 2013).

The Laz community represents the cultural layer with the strongest continuity in the coastal and valley settlements of Arhavi (Hann & Beller-Hann, 2001). Lazuri has functioned not only as a language of communication, but as a cultural coding system used in naming space, production, and rituals (Kutscher, 2008; Özsoy, 2011). Concepts such as “nalia,” “k’vani,” “makri,” and “ts’q’vani,” which relate to both architectural and agricultural arrangements, clearly demonstrate the capacity of language to carry spatial memory (Rapoport, 2005; Öztürk, 2013).

Georgian cultural influence can be traced particularly in place names, wood and stone craftsmanship, certain ritual practices, and kinship terminology in the middle valley zones (Braund, 1994; Aksoylu, 2009). The structural proximity between Lazuri and

Georgian has created a high degree of permeability between these two cultures (Kutscher, 2008). Pontic Greek presence left spatial traces until the 19th century, particularly through stone craftsmanship, serender architecture, and specific agricultural practices (Bryer, 2014; Lowenthal, 1998). Ottoman-Turkish and Islamic cultural influence became decisive through administrative organization, mosque-centered village layouts, and the redefinition of intra-family division of labor (İnalcık, 2009; Aksoylu, 2009).

This multilayered structure defines Arhavi culture not as a singular and homogeneous identity, but as an interactive and permeable cultural landscape (Smith, 2006; Waterton & Smith, 2010). Accordingly, the theoretical foundation of the Laz Village Model is based not on an assumption of homogeneity, but on collectively produced spatial memory (Lowenthal, 1998; Rapoport, 2005).

Spatial Organization in the Ottoman Period: Miri Land and Collective Order

During the Ottoman period, the spatial organization of rural Arhavi was shaped by the miri land system (İnalcık, 2009; Faroqhi, 2014). State ownership of land, with usage rights granted to peasant families, necessitated the collective and topography-adaptive use of limited agricultural areas (İnalcık, 2009).

In this period, stream beds functioned as common-use areas, regulating grazing, meadow use, and water access (Erinç, 2001; Öztürk, 2013). Terrace systems allocated to families on sloped terrain institutionalized a production model based on the maize–cabbage–bean cycle (Altieri, 2004; Toledo & Barrera-Bassols, 2008). Houses were positioned at the center of production areas, and gardens became the core of food production, animal cycles, and social life (Rapoport, 2005; Aksoylu, 2009). Locating animal shelters on the ground floor offered a functional solution in terms of both production and climatic adaptation (Oliver, 2006).

This spatial order strengthened the collective character of the relationship with land, integrating mutual aid (imece), harvest rituals, and seasonal division of labor with spatial organization (Scott, 1998; Smith, 2006).

Republican Modernization: Rupture and Discontinuity

With the Republican period, three major ruptures occurred in rural Arhavi: changes in the property regime, agricultural monocropping, and the spread of reinforced concrete construction (Keyder, 1987; Tekeli, 2009). Title deed and cadastral practices transformed collectively oriented land relations into individual ownership, fragmenting gardens and weakening the house–garden relationship (Tekeli, 2009; Öztürk, 2013). The promotion of tea cultivation from the 1940s onward disrupted diverse ethnobotanical production cycles, creating a monocultural agricultural regime (Altieri, 2004; Toledo & Barrera-Bassols, 2008). Reinforced concrete construction replaced topography-adaptive architectural intelligence with standardized plan types detached from geography (Oliver, 2006; Rapoport, 2005). These transformations affected not only space, but also rituals, production practices, and social memory (Lowenthal, 1998; Smith, 2006).

Demographic Dissolution and the Resistance of Memory in Space

Post-1980 migration movements accelerated spatial abandonment in rural Arhavi. Houses were reduced to seasonal use, and gardens ceased to function as production areas, transforming into spaces of memory (Keyder, 1999; Tekeli, 2010; Öztürk, 2013). Yet cultural memory did not disappear entirely; it persisted embedded in topography. Plant distributions, water sources, boundary trees, and spatial terminology function as carriers of this memory (Ingold, 2000; Hirsch & O’Hanlon, 1995; Aksoylu, 2009).

The House–Garden–Animal Triangle and Traditional Ecological Cycles in Arhavi

In rural settlements of Arhavi, the fundamental spatial and productive logic shaping traditional life patterns is the house–garden–animal triangle, which transforms the house from a mere shelter into a holistic ecological system operating together with garden and animal production areas (Table 1) (Rapoport, 1969; Altman & Chemers, 1980; Netting, 1993). This triadic structure has shaped Arhavi's rural identity not only as a spatial arrangement, but also as a fundamental system determining economic production modes, networks of social relations, intra-family division of labor, and the transmission of cultural memory (Berkes, 1999; Smith & Watson, 2009).

Table 1 Spatial and Ecological Components

Component	**Function**	**Cultural Correspondence**
House	Shelter + organization of production	Family structure, everyday life
Garden	Food production + ecology	Ethnobotanical knowledge
Animal Area	Cyclical production	Rituals, seasonality
Common Area	Social interaction	Community memory
Water System	Life and production	Harmony with nature

In this context, the house functioned as the center where production was managed; the garden as the primary arena for food production and knowledge transmission; and animal husbandry as the biological support mechanism ensuring the continuity of this cycle (Netting, 1993; Berkes, Colding & Folke, 2000). The local expression "the abundance of the house comes from the garden" demonstrates that this triadic structure constituted not only a functional but also a symbolic unity (Aksoylu, 2009).

The house–garden–animal relationship in Arhavi was not accidental; rather, it was based on a compulsory settlement logic shaped by the constraining conditions of topography. Houses were generally located on ridge lines or slopes where air circulation was more balanced and flood risk relatively lower (Tunçdilek, 1967; Özçağlar, 2015). Gardens were established on terraced lands, taking into account solar exposure and soil retention capacity, while animal shelters were often positioned on the lower floor of the house or at topographically lower elevations (Rapoport, 1969; Oliver, 2006).

This spatial organization produced an optimal system in terms of both energy efficiency and the continuity of production cycles. Locating animal shelters on the lower level contributed to heating the upper living spaces during winter months and enabled manure to be directly integrated into the garden cycle (Vale & Vale, 1991; Berkes, 1999). This spatial intelligence constitutes a tangible manifestation of traditional architectural knowledge in which geography actively participates in design decisions (Oliver, 2006).

The traditional Arhavi house represents a distinctive building typology adapted to humid climatic conditions, combining a timber frame system with stone foundations. Wide eaves, pitched roof forms, raised floor solutions, and flexible structural systems are products of local engineering knowledge developed in response to both climatic and seismic conditions (Kuban, 1995; Oliver, 2006).

The façade of the house facing the valley reflects not merely a preference for scenery, but also the need to monitor the garden, oversee production processes, and maximize exposure to sunlight (Rapoport, 1969). Stone-paved terraces between the house and the garden functioned as multi-purpose intermediate spaces during production seasons, accommodating daily practices such as corn husking, crop drying, and laundry washing (Aksoylu, 2009; Öztürk, 2013).

In Arhavi, the garden is not merely an area for vegetable cultivation, but a living production space at the center of cultural memory, dietary practices, and the intra-household division of labor (Netting, 1993; Barthel, Crumley & Svedin, 2013). The traditional garden system is based on polycultural production and operates according to a cyclical ecological logic in which crops such as maize, collard greens, and beans mutually support one another (Altieri, 2004).

Trees found in gardens—such as walnut, medlar, plum, persimmon, and wild pear—functioned not only as food sources but also as spatial boundary markers and memory anchors (Ingold, 2000; Hirsch & O'Hanlon, 1995). The local expression "the tree that holds the garden" clearly reflects this symbolic role (Aksoylu, 2009). Historically, the management of garden production has largely relied on women's labor. Knowledge related to seed selection, timing of planting, and the drying and storage of produce was transmitted orally across generations, transforming the garden into a space of knowledge transmission as well (Oakley, 1974; Howard, 2003). In the rural context of Arhavi, animal husbandry existed not as a large-scale economic activity but as a complementary element completing the household production cycle (Netting, 1993). Animal manure served as a primary input enhancing soil fertility, enabling the establishment of a closed-loop agricultural system that did not require chemical fertilizers (Berkes, 1999; Altieri, 2004).

The production of dairy products (butter, cheese, clotted cream) supported household consumption and strengthened economic self-sufficiency (Öztürk, 2013). The spatial positioning of animal shelters reflects a conscious choice aimed at minimizing natural disaster risks while adapting to climatic conditions (Oliver, 2006). Modernization, migration, the expansion of tea cultivation, and reinforced concrete construction have exerted multidimensional pressures on the house–garden–animal triangle. Houses have been reduced from centers of production to mere spaces of shelter; gardens have experienced functional decline; and animal husbandry has largely diminished (Keyder, 1999; Tekeli, 2010). Nevertheless, traces of this triadic structure have not been entirely erased and continue to be maintained on a limited scale by older generations in certain villages (Aksoylu, 2009; Öztürk, 2013). This situation indicates the existence of a reproducible cultural and ecological foundation for the Laz Village Model (Berkes, 1999; Barthel et al., 2013).

Holistic Analysis of Tangible and Intangible Cultural Heritage

The cultural landscape of Arhavi is characterized by a multilayered structure in which tangible and intangible heritage elements mutually generate and sustain one another (UNESCO, 2003; Smith, 2006; Antrop, 2013). Tangible heritage can be interpreted through buildings, agricultural landscapes, and production systems, while intangible heritage persists through language, rituals, music, oral culture, and production-related knowledge (Kirshenblatt-Gimblett, 2004; Harrison, 2015). Traditional houses, granaries (serender), water mills, terraces, and gardens function as carriers of spatial memory (Rapoport, 1982; Low & Lawrence-Zúñiga, 2003). The Laz language forms the conceptual framework through which space and production are defined (Holisky, 1991; Kutscher, 2008). Rituals, music, and dance reinforce social cohesion, while gastronomy represents the cultural counterpart of garden and animal production cycles (Mintz & Du Bois, 2002; Bessière, 2013).

The weakening of any one of these elements renders the entire system fragile (Harrison et al., 2013; Logan, Craith & Kockel, 2015). Therefore, the preservation of cultural heritage cannot be achieved solely through building restoration; it requires the integrated consideration of production, language, and ritual cycles (UNESCO, 2015; Fairclough, 2012).

In rural Arhavi, modernization has been experienced not merely as technical progress but as a multidimensional process of spatial and cultural disintegration (Harvey, 1989; Mitchell, 2003). Changes in property regimes, monocrop agricultural policies, migration, and standardized architectural practices have weakened the continuity of the traditional Laz village model (Scott, 1998; Keyder & Yenal, 2011). With migration, chains of knowledge transmission have been broken, and garden and production practices have retreated from everyday life, transforming into nostalgic memory spaces (Assmann, 2011; Connerton, 2009). Reinforced concrete buildings have marginalized the role of geography as a determinant of design, rendering the spatial expressions of traditional architectural intelligence increasingly invisible (Oliver, 2006; Rudofsky, 1964). Nevertheless, ethno-ecological memory has not been entirely lost and continues to exist through plant arrangements, spatial thresholds, local concepts, and residual ritual practices (Berkes, 2012; Toledo & Barrera-Bassols, 2009). This indicates that cultural disintegration is not an irreversible loss but can serve as a starting point for cultural regeneration when addressed at appropriate scales (Harrison, 2015; Smith, 2006).

The Laz Village Model (Lvm): Conceptual Framework, Structural Configuration, And Practice-Based Design Logic

The Laz Village Model (LVM) proposed in this study is a holistic approach that aims not only to preserve but also to reinterpret and re-produce the traditional house–garden–animal-based life organization of the Eastern Black Sea region—specifically within the Arhavi basin—as a reproducible, applicable, and sustainable system under contemporary social, ecological, and economic conditions (Berkes & Folke, 1998; Ostrom, 2009). The model does not propose a nostalgic reconstruction or historical replica. Rather, it offers a flexible, adaptive, and scalable rural living framework shaped by historical documents, ethnographic observations, spatial analyses, and ethno-ecological data (Ingold, 2000; Toledo & Barrera-Bassols, 2009).

The point of departure for the Laz Village Model lies in the theoretical premise that culture is not limited to symbolic practices, rituals, or material heritage elements, but exists as a living system intertwined with space, production, language, ecological cycles, and everyday practices (Geertz, 1973; Rapoport, 1982). Accordingly, the model treats cultural heritage not as a passive object to be preserved, but as an active social process that must be continuously reproduced (Smith, 2006; Harrison et al., 2013) (Table 2).

The central research question of the model is formulated as follows: "How can traditional Laz village life be made compatible with today's ecological vulnerabilities, economic transformations, and social realities?" (Folke et al., 2010; Scoones, 2015).

In response to this question, the Laz Village Model is structured around a three-tiered system whose components are not independent but operate in continuous feedback relations (Meadows, 2008).

At the conceptual level, the model interprets the Laz village not merely as a physical settlement unit, but as a multilayered cultural system (Antrop, 2013; Fairclough, 2012). This system is defined through three core components (Table 3).

Table 2 Conceptual Components of the Laz Village Model

Layer	Definition	Content
Cultural Knowledge Core	The intangible carrier of culture	Language, oral history, rituals, production knowledge, sense of belonging
Structural–Spatial Shell	The spatial manifestation of culture	House, garden, *serender*, water systems, communal spaces
Sustainable Transmission Domain	The mechanism for transferring culture into the future	Education, digital archives, cooperatives, intergenerational learning

The first component, the Cultural Knowledge Core, constitutes the innermost layer of the model. This core encompasses elements such as ancestral memory, oral history, ritual knowledge, linguistic transmission, production practices, and a sense of village belonging (Assmann, 2011; Connerton, 2009). In the specific context of Arhavi, this knowledge has been transmitted largely through oral culture and directly encoded into space through garden use, seasonal production cycles, settlement patterns, and everyday practices (Ingold, 2000; Berkes, 2012). One of the primary objectives of the Laz Village Model is to render this cultural knowledge core visible, documentable, and transferable across generations (UNESCO, 2015).

The second component, the Structural–Spatial Shell, refers to the spatial organization through which cultural knowledge becomes materialized (Rapoport, 1982). The relationship between houses and topography, the configuration of gardens, the location of communal spaces, and the hierarchy between production areas and living spaces constitute the fundamental components of this shell (Oliver, 2006; Rudofsky, 1964). The model proposes that this spatial shell be reinterpreted in a manner that remains faithful to historical references while simultaneously responding to contemporary living requirements, ecological risks, and social expectations (UN-Habitat, 2019).

The third component, the Sustainable Transmission Domain, encompasses the educational, digital, and institutional instruments that enable the cultural system to be carried into the future (Smith & Waterton, 2009). Living museum approaches, digital archives, open-access databases, local education modules, and intergenerational learning environments constitute the key elements of this domain (Harrison, 2015; Giaccardi, 2012).

At the structural level, the Laz Village Model is decomposed into concretely applicable components and provides answers to the question of "how it is to be implemented," making this the most critical layer of the model (Alexander et al., 1977). At this level, the model adopts a spatial–landscape-based planning approach as its foundation (Forman, 1995).

The settlement pattern is explicitly designed to prevent villa-type development and spatial fragmentation resulting from parcelized ownership. Instead, it is based on a structure that adapts to slope gradients, employs terracing, and preserves natural drainage systems (Forman & Godron, 1986; Turner, 2001). Houses, serender (granaries), gardens, agricultural fields, and water lines are not treated as isolated units but as an integrated functional whole (Berkes, 2012). Communal-use spaces—such as ovens, mills, threshing grounds, and shared water features—are redefined as the social and cultural centers of village life (Low & Lawrence-Zúñiga, 2003).

Within this model, the garden is positioned not merely as an agricultural production area, but as the core of household economy, food security, ecological balance, and cultural continuity (Altieri, 2004; FAO, 2014). The use of local seeds, polycultural planting, organic production, and the preservation of seasonal cycles are among the model's fundamental principles (Toledo & Barrera-Bassols, 2009). The relationship between the garden, family structure, and intergenerational division of labor is given particular consideration during the spatial design process (Netting, 1993).

In terms of social organization, the model proposes a governance structure based on cooperatives and village councils (Ostrom, 1990; Ostrom, 2009). Ensuring that local residents are not passive recipients but active agents of the process constitutes one of the model's core ethical principles (Chambers, 1997).

The implementation of the Laz Village Model is carried out through a four-stage cyclical process, with each stage producing concrete outputs (Meadows, 2008).

Table 3 Implementation Logic of the Laz Village Model (LVM)

System Layer	Definition / Content	Primary Function	Intra-System Relationship	Produced Output
Cultural Knowledge Core	Language, rituals, ancestral memory, traditional production knowledge, local sense of belonging	Preservation and transmission of cultural continuity	Nourished by the spatial shell and educational domains	Active cultural practices, language use
Spatial–Structural System	Houses, gardens, *serender*, communal spaces, topography	Spatial infrastructure of the living–production cycle	Operates simultaneously with cultural knowledge and	Functional village fabric

	-adaptive settlement pattern		ecological systems	
Ecological Cycle System	Gardens, soil, water, animals, plant diversity	Maintenance of ecosystem services	Integrated with agriculture–livestock and landscape systems	Food security, biocultural diversity
Production – Economic System	Cooperatives, local products, tourism, craftsmanship	Economic sustainability	Supports cultural and spatial systems	Income, employment, economic resilience
Education and Transmission Domain	Workshops, master–apprentice model, Laz language education	Intergenerational transmission of knowledge	Interacts with digital archives and the cultural core	Learning environments
Digital Archive System	Architectural, ethnographic, botanical, and oral history data	Permanent documentation of cultural knowledge	Supplies data to education and monitoring systems	Open-access database
Governance Mechanism	Village council, cooperatives, local	Decision-making and implementation coordination	Overarching structure linking all systems	Participatory governance

	stakeholder s			
Monitorin g and Feedback	Indicators, annual reports, evaluation processes	Continuity and adaptive updating of the model	Provides feedback to all systems	Measurabl e success

The Laz Village Model rejects passive conservation approaches and conceptualizes culture as a value that is lived, produced, and continuously transformed (Smith, 2006). The success of the model is measured not by the restoration of physical structures alone, but by the reactivation of cultural and ecological cycles (Berkes, 2012). In this respect, the LVM positions the rural landscape of Arhavi not merely as an area bearing traces of the past, but as a cultural laboratory in which sustainable rural life can be re-envisioned and reconfigured (Harrison et al., 2013) (Table 4).

Table 4 Step-by-Step Implementation Plan

Stage	**Content**	**Output**
1	Ethnographic interviews, architectural documentation, plant inventory	Village Cultural Inventory
2	Risk mapping, prioritization	Cultural Risk Index
3	Pilot house and garden, master–apprentice model	Model framework
4	Education, digital archive, cooperative establishment	Permanent system

Despite offering settlement patterns with high historical, cultural, and ecological continuity, Laz settlements located along the Eastern Black Sea coastal belt have been undergoing rapid dissolution due to processes of modernization, rural-to-urban migration, cultural assimilation, and pressures of spatial transformation (Rapoport, 1969; Lowenthal, 1998; Antrop, 2005). Particularly over the past four decades, the Laz language, traditional production practices, the house–garden–animal-based life cycle, and local knowledge systems have experienced significant ruptures, constituting a critical breaking point that has weakened cultural continuity (UNESCO, 2003; Ingold, 2000; Smith, 2006).

This study approaches Laz culture not as a static folkloric element of the past, but as a reproducible, livable, and sustainable life system that can be reactivated under contemporary conditions (Harrison, 2013; Waterton & Smith, 2010). In this context, the Laz Village Model (LVM) has been developed as a holistic settlement and life model grounded in cultural landscape theory, the socio-ecological systems approach, and principles of community-based conservation (UNESCO, 2011; Berkes, 2012; Folke et al., 2005). The model aims not only to protect the physical environment, but also to simultaneously reactivate cultural knowledge, production practices, and networks of social relations (Taylor, 2015).

The Arhavi region and its surroundings constitute a multilingual, culturally permeable, and spatially hybrid rural structure, shaped by historical interactions among Laz, Georgian, Pontic Greek, and Ottoman–Turkish cultures (Braudel, 1996; Horden & Purcell, 2000). This multilayered structure is materially expressed through the coexistence of chestnut, maize, tea, and diverse vegetable species within garden and agricultural practices, forming the spatial projection of cultural continuity (Altieri, 2004; Nazarea, 1999). In Laz villages, space emerges not merely as a physical environment, but as an active agent that produces identity, carries memory, and shapes social relations (Norberg-Schulz, 1980; Relph, 1976).

The traditional Laz life system is structured around a triadic cycle composed of the house, garden, and barn. The house represents the family nucleus and the center of production-related decision-making; the garden constitutes the primary space where food production, healing practices, and seasonal cycles are managed; and the barn ensures the continuity of this cycle through animal production and manure inputs (Berkes, 2012; Toledo, 2002). This closed ecological loop—operating through an animal–manure–soil–plant–human–animal feeding chain—forms the foundation of a low-input, nature-compatible life model (Pretty, 2002; Altieri, 2018). Plant selection and spatial organization within gardens were not random but based on functional classifications—such as early-spring species, soil-drying plants, or shade-providing vegetation—transmitted across generations through oral culture (Nazarea, 2005; Ingold, 2000). Notably, many of these traditional classifications align closely with contemporary scientific approaches in botany and ecology (Altieri & Nicholls, 2017).

However, since the second half of the twentieth century, the expansion of tea cultivation as a monocultural production system, the proliferation of reinforced concrete construction, the abandonment of animal husbandry, and the outmigration of younger populations have fragmented this holistic life cycle (FAO, 2014; Tekeli, 2010). Gardens have gradually become passive spaces, losing their productive and cultural transmission functions (Brookfield, 2001). Nevertheless, these gardens and settlement patterns today provide a strong reference framework for restorative ecological interventions and processes of cultural revitalization (Higgs, 2017; McGinnis & Ostrom, 2014).

Within this context, the Laz Village Model is not merely a conservation strategy, but a future-oriented vision in which culture, space, and life are co-produced and regenerated (Harrison, 2013). By integrating academic knowledge with local memory and aligning them with contemporary sustainability approaches, the model offers an original and applicable framework for sustaining Laz culture

(Berkes & Ross, 2013; UNESCO, 2016). The success of the LVM lies not in preserving the past unchanged, but in its capacity to adapt traditional knowledge and spatial principles to present-day ecological, social, and economic conditions (Folke et al., 2016) (Table 5).

Table 5 Laz Village Model (LVM) — Implementation Components, Activities, and Outputs

Component Area	**Sub-Activities / Interventions**	**Tools & Methods**	**Expected Outputs**
Architecture (Accommodation & Restoration)	Preparation of a building and material catalogue; Conservation of stone foundations, timber structures, serender (traditional granaries) and drainage systems; Passive heating/cooling solutions	Photogrammetry, measured drawings, material analysis; Traditional construction techniques, local craftsmen; Façade orientation, natural ventilation	Inventory of local building typologies; Functional, inhabited traditional houses; Energy-efficient, low-carbon buildings
Landscape & Water Management	Terrace repair, dry-stone wall restoration; Rainwater cisterns, surface runoff management; Multi-layered	Dry-stone wall techniques, topographic analysis; Rainwater harvesting, micro-watershed planning; Tree–	Erosion control and continuity of agricultural land; Water-resilient landscape system;

	polyculture systems	understory–groundcover integration	Increased biodiversity
Agriculture & Livestock	Establishment of a local seed bank; Compost and animal manure cycles; Seasonal routes and threshing areas	Seed collection and cataloguing; Small-scale composting areas; Restoration of shared spaces	Conservation of genetic diversity; Improved soil fertility; Continuity of collective production
Cultural Programs & Education	Laz language schools and adult workshops; “Laz Year” ritual calendar; Master–apprentice model; Digital content production	School–village collaboration; Revitalization of harvest, transhumance (yayla), and wedding practices; Wood, stone, and culinary practices; Video, podcast, short documentary	Language vitality; Cultural continuity; Transmission of traditional knowledge; Increased visibility of culture
Digital Archive & Knowledge Management	Integrated data model; On-site kiosks and online portal	Architectural + ethnographic + botanical data; Multilingualism (Laz / TR / EN)	Open-access digital archive; Local and global accessibility

Monitoring & Evaluation	Development of indicator sets; Periodic reporting	Language index, number of gardens, seed varieties; Annual field reports, 3-year audits	Measurable sustainability; Continuity of the model
Financing Mechanisms	Start-up grants; Multi-channel income model; International funding	Development agencies, cultural funds; Cooperative + tourism + education; International funds	Pilot implementation; Financial sustainability; Scalability
Risk Management	Risk of museumification; Lack of youth participation; Climate and ecological risks; Governance conflicts	Daily production-oriented practices; Digital programs, scholarships; Erosion control, adaptive agriculture; Transparent governance, mediation	Living culture; Intergenerational continuity; Resilient rural system; Social cohesion

In conclusion, this study demonstrates that Laz settlements are not merely cultural heritage sites in need of preservation, but living laboratories that can serve as exemplary models for sustainable living in an era marked by climate crisis, rural depopulation, and cultural fragmentation. The Laz Village Model should be understood as a holistic rural living strategy that learns from the past, transforms the present, and actively shapes the future.

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BÖLÜM 4

ARTIFICIAL INTELLIGENCE AND PLANTING DESIGN: EXPECTATIONS AND LIMITATIONS

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Introduction

The effects of the urban transformation that began with the industrial revolution in the 19th century continue to this day. These changes have brought about transformations in various areas such as employment, social relations, and spatial preferences. However, this process has also triggered several problems in cities, including rapid population growth, haphazard and unplanned urbanization, overconsumption of natural resources, and environmental pollution (Özçatalbaş & Erdoğan, 2025:38).

A growing body of research shows that urban green spaces provide important spiritual, recreational, and cultural services that improve the health of residents (Li et. al. 2022: 1). This shows that one of the most important tools to be used in solving urbanization

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problems is landscape design, which plays a significant role in the organization of urban green spaces.

Landscape design is a broad multidisciplinary field that interpolates aspects of aesthetic, functionality, sustainability, and ecological harmony to shape outdoor spaces. For the spaces to provide visual and cultural satisfaction to the user and to instill a sense of civic awareness, attention must be paid to the elements used in the design (Engin & Erdoğan, 2020:23).

Artificial intelligence (AI) transforms the domain of design by integrating technological advancements to optimize ecological, aesthetic, and functional aspects of landscape and urban planning. Plant design is one of the elements of landscape design most affected by the interaction of artificial intelligence. Artificial intelligence interprets information about plants (such as their functions and aesthetic characteristics) from an ecological perspective and is becoming increasingly effective today by presenting this information to the user as a very powerful tool.

AI utilizes machine learning algorithms and environmental data to recommend the most suitable plant species and varieties for a specific location. These recommendations are based on factors such as soil type, sunlight conditions, rainfall patterns, moisture, and temperature ranges. AI-driven generative models possess strong generalization capabilities.

Landscape architects are inspired by a variety of landscape designs (Erdoğan et. al, 2022:285). Similarly, artificial intelligence can discover hidden creative patterns and landscape aesthetic principles, providing by learning from many garden design cases (Xing et.al., 2025:221). This allows designers to create intuitive planting schemes that boost ecological synergy and reduce intensive tasks like traditional methods of designing. Advances in deep learning have significantly contributed to computer vision applications and image processing techniques. One of these advancements has emerged in the field of image synthesis, which involves the creation and manipulation of images (Kahvecioğlu et. al., 2025: 1838).

Traditional landscape design methods are shaped by various factors, constraints, local ecological climate, available resources, and environmental considerations. These methods often rely on the designer's personal experience and subjective aesthetics, with design standards rooted in subjective perception (Xing et al. 2025: 220). Also, these methods can become inefficient or deficient when dealing with the dynamic and multifunctional demands of modern planting designs. The integration of artificial intelligence into landscape architecture has opened new frontiers for computational design, enabling the generation of garden and outdoor spatial layouts that blend ecological logic with aesthetic innovation (Yang et. al., 2025: 151365).

This study is structured around what academics and designers expect from artificial intelligence in plant design and what benefits and drawbacks they anticipate in the future. To answer the hypothesis that "artificial intelligence will become an indispensable tool in plant design," various research questions have been developed. These are:

1. What are the factors influencing plant design?
2. Can artificial intelligence analyze these factors?
3. Can artificial intelligence produce appropriate and acceptable results?

To answer these questions, verbal interviews were conducted with landscape architects who specialize in plant design. The results were discussed in detail, and the study ultimately aimed to determine the role of artificial intelligence in plant design, a crucial component of landscape design.

Methodology

A qualitative research design was adopted to capture expectations and considerations of landscape planting design professionals. Semi-structured interviews allowed to express detailed insights and experiences regarding AI-driven planting design.

The study was based on voluntary participation, with 6 academics (university level instructors and researchers, 6 company owners, and 6 company employees taking part. This distribution balances theorical, management, and practical viewpoints.

Verbal interviews were conducted using semi-structured interview form. These interviews are conducted either face to face or online. Each interview lasted between 20 to 40 minutes. Questions focused on three research topics. These are design factors, AI capability, and AI-generated outputs. The questionnaire is created in three sections.

First, participants were asked to describe the key factors that influence planting design in their practice. They were asked to elaborate on ecological and environmental considerations, such as climate, microclimate, soil properties, and topography, as well as aesthetics and spatial elements including color, texture and form. Additional prompts focused on practical constraints such as maintenance requirements, project budgets, and plant availability, allowing participants to discuss both technical and subjective influences.

The second part of the interview addressed the analytical potential of artificial intelligence. Participants were invited to reflect on whether they believe AI could effectively analyze the factors influencing planting design and to justify their reasoning. Following questions explored which specific factors participants considered suitable for AI analysis and which aspects they felt AI currently struggles with.

In the third section, AI's ability to generate appropriate and accurate planting design outcomes questioned. Participants were asked whether they believe AI could produce realistic, applicable, and professionally credible planting proposals. They were asked to comment on their experiences or observations of AI-generated design suggestions, species combinations, or visualizations. Participants were also asked under what conditions they could trust or adopt AI-generated suggestions in real projects.

The qualitative data collected from the semi-structured interviews were analyzed using Thematic Analysis, following the systematic framework outlined by Braun and Clarke (2006). An inductive approach was adopted, meaning the codes and themes were derived directly from the data content rather than fitting into a pre-existing coding frame. The analysis process consisted of six phases:

1. familiarization with the data through verbatim transcription,
2. generating initial codes by examining the text line-by-line,
3. searching for themes by collating codes into potential patterns,
4. reviewing themes to endure they accurately reflected on the dataset,
5. defining and naming the final themes, and
6. producing the report. This structured approach ensured a rigorous interpretation of the participants'

expectations and limitations regarding AI in planting design.

Coded data was systematically analyzed to identify recurring themes, interpretations, and insights. This step allowed researchers to develop a structured understanding of how participants perceived artificial intelligence in planting design. To identify similarities and differences, the findings were compared among the three participant groups (academics, business owners, and employees). This comparison highlighted how professional role and experience influenced expectations and concerns regarding artificial intelligence.

Results

Eighteen experts were interviewed for this study. Academics ranged from research assistants to professors, with experience in plant sociology, ecological planning, urban ecology, digital design, landscape management, and parametric design. AI competency ranged from beginner to advanced, which several are using tools such as Python, Grasshopper, GIS platforms, or simulation software tools.

Firm owners managed practices focused on public parks, residential gardens, structural implementation green roofs, and urban design. Their experience ranged from 8 to 28 years. AI competency level varied significantly from beginner to advanced level.

Landscape architecture employees included project designers, visualizers, and 3D specialists. This group showed the highest AI competency level. Also, this group frequently uses Lumion, D5 Render, Stable Diffusion, Vizcom, Firefly, and ChatGPT for visualization and concept development.

The role/position, experience, area of expertise, AI competency level, and primary software used by these experts are given in Table 1.

Table 1 Participants Characteristics

Role / Position	Experience (Years)	Area of Expertise	AI Competency Level	Primary Software Used
Academic (Professor)	30	Plant Sociology / History	Beginner	Hand Drawing, Excel, Word
Academic (Assoc. Prof.)	18	Landscape Management	Intermediate	AutoCAD, MS Project
Academic (Asst. Prof.)	7	Parametric Design	Advanced	Rhino, Python, Grasshopper
Academic (Res. Asst.)	4	Urban Ecology / GIS	Advanced	ArcGIS, QGIS, R Studio
Academic (Professor)	25	Ecological Planning	Beginner	GIS, ArcGIS
Academic (Dr.)	10	Digital Design	Advanced	AutoCAD, Grasshopper
Firm Owner	22	Public Park Projects	Intermediate	AutoCAD, Photoshop
Firm Owner	12	Residential Gardens	Advanced	SketchUp, Midjourney
Firm Owner	28	Structural Implementation	Beginner	AutoCAD, NetCAD
Firm Owner	8	Green Walls / Roof Gardens	Intermediate	Revit, SketchUp
Firm Owner	20	Urban Design	Intermediate	AutoCAD, Lumion
Firm Owner	15	Residential Landscape	Beginner	SketchUp, Midjourney
Landscape Architect	8	Implementation Projects	Intermediate	AutoCAD, LandFX
Landscape Architect	6	3D Visualization	Advanced	Lumion, D5 Render, Photoshop
Landscape Architect	3	3D Visualization	Advanced	SketchUp, Stable Diffusion
Landscape Architect	5	Implementation Projects	Intermediate	Revit, Civil 3D
Landscape Architect	1	Concept Development	Advanced	Vizcom, Firefly, ChatGPT
Landscape Architect	1	Graphic Presentation	Advanced	Midjourney, Canva AI

In the questionnaires first part, participants identified planting design as a multi-factorial process shaped by ecological, functional, aesthetic, and practical considerations across all groups. Academics strongly emphasize that ecological compatibility serves as a primary determinant in planting design, where decisions are shaped by microclimatic conditions, soil characteristics, and urban challenges including heat islands and pollution. While academics focused on ecological compatibility practitioners similarly reinforce the practical importance of site constraints, arguing that ‘sun exposure, irrigation access, and soil quality’ are the primary determinants of plant survival. Functional and management considerations were prominent among both academic and firm owners. Participants emphasized that design decisions are heavily influenced by maintenance capacity and long-term costs. Firm owners further contextualized these economic factors, noting that project outcomes are often dictated by the interplay between public expectations and maintenance budgets. For employees, perceptual and compositional elements were paramount. The design process was described as driven by principles such as ‘color rhythm, form composition, and spatial atmosphere’, including a focus on the phenomenological experience of space. Conversely, firm owners consistently identify economic and logistical realities as the primary limiting factors. Financial constraints and supply chain issues were frequently cited, with one owner noting that ‘budget and plant market availability’ often act as the biggest constraints. Beyond cost, the realization of a project is heavily dependent on implementation capabilities, as technical feasibility and logistics determine what can be built.

In the second part, participants widely validated AI’s analytical strengths, particularly in handling measurable environmental data. Expert respondents described AI as superior in evaluating multi-variable datasets and analyzing physical parameters like sunshine and soil. From a business perspective these capabilities were valued for streamlining cost estimates and plant listing processes. Despite its analytical power, participants questioned AI's reliability in real-world applications. The primary concern was the dependence on dataset quality, with owners asserting that software cannot substitute for on-site fieldwork. Additionally, AI was described as lacking contextual intelligence, failing to address cultural nuances or the practical constraints of constructability and logistics.

In the third part, participants widely agreed that AI-generated output can be useful tool but require human expertise for refinement. In terms of preliminary design and visualization, AI tools received strong endorsement across practitioner groups. Visualization specialists praised the generative capacity of AI, noting that it aids in developing mood and direction and producing visuals that are client-friendly and convincing. This communicative efficiency was corroborated by firm owners, who valued AI not only for exploration but also its impact on workflow. As one firm-owner remarked, clients accept AI renderings; they speed up decision-making', suggesting that AI effectively bridges the gap between conceptual abstraction and client approval. Despite the operational benefits of AI, participants universally agreed on the indispensable professional oversight. There was a consensus that AI can generate options, but the critical evaluation must remain on human judgement. Employees noted that AI-generated plant lists need adjustment for on-site realities, while construction-focused participants warned that without expert adaptation, AI results are often unrealistic from a construction perspective.

A coding structure was needed to make the qualitative analysis process transparent. This code evaluated the data within the themes of human factors, AI capacity, and adaptation barriers as shown in Table 2.

Table 2 Thematic synthesis of findings and AI integration

Theme	Sub-theme	Codes
Human Factor	Tacit Knowledge and Creative Control	Intuition, Experience, Spirit of Place, Emotional Perception, Curatorship, Signature Design, Final Decision Maker, Education
AI Capacity	Data Processing and Limitations	Speed, Big Data, Climate Modeling, Optimization, Hallucination, Lack of Context, Superficiality
Adaptation Barriers	Trust, Risk and Technical Barriers	Need for Verification, Responsibility, Fear of Error, Learning Curve, Software Cost, Lack of Data, Data Security, Ethics

Thematic synthesis of finding and AI integration in planting design is given in Table 3 and comparison of AI capabilities and the necessity of human expertise in planting design is given in Table 4.

Table 3 Thematic synthesis of findings and AI integration

Theme	Key Findings	Implication for Practice
Multidimensional Design Drivers	Planting design is governed by a complex interplay of ecological, functional, aesthetic, and practical constraints.	Design tools must address diverse variables ranging from soil pH to maintenance budgets.
Analytical Capabilities vs. Contextual Gaps	AI excels in processing quantifiable environmental and management data but lacks "contextual intelligence" for cultural and historical nuances.	AI is best utilized for data-driven analysis, while human insight is required for site-specific interpretation.
Process Integration: From Concept to Reality	AI tools are highly effective for early-stage conceptualization and visualization but require expert review for constructability and logistics.	AI accelerates the "ideation" phase, but the "realization" phase remains dependent on professional oversight.
Synthesis: The Complementary Model	The most effective workflow combines AI’s computational power with human expertise and ethical judgment.	AI should be viewed as a collaborative tool (co-pilot) rather than a replacement for the landscape architect.

Table 4 Comparison of AI capabilities and the necessity of human expertise in planting design.

Design Domain	AI Contribution (Strengths)	Human Expertise Requirement (Limitations)
Environmental Analysis	Processes measurable variables (sunlight, soil data, hydrology) efficiently.	Interprets complex ecological interactions and micro-climatic nuances.
Design Determinants	Handles quantifiable management factors and large datasets.	Addresses cultural values, user experiences, and aesthetic composition.
Visualization & Planning	Generates rapid, client-friendly visualizations and preliminary plant lists.	Validates technical feasibility, constructability, and logistical reality.
Overall Workflow	Acts as a tool for speed, optimization, and data synthesis.	Provides ethical judgment, creative direction, and final approval.

Discussion

This study demonstrates that planting design professionals view AI tools as a promising but still an incomplete tool. AI excels in data-driven analysis and rapid visualization, yet struggles with contextual judgement, cultural interpretation, and practical implementation.

Academics consistently mentioned the scientific integrity of the planting design process. Their focus on ecological compatibility in earlier themes is reinforced here by their appreciation of AI's computational power for environmental data, balanced by a persistent skepticism regarding its ability to handle qualitative nuances.

Firm owners maintained a utilitarian perspective through the study. The thematic emphasis on practical and economic constraints is consolidated in this group profile, confirming that their acceptance of AI is conditional on its ability to streamline workflows, estimate costs, and satisfy client expectations.

Employees noted that aesthetic factors and visualization align with groups openness to adopt advanced tools for concept development, positioning them as the bridge between digital innovation and creative practice.

The divergence in perspectives observed in result section is not arbitrary; rather it reflects the distinct roles each group plays in the landscape architecture ecosystem. While academics guard the theoretical rigor, firm-owners enforce the projects reality and landscape architecture employees drive the creative output. AI is rapidly becoming an influential tool in planting design, offering powerful computational and visualization capabilities. While professionals recognize its strengths, they also stress the need for human interaction and ecological adjustments. Cross-analysis of stakeholder priorities is given in Table 5.

Table 5 Cross-Analysis of Stakeholder Priorities

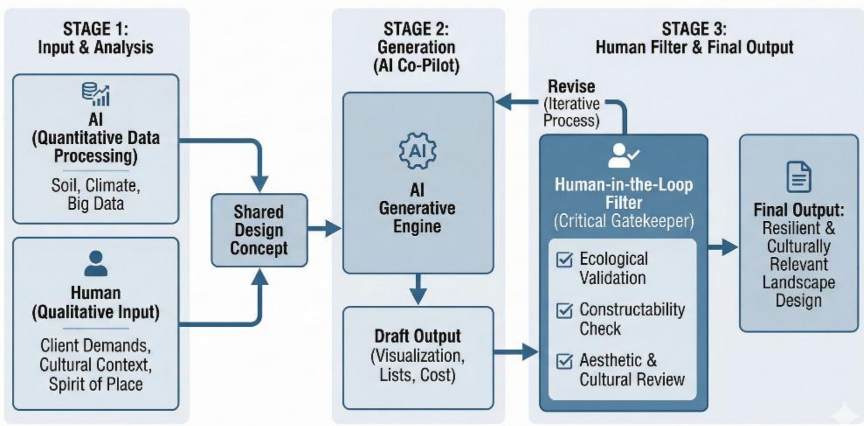
Stakeholder Group	Primary Focus (Section 6)	Linked Previous Findings (Quotes)	Key Motivation
Academics	Ecological & Analytical Accuracy	Cultural nuances, multi-variable datasets	Scientific Validity
Firm Owners	Efficiency, Cost & Feasibility	Maintenance budgets, technical feasibility	Business Viability
Employees	Visualization & Creativity	Mood and direction, spatial atmosphere	Design Innovation

Conclusion

The findings of the study reinforce the necessity of a 'human-in-the-loop' approach in landscape architecture. While AI demonstrates significant potential in processing quantitative environmental data, it fundamentally lacks the ability to interpret the qualitative 'spirit of the place (genius loci)'. As highlighted by the participants, cultural nuances, historical context, and the phenomenological experience of space remain currently strictly human domains. Therefore, AI should not be viewed as a substitute for the landscape architect, but rather as a powerful analytical assistant that requires strict professional oversight to ensure that design proposals are both culturally relevant and technically constructable.

As illustrated in Figure 1, the study proposes a hybrid workflow where AI functions as a generative engine for data-driven tasks, while the landscape architects act as the critical gatekeeper. This 'human-in-the-loop' model ensures that the speed of algorithmic production is balanced by the necessity of site-specific verification and cultural interpretation.

Figure 1 Human-in-the-loop workflow model



For professional practice, the integration of AI offers a clear dichotomy between efficiency and reliability. Firm owners and employees stand to benefit from AI's capacity to expedite visualization and preliminary cost estimations, effectively streamlining client communication and decision-making processes. However, this efficiency comes with the risk of overlooking practical constraints. As evidenced by the concerns regarding on site realities and logistic feasibility, professionals must treat AI-generated plant lists and layouts as tentative drafts rather than final solutions. The industry must establish new verification protocols where AI outputs are systematically cross-referenced with site-specific biological constructional realities.

Since academics prioritize ecological validity and scientific integrity, future education models should aim to build AI literacy that goes beyond mere software proficiency. Students must be trained not only to use generative tools but also to critically evaluate algorithmic outputs against ecological principles and technical standards. Bridging the gap between the theoretical rigour valued by academia and the practical efficiency demanded by the market will be essential in preparing the next generation of designers for an augmented workflow.

The future of planting design lies in a hybrid model that leverages the best of both worlds: the computational speed of artificial intelligence and the adaptive, empathetic reasoning of human designers. As AI technologies evolve, the collaboration between human designers and intelligent systems is likely to deepen supporting the hypothesis that 'AI will become the indispensable tool in planting design'. The current situation shows that it has not yet developed sufficiently and cannot replace expert opinion.

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BÖLÜM 5

LAND SURFACE TEMPERATURE AND EVAPOTRANSPIRATION IN LANDSCAPE ARCHITECTURE

1. HAKAN OĞUZ[1]

Introduction

Climate change, rapid urbanization, and land-use intensification have profoundly altered surface energy and water balance processes across urban and rural landscapes (Oke, 1982; Seto et al., 2012; Santamouris, 2015; Tuğluer, 2022). The replacement of natural and semi-natural surfaces with impervious materials has led to increased surface temperatures, reduced evapotranspiration rates, and heightened thermal stress, particularly in metropolitan regions (Chen et al., 2006; Li et al., 2017). These dynamics are commonly expressed through the Urban Heat Island (UHI) phenomenon, which poses significant risks to human health, ecological integrity, and urban livability (Santamouris, 2015).

Landscape architecture, as a discipline concerned with the planning, design, and management of land-based systems, is uniquely positioned to address these challenges. Through the

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strategic integration of vegetation, water, and landform, landscape architects directly influence surface–atmosphere interactions and contribute to climate regulation and ecosystem service provision (Bonan, 2008; Turner, 2005). In this context, Land Surface Temperature (LST) and Evapotranspiration (ET) emerge as critical indicators for evaluating the environmental performance of landscapes (Weng, 2009; Anderson et al., 2012).

Unlike conventional air temperature measurements, LST captures the thermal behavior of actual surface materials, while ET reflects the capacity of landscapes to dissipate heat through latent energy fluxes (Oke, 1982; Miralles et al., 2011). When combined with vegetation indices such as the Normalized Difference Vegetation Index (NDVI), these indicators support better landscape planning, design, and management. (Çakır et al., 2022; Zhou et al., 2014; Zhang et al., 2017).

Theoretical Background

Land Surface Temperature in Landscape Systems

Land Surface Temperature (LST) represents the radiative skin temperature of the Earth's surface and constitutes a fundamental variable in urban climate and land surface studies (Oke, 1982; Weng, 2009). Unlike air temperature, which is typically measured at standardized heights under controlled conditions, LST directly reflects the thermal behavior of surface materials such as vegetation, soil, water bodies, and built structures. As a result, LST exhibits strong spatial heterogeneity, particularly in landscapes characterized by complex land cover mosaics.

In landscape systems, LST is shaped by surface albedo, emissivity, moisture availability, vegetation structure, and solar exposure. Impervious surfaces such as asphalt, concrete, and rooftops generally absorb and store large amounts of heat, resulting in elevated LST values (Chen et al., 2006; Buyantuyev & Wu, 2010).

In contrast, vegetated surfaces dissipate heat through shading and evapotranspiration, leading to lower surface temperatures. These contrasts make LST a powerful indicator for identifying thermal hotspots and evaluating the climatic performance of different landscape configurations.

From a landscape architecture perspective, LST should be interpreted not merely as a descriptive climatic parameter, but as an indicator that shows how planning and design decisions perform. Spatial patterns of LST can reveal the thermal consequences of land use change, fragmentation of green spaces, and material choices in the built environment. Consequently, LST mapping supports evidence-based approaches to climate sensitive landscape planning and design.

Evapotranspiration as an Ecosystem Service

Evapotranspiration (ET) refers to the combined processes of evaporation from soil and water surfaces and transpiration from vegetation (Allen et al., 1998; Miralles et al., 2011). It represents a key mechanism through which landscapes regulate surface energy balance by converting sensible heat into latent heat. ET is therefore closely linked to microclimate regulation, thermal comfort, and ecosystem resilience.

In ecological and landscape planning literature, ET is increasingly conceptualized as a regulating ecosystem service. Landscapes with high ET capacity such as forests, wetlands, riparian corridors, and irrigated urban green spaces provide significant cooling benefits and contribute to local and regional climate moderation. In contrast, landscapes with low evapotranspiration tend to increase heat stress and worsen urban heat island effects.

For landscape architecture, ET offers a functional lens through which the performance of green infrastructure and vegetation-based design strategies can be evaluated. Incorporating

ET considerations into planning and design enables the development of water-sensitive and climate-adaptive landscapes, particularly in regions facing increasing water scarcity and climatic extremes.

Remote Sensing and GIS-Based Methods

Remote Sensing Data Sources

Remote sensing technologies constitute the primary data source for spatially explicit analyses of Land Surface Temperature and Evapotranspiration. Medium resolution satellite systems, including the Landsat series, MODIS, and Sentinel platforms, have been widely employed in urban climate and landscape studies due to their spectral capabilities, temporal continuity, and open-access data policies (Weng, 2009; Miralles et al., 2011; Oguz, 2017; Oguz, 2018; Oguz, 2020a; Oguz, 2020b; Oguz, 2022a; Oguz, 2022b; Oğuz & Tuğluer, 2022). Landsat missions, in particular, provide a long-term archive with spatial resolutions suitable for landscape-scale assessments, making them highly relevant for evaluating the thermal performance of urban green spaces, land-cover change, and landscape configuration (Chen et al., 2006; Zhou et al., 2011).

MODIS data, despite their coarser spatial resolution, offer high temporal frequency, enabling the monitoring of seasonal and interannual evapotranspiration dynamics across large regions (Anderson et al., 2012; Miralles et al., 2011). Sentinel-2 and Sentinel-3 missions further complement these datasets by providing improved spectral resolution and revisit times, supporting integrated analyses of vegetation condition, surface temperature, and land–atmosphere interactions (Li et al., 2017).

Land Surface Temperature Retrieval Techniques

Several algorithms have been developed to retrieve LST from thermal infrared satellite data, including the Single Channel, Split Window, and Radiative Transfer Equation approaches. The selection of an appropriate method depends on sensor characteristics, atmospheric conditions, and data availability (Weng, 2009; Sekertekin et al., 2016). Automated and semi-automated LST retrieval workflows based on Landsat 8 imagery have been widely applied in urban environments, demonstrating robust performance across different climatic regions (Oguz, 2016; Oguz, 2018; Oguz, 2020a; Oguz, 2022a).

Accurate LST estimation requires careful correction for atmospheric effects and precise determination of surface emissivity, which varies significantly across land cover types. Vegetated surfaces generally exhibit higher emissivity values than built-up areas, contributing to lower retrieved LST values and reinforcing the importance of land cover classification in thermal analyses (Buyantuyev & Wu, 2010; Zhou et al., 2014). From a landscape architecture perspective, these methodological considerations are essential for ensuring that LST maps accurately reflect the thermal consequences of design and planning decisions.

Evapotranspiration Estimation Models

Evapotranspiration is commonly estimated using surface energy balance models that resolve net radiation, soil heat flux, and sensible heat flux components. Widely applied models include SEBAL (Surface Energy Balance Algorithm for Land), METRIC (Mapping Evapotranspiration at High Resolution with Internalized Calibration), and SEBS (Surface Energy Balance System) (Allen et al., 1998; Anderson et al., 2012). These models enable spatially explicit estimation of actual ET across heterogeneous landscapes and have been extensively validated in agricultural, urban, and semi-natural environments.

Recent applications in Türkiye have demonstrated the effectiveness of Landsat-based ET retrieval for monitoring spatio-temporal changes in water consumption and cooling capacity in urban and peri-urban landscapes, particularly in Adana (Oguz, 2020b; Oguz, 2022b). GIS-based integration of ET outputs with land use, vegetation, and planning data supports multi-scale analyses that inform irrigation management, green infrastructure planning, and climate-adaptive landscape design (Jenerette et al., 2011; Zhang et al., 2017).

Relationships between NDVI, LST, and ET in Landscape Architecture

The relationships between vegetation cover, land surface temperature, and evapotranspiration constitute a central analytical framework for climate-responsive landscape architecture. Among vegetation indicators, the Normalized Difference Vegetation Index (NDVI) has been widely used as a proxy for vegetation density, vigor, and photosynthetic activity. Numerous empirical studies demonstrate a strong inverse relationship between NDVI and LST, alongside a positive relationship between NDVI and ET, highlighting the cooling role of vegetation across different landscape contexts.

At a fundamental level, higher NDVI values generally correspond to increased canopy cover, enhanced shading, and greater transpiration capacity, all of which contribute to reduced surface temperatures. Conversely, low NDVI values are typically associated with impervious surfaces, sparse vegetation, and degraded landscapes, where sensible heat flux dominates energy exchange processes, resulting in elevated LST. However, the strength and spatial expression of NDVI/LST/ET relationships vary considerably depending on climatic conditions, vegetation type, and landscape configuration.

In humid and temperate climates, dense tree canopies often produce pronounced cooling effects, with ET playing a dominant role in regulating surface temperatures. In semi-arid and arid regions, by contrast, the relationship between NDVI and ET is strongly mediated by water availability. Under water-limited conditions, vegetation may exhibit high NDVI values but relatively constrained ET rates, reducing its cooling effectiveness. These dynamics underscore the importance of interpretations of NDVI/LST/ET interactions in landscape planning and design.

From a landscape architecture perspective, NDVI/LST/ET analyses provide a quantitative basis for evaluating design scenarios and management strategies. For example, increasing vegetation cover alone may not guarantee effective thermal mitigation if plant species are poorly adapted to local climatic and hydrological conditions. Tree canopy structure, leaf area index, rooting depth, and irrigation regimes all influence ET capacity and, consequently, landscape cooling performance. Recent empirical evidence strengthens this argument by demonstrating that species-level ecological tolerance plays a decisive role in the cooling performance of planted landscapes. Field studies conducted in humid and semi-humid urban parks show that many commonly used taxa exhibit low resilience to key ecological stressors such as wind, salinity, heat, and drought. Selecting species with insufficient ecological tolerance reduces evapotranspiration capacity and weakens the thermal effectiveness of green spaces, whereas resilient native and well-adapted taxa contribute to more stable microclimatic cooling under changing environmental conditions (Ekren et al., 2024).

Furthermore, spatial configuration plays a critical role. Fragmented green spaces may exhibit high NDVI values locally but fail to generate meaningful cooling at the neighborhood or city scale. In contrast, contiguous green corridors and large urban parks often produce extended cooling footprints, as reflected in both LST and ET patterns. These insights reinforce the relevance of landscape connectivity, patch size, and spatial hierarchy in climate-responsive landscape architecture.

International and Turkish Case Studies

Istanbul Metropolitan Area

The Istanbul metropolitan region provides a representative example of a rapidly urbanizing landscape characterized by pronounced thermal heterogeneity. Remote sensing–based LST analyses consistently reveal high surface temperatures in dense residential, industrial, and transportation corridors, while significantly lower LST values are observed in forested areas, coastal zones, and large urban green spaces (Yilmaz et al., 2007; Sekertekin et al., 2016; Oguz, 2017; Oguz, 2018; Oguz, 2020a). Multi-temporal analyses based on Landsat imagery demonstrate that the spatial extent and intensity of high-LST zones have expanded over recent decades, closely associated with urban growth patterns (Oguz, 2022a).

NDVI and ET based assessments further highlight the cooling role of extensive vegetation cover, particularly in the Belgrad Forest and along the Bosphorus corridor (Guneroglu et al., 2018). From a landscape architecture perspective, these findings emphasize the strategic importance of preserving large, contiguous green infrastructures and strengthening ecological connectivity. LST/ET analyses also provide evidence to support planning decisions aimed at limiting urban sprawl and protecting peri-urban forest systems that function as regional climate regulators.

Ankara: A Semi-Arid Urban Context

Ankara represents a contrasting case characterized by a semi-arid climate and limited water resources. LST patterns indicate substantial thermal contrasts between built-up areas and vegetated spaces such as parks, university campuses, and institutional grounds (Erdogan et al., 2015; Karakose et al., 2020). Although fewer long-term ET studies exist for Ankara compared to coastal cities, methodological approaches developed for other semi-arid Turkish cities provide valuable insights into vegetation-driven cooling mechanisms and water-use efficiency (Oguz, 2020b; Oguz, 2022b).

For landscape architects, the Ankara case underscores the necessity of integrating drought-tolerant planting strategies, soil moisture conservation techniques, and water-sensitive design principles. LST/ET analyses suggest that even modest increases in vegetation cover can generate meaningful cooling benefits when combined with appropriate species selection and management practices.

Central Park, New York

Central Park is frequently cited as a paradigmatic example of an urban green space functioning as a thermal refuge within a dense metropolitan fabric. Empirical studies based on Landsat derived LST data demonstrate that Central Park exhibits significantly lower surface temperatures compared to surrounding built-up areas, with cooling effects extending beyond park boundaries (Rosenzweig et al., 2006; Zhou et al., 2011). Similar methodological frameworks have been successfully applied in Turkish and international case studies, enabling comparative assessments of urban green space cooling performance across different climatic contexts (Oguz, 2028; Oguz, 2022a).

This case illustrates the capacity of large-scale landscape interventions to influence urban microclimates beyond their immediate boundaries and highlights the long-term climatic value of investing in multifunctional urban green spaces.

Singapore

Singapore offers an instructive example of climate-responsive landscape planning in a tropical context. Despite high ambient temperatures and humidity, extensive green infrastructure including urban parks, green roofs, and vertical greenery systems that contributes to moderated LST patterns across the city-state

(Roth et al., 2017; He et al., 2019). Elevated ET rates associated with dense vegetation play a central role in dissipating heat, particularly in highly urbanized districts.

From a landscape architecture standpoint, Singapore highlights the potential of integrating vegetation into all spatial levels of the urban fabric and reinforces the role of landscape design in urban climate adaptation strategies.

Mediterranean Cities: Barcelona

In Mediterranean cities such as Barcelona, LST and ET exhibit strong seasonal variability, with pronounced thermal stress during summer months. Remote sensing studies indicate that urban green spaces and tree-lined streets provide critical cooling services despite water scarcity constraints (Moreno-Garcia, 1994; Buyantuyev & Wu, 2010; Vaz Monteiro et al., 2016). LST/ET analyses reveal that strategically located parks and green corridors play a key role in mitigating heat stress.

This case emphasizes the importance of adaptive planting design, efficient irrigation systems, and landscape management practices tailored to Mediterranean climatic conditions.

Applications across Planning, Design, and Management Scales

In response to rising urban surface heat and environmental pressures, multiple case studies have shown that cities integrate different green infrastructure strategies in various forms and scales such as urban forests, green corridors, community gardens, pocket parks, bioswales, permeable surfaces, and restored vacant lots (Kordon, 2024a; Tan & Kordon, 2024). At the planning scale, LST and ET maps inform climate-sensitive land use decisions and the allocation and configuration of these green infrastructure networks. At the design scale, these indicators guide vegetation selection, spatial configuration, and material choices. At the management scale, ET-based assessments support efficient irrigation and maintenance strategies for these systems.

Integration into Landscape Policies and Climate Adaptation Strategies

LST and ET indicators can be incorporated into landscape policies, urban climate action plans, and environmental impact assessments. By translating thermal and hydrological data into spatial decision-support tools, landscape architecture contributes directly to climate adaptation and mitigation strategies. However, policy effectiveness is strongly shaped not only by technical evidence but also by public acceptance, user experience, and the perceived benefits of landscape interventions. Studies have shown that community attitudes toward green spaces significantly influence the long-term success, maintenance, and political support for climate-adaptive projects, highlighting the need for policies that integrate both biophysical metrics and social perception frameworks (Kordon et al., 2022).

In addition to generic climate policy frameworks, national climate legislation can explicitly define how spatial planning and landscape-based interventions contribute to mitigation and adaptation targets. In the Turkish context, the recently adopted Climate Law No. 7552 establishes a comprehensive legal framework that links net-zero ambitions, carbon sinks, ecosystem-based adaptation and nature-based solutions to planning and implementation instruments. A textual analysis of this law from the perspective of landscape architecture demonstrates that green infrastructure, climate-resilient open space design and multi-scalar governance mechanisms are formally recognized as key components of climate action, thereby positioning landscape architects as strategic actors and LST and ET maps are critical indicators in delivering national climate goals (Ekren & Kordon, 2025).

Scientific and Professional Contributions to Landscape Architecture

The integration of LST and ET into landscape architecture strengthens evidence-based practice and enhances the discipline's capacity to address climate-related challenges. These indicators provide measurable links between landscape form, function, and environmental performance.

Future Research Directions

Future research should focus on high-resolution remote sensing, UAV-based thermal mapping, machine learning approaches, and long-term monitoring frameworks. Interdisciplinary collaboration will be essential to fully realize the potential of LST/ET-based methods in landscape architecture. In addition, future studies should integrate human-centered dimensions into microclimate-based mapping approaches. While LST and ET provide essential information on the physical performance of landscapes, planning and design strategies can only be fully effective when combined with spatial data on landscape perception, user satisfaction, and patterns of public activity. Evidence shows that people tend to use spaces where they hold positive perceptions and avoid those perceived as uncomfortable, unsafe, or thermally stressful (Kordon, 2024b; Kordon & Miller, 2023; Kordon et al., 2022). Although such perceptual indicators cannot yet be directly embedded into LST or ET datasets, developing socio-ecological mapping frameworks that overlay thermal metrics with perception- and behavior-based layers would enable more holistic and human-responsive decision-making in urban landscapes.

Conclusion

Land Surface Temperature and Evapotranspiration analyses provide powerful and complementary tools for understanding and improving the environmental performance of landscapes. When integrated into landscape architecture, these indicators enable evidence-based approaches to climate-responsive planning, design, and management. By linking spatial patterns of temperature, vegetation, and water use, LST/ET-based assessments support the creation of resilient, adaptive, and sustainable landscapes across diverse climatic and cultural contexts.

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GEÇİCİ KAPAK

Kapak tasarımı devam ediyor.