NATURAL MATERIALS FOR LANDSCAPE ARCHITECTS IN TIMES OF CLIMATIC HAZARD












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1. INTRODUCTION

Contemporary approaches to material selection in landscape architecture are visibly different. Scientists and designers advocate a return to native vegetation and natural materials (Meiyuan, 2014; Ahmed & Aly, 2023). These approaches are more readily accepted when they serve to denaturalize and restore ecosystems, where, for obvious reasons, native plants and natural building materials are used. However, in the case of gardens and urban green spaces, where the “decorativeness” expected by investors seems at odds with contemporary, naturalistic concepts, this is less straightforward.

Looking at plantings designed by laypeople, designers are often incensed that the plant selection is haphazard, the design concept is inconsistent with style and composition, and the arrangements are based on simple contrasts of form and color. Users, however, have their own, established opinions on the matter, basing their taste on deeply ingrained beliefs and mental barriers. A lack of understanding leads to poor choices, and, with them, the degradation of the landscape, not only in terms of its image and, consequently, spatial order, but also in conflict between project stakeholders.

The problem becomes even more serious when designers themselves are unsure whether to use “traditional” plant types and species or embrace new “ecological” concepts. Should they opt for more durable, contemporary building materials, traditional or locally sourced materials from the landscape, or recycled materials? Which to choose and when? Comparing the eternal opposition of nature and culture in the environment would be an oversimplification, and the visible global climate change does not make the decision any easier, introducing additional variables and difficulties. It is increasingly difficult to draw on one’s own traditions; we must look elsewhere for models.

The idea for this handbook arose from a desire to evoke both the history of garden art and the tradition of using materials and plants that build the identity of a place, often with symbolic meaning (Kandeler & Ullrich, 2008), as well as contemporary solutions that reference “nature” understood in a new way (Clément, 2004; Rostański, 2012). We undertook this task to highlight the coherence of the semantic layer of composition and material selection in landscape architecture, and to raise discussion of the necessary changes in thinking about materials and plants in the era of global climate change.

We decided to refer to good practices to better understand the problems related to the climate crisis across different regions of the world.

This book features a series of chapters on traditions and contemporary best practices, as well as plant selection for landscape projects in Poland, the Czech Republic, Indonesia, Peru, Iceland, and Lebanon. They aim to demonstrate the similarities and differences in plant design across various climate zones – temperate, Mediterranean, equatorial, subarctic, and tropical.

The chapters presented in this handbook are preceded by a bit of theory, an introduction to the concept of material selection in the history of garden art, traditions in composing plant cover and modern trends based on this tradition – post-environmentality (Certomà, 2016) and post-gardenizm, as well as the models of first, second, third, fourth and fifth nature, as a representation of structural changes, as well as changes in the perception of the natural layer of the cultural landscape (Kowarik, 2011).

This book will be useful to students of landscape architecture, architecture, and related fields. It can also be valuable for existing designers seeking a quick introduction to historical and contemporary concepts.

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2. DESIGNING VEGETATION IN THE POST-HUMANIST ERA OF RELATIONAL SUBJECTIVITY: POST-ENVIRONMENTALISM AND RELATED THEORIES

What is this chapter about:
This chapter introduces the contemporary understanding of vegetation as a key element of the language of landscape. It demonstrates how the concept of vegetation conveys cultural meanings and reflects the relationships between humans and the environment. It also discusses changes in the approach to green space design in the Anthropocene era, the role of residents in shaping spaces, and the significance of community gardens and post-gardening.

What will you learn:

- You will recognize the landscape as a language of signs. You will notice elements of the cultural landscape – buildings, gardens, parks, and plant arrangements – and attempt to interpret them as signs carrying social and cultural meanings.
- You will understand contemporary approaches to the relationship between humans and the environment.
- You will learn about shifts in thinking about nature and plants – from treating them objectively as a resource to their empowerment through post-humanist concepts of a multi-agent landscape.
- You will analyze the role of residents in shaping the city.
- You will learn what the “game of the city” entails and how various actors – authorities, investors, designers, and residents – influence the use of urban space.
- You will explore the concept of post-gardening and new trends in landscape design.
- You will understand how contemporary green space design utilizes ecological processes, plant succession, and community engagement, treating the garden as a dynamic system co-created by humans and the environment.

2.1. INTRODUCTION

Have you ever wondered why it takes only a fraction of a second to determine whether you are looking at a garden, a park, or another green space? At a glance, you can tell if plants were planted by human hands, and with a little practice – who or what group of people did it and what message were they trying to convey?

The cultural landscape, as the result of human adaptation to space through habitation, is treated as a language (Gawryszewska, 2013), while its elements are read and interpreted as a semantic code (Spirn, 1998). Semantic means relating to meaning. A semantic code is a set of rules through which we understand the meaning of signs. The elements visible in the landscape (e.g., residential houses and other buildings, the layout of fields, tree-lined avenues, parks, and gardens) are treated as signs or sets of signs – carriers of meaning. Gardens and green spaces in the city and beyond, and their significance as signs in the language of the cultural landscape, are distinguished by perceiving plants – not only their individual species and types, but also how they have been combined – arranged into compositions by the owner or gardener, or into what communities nature has assembled them.

In the past, nature was treated as a finite primary resource that had to be managed rationally to avoid catastrophe, in accordance with the two-century-old but still popular Malthusian concept – so-called static theory of resources (Malthus, 1798). The values it represented were unambiguous and essential for future generations. Alongside a layer of meanings that remains relevant, a new layer has emerged in the present day. In our post-Malthusian world, the environment – described as a new geological epoch, the Anthropocene – represents both the potential for further development and a source of knowledge derived not only from the laws of nature but also from the specific ways humans utilize it. This shift in approach has implications for every landscape architecture project and its vegetation design.

2.2. THE POST-ENVIRONMENTAL LANDSCAPE FROM A SEMIOTIC PERSPECTIVE

In his essay “The politics of nature,” Bruno Latour writes about human and non-human actors in space, ultimately breaking with anthropocentrism and heralding the dawn of the post-humanist era (Latour, 2009). The equivalence of human and non-human subjects postulated by post-humanists allows us to view the contemporary cultural landscape – and with it, parks and gardens – from a multi-subject perspective. How should we understand multi-subjectivity in a garden built for humans, where plants – as objects – seem to play a subordinate role? Subjective relativism states that there is no single objective perspective

on the world. Reality, however, is perceived differently by various subjects. Reality – and thus what surrounds us and what we perceive through our senses – is created by many different subjects, not just by humans.

Post-humanist subjective relativism means that:

- the world has no single privileged human perspective,
- different beings (humans, animals, plants) have their own ways of "experiencing" and co-creating reality,
- knowledge of the world is always relational and multi-perspectival.

Contemporary approaches to landscape and the environment stem from a post-humanist perspective. Concepts such as the so-called working landscape (Cannavò, 2007), which reconciles exploitation with landscape conservation by integrating its social and ecological functions, or the so-called engaged landscape (Berleant, 2014), which posits a sense of continuity with the surroundings that accompanies humans in their everyday aesthetic experience, are transforming the existing perception of the landscape's functions. It is treated both as a tool and as a stage for mutual relations. All of this contributes to a post-environmental backdrop that would not be possible without theoretical reflection on the condition of the contemporary world.

Today, nature is no longer merely a basic element or foundation of the landscape architect's work that must be monitored and protected. Plants are not "colors on the designer's palette." Nature is becoming an essential component of social dialogue, a platform for participatory democracy, and the basis for spatial policies. In the post-environmental approach, landscape contributes to the development of new technological and social tools for universalist planning, shaping living spaces as areas of collective debate on the quality of the environment in its broadest sense – healthy, beautiful, and rationally shaped – while properly identifying and protecting its resources (Certomà, 2016). The departure from the earlier concept of landscape as an object of protection means that post-environmental theories favor creative user attitudes that harness the potential of the Anthropocene through new, "clean" technologies.

2.3. LANDSCAPE PLURALISM REQUIRES DIVERSE PERSPECTIVES: LANDSCAPE CROWDSOURCING

The multidimensionality of landscape necessitates an interdisciplinary approach. Philosophy, environmental psychology, sociology, geography, art, landscape architecture, architecture, and urban planning analyze its various aspects,

combining the abstract and material dimensions. Just as there are many landscapes and many ways of perceiving them, a multifaceted approach allows us to discern more levels, themes, and specific characteristics, facilitating an understanding of its structure and meaning. This is not an approach intended solely for academic research – interdisciplinarity broadens the range of research tools and enables a more complete picture of the space inhabited and shaped by humans.

Dynamic changes in the landscape compel researchers to seek new analytical tools, leading to the formation of interdisciplinary teams that also include residents. The concept of the "invisible city" suggests that residents are not merely users of space but its co-creators, transforming and negotiating its forms through everyday practices. From this perspective, the planting plan is no longer a closed compositional design but becomes a relational process, co-shaped by both human and nonhuman actors (Krajewski, 2013). In the post-environmental approach, the collaboration between residents and researchers constitutes a vital resource, strengthened through networking (Certomà, 2016). Therefore, the image of the contemporary city is increasingly that of a community garden – that is, vegetable and herb beds, fruit trees, and fruit-bearing shrubs.

2.4. THE GAME OF THE CITY

The game of the city refers to a process in which various actors – local authorities, investors, designers, residents, civic organizations, and public institutions – participate in negotiating how urban space is used. Each of these actors has different resources, interests, and strategies, which is why the city's form emerges from a constant interplay of cooperation, conflict, and compromise.

In this sense, the city is not merely a physical urban structure, but an arena of social and political processes where different visions of development, models of space use, and ideas about what a good urban environment should be clash. The game for the city encompasses both formal mechanisms of spatial planning and investment decision-making, as well as grassroots actions by residents, urban movements, or social initiatives that seek to influence the shaping of space. Understood in this way, the game for the city finds its theoretical foundations in several important currents of contemporary reflection on the city.

First, it draws on Henri Lefebvre's concept of the right to the city, according to which urban space is a product of social relations, and residents should have the opportunity to co-decide on how it is used and transformed (Lefebvre, 1968). In this view, the city becomes a battleground over access to space, resources, and opportunities to participate in decision-making.

Second, this concept can be linked to David Harvey's (2008) analysis, which shows that urbanization processes are closely tied to the logic of capitalist accumulation. Urban space then becomes the object of investment and

speculation, and conflicts over its use stem from the tension between economic interests and social needs.

Third, the game for the city corresponds to the concept of the so-called growth machine formulated by Harvey Molotch (1976), according to which urban development is largely driven by coalitions of local elites – landowners, investors, and public institutions – interested in increasing property values and intensifying investment. In this context, urban space becomes the subject of negotiation and conflict among various interest groups.

In the context of landscape architecture, the game for the city is particularly evident in the case of community gardens, which often emerge from grassroots initiatives by residents and serve as examples of alternative ways of using urban space. These gardens are not merely a form of green space development but also a social and political practice in which residents negotiate their right to co-create urban space. They often emerge on unused or temporarily abandoned sites, such as post-industrial plots, undeveloped lots, or spaces between apartment blocks, which are viewed as potential development resources in investment processes.

In this sense, community gardens become part of a broader “battle for the city,” as they reveal tensions between different visions for the use of space. On the one hand, there are grassroots initiatives by residents who treat the garden as a communal space, a place for social integration, environmental education, and local food production. On the other hand, the same areas may be viewed by municipal authorities or developers as land reserves earmarked for future development or commercial projects. Researchers emphasize that community gardens can also serve as microscale laboratories of urban democracy, where residents learn to co-manage space, build social relationships, and develop practices of environmental stewardship (Barthel et al., 2015).

At the same time, their presence within the urban fabric can be seen as a reimagining of the landscape that transcends the traditional model of the garden as a fully designed, controlled space subordinated to compositional aesthetics. In a post-garden framework, the garden ceases to be a closed cultural form and becomes a dynamic system of relationships between design, ecological processes, and spontaneous vegetation succession.

2.5. POST-GARDENING

Post-gardening signifies a shift in emphasis from composition to process, from control to coexistence, and from an anthropocentric model of shaping space to an approach that accounts for the agency of the environment. In such landscapes, design does not consist of completely shaping form, but rather of initiating and moderating natural processes that co-create space alongside human actions.

> Post-gardening is an approach to landscape in which the garden ceases to be a fully controlled composition and becomes a space co-created by natural processes.
>
> From a post-gardening perspective, the garden ceases to be a closed cultural form and becomes a dynamic system of relationships among design, ecological processes, and spontaneous vegetation succession. This signifies a shift in emphasis from composition to process, from control to coexistence, and from an anthropocentric model of shaping space to an approach that accounts for the agency of the environment (Corner, 1999; Waldheim, 2016).

Post-gardening denotes an approach to landscape design in which the traditional idea of the garden as a closed, fully controlled composition is replaced by an understanding of space as a dynamic system of relationships between human action and ecological processes. In this view, the designed landscape is not merely the result of formal composition, but the outcome of the interplay between design, spontaneous vegetation succession, and long-term environmental processes.

Classical gardening refers to a space designed by humans, aesthetically ordered, maintained, and controlled; separated by a fence from “wild” nature. Here, the garden serves as a model of the relationship between humans and nature, in which humans are the stewards and designers. The prefix “post-” does not mean “after the garden,” but rather “beyond the traditional model of the garden.” In other words, green spaces no longer need to be entirely designed, fully controlled, and aesthetically “perfect.” Post-gardening describes spaces where the design “collaborates” with natural processes, nature has greater autonomy, spontaneous vegetation emerges, and the aesthetics are more “ecological” than ornamental.

These are often hybrid landscapes – somewhere between a garden and nature. In such places, the design does not rely on complete control, but on initiating ecological processes. Contemporary design practice has developed several trends that can be seen as manifestations of this understanding of post-gardening.

Naturalistic design is based on imitating the structures and dynamics of plant communities found in nature. Here, garden composition is not understood as a static arrangement of forms, but as a process that evolves over time. Plants are

selected primarily based on their ecological relationships, ability to coexist, and resilience to changing environmental conditions. In this context, the design does not aim to maintain a static image of the garden, but rather to initiate a system that will evolve alongside succession processes and the seasonal dynamics of plants. This approach is developed in both theory and design practice, including in the works of Piet Oudolf, Noel Kingsbury, and Nigel Dunnett (Dunnett & Kingsbury, 2004; Kingsbury & Oudolf, 2013).

Ecological design shifts the focus from compositional aesthetics to the functioning of natural systems. Here, the landscape is treated as a network of hydrological, soil, and biological connections, and the task of design is to support these processes and restore ecosystems' capacity for self-regulation. In this approach, a garden or park becomes part of the city's broader ecological infrastructure, serving functions such as water retention, increasing biodiversity, and mitigating the effects of climate change. The foundations of this approach were laid out in Ian McHarg's seminal work "Design with nature" (McHarg, 1969).

Successional (process-oriented) design assumes that the shape of a space emerges from long-term ecological processes rather than a single compositional act. The designer establishes specific environmental conditions that enable the development of spontaneous vegetation and natural succession. As a result, the landscape emerges as a dynamic structure in which the relationship between design and nature is open-ended and fluid, and the final form of the space remains partially unpredictable. This approach has developed particularly clearly in the design of post-industrial landscapes, as exemplified by the works of Peter Latz, in which natural succession processes become an integral element of the landscape composition (Latz, 2001).

Regenerative design focuses on restoring the landscape's capacity to reproduce ecological processes and on restoring degraded environments. It is particularly important in post-industrial and degraded landscapes, where the design initiates processes of biological and social renewal. In this context, the designed space is not merely an aesthetic form but becomes a medium for long-term environmental regeneration, supporting both the functioning of ecosystems and the well-being of human communities. Contemporary regenerative approaches are being developed, among other things, within the framework of landscape urbanism, which emphasizes the importance of landscape processes as the foundation for shaping contemporary cities (Corner, 1999; Waldheim, 2016).

All these trends share a departure from the classical idea of the garden as a closed composition in favor of landscape understood as a dynamic system of ecological and cultural processes, co-created by human activity and the environment.

Review questions:

1. Why can the cultural landscape be treated as a language of signs? Explain how landscape elements (e.g., gardens, parks, plant arrangements) convey cultural meanings.
2. What is the post-humanist approach to landscape? Explain what subjective relativism is and what significance it has for the perception of the concept of vegetation.
3. What does the term “game for the city” mean? Identify which groups of actors participate in this process and what interests they may represent.
4. Why can community gardens be viewed as an example of the realization of the “right to the city”? Explain their social and spatial significance.
5. What is post-gardening, and how does it influence contemporary vegetation design? Identify the differences between the traditional approach to the garden and the post-gardening approach.

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3. PLANTS IN THE HISTORY OF GARDEN ART

What is this chapter about:
Plants are a fundamental element of garden design, regardless of era or style. The art of gardening dates back to ancient times, when gardens served not only practical purposes but were also places of relaxation and entertainment for rulers. Understanding the history of garden art allows us to discover specific compositional principles used in different eras (their diversity and evolution). Studying the history of gardens also reveals how to select typical plants, explains the ideological and symbolic meanings of garden elements, and provides insight into the social conditions that shaped the design and content of historical gardens. Understanding the legacy of past creators (and the history of garden art) helps us effectively address problems arising from contemporary challenges, such as those related to climate change.

What will you learn:
In this chapter, you will learn what criteria guided the selection of plants for ornamental gardens in Europe and how garden designers adapted to conditions in places where the climate differed significantly from that of the “birthplace” of a given style. You will also learn about the routes along which plants traveled to please owners in other parts of the world. Why? Who imported them? Moreover, where were they sought out? The composition of a garden (or park) – its species composition, the building materials used, the form and “density” of architectural elements, its functions, and aesthetics – reflects, among other things, the time of its creation, the social status and financial resources of the founder, and the prestige of the site. Often, in the garden’s composition – for example, in its symbolism and the selection of elements and architectural details – the influence of the creator’s worldview – the prevailing philosophies and religions – is evident.

3.1. INTRODUCTION

What makes gardens extraordinary works of art stems primarily from the physiognomic variability and "nature" of the main material – the living building blocks – plants. Their seasonal variability, the transience inherent in the life cycle – birth, growth, maturity, and death – combined with the variability of weather and geographical conditions (topography, climate, natural water bodies and watercourses, etc.), creates a unique work, a fusion of nature and culture. All of the above-mentioned distinguishing features of garden art were outlined in the so-called Florence Charter, approved in 1981 by the International Committee of ICOMOS-IFLA. The Charter, often referred to as the Charter of Historic Gardens, serves as the basis for action and a framework for the conservation of historic gardens and parks. It should be emphasized that gardens can exist as long as people care for and maintain them. This is an absolute prerequisite for the existence of any garden. In this context, the main function, the time of establishment (style) and the character of the garden cease to be important.

Excerpts from the Florence Charter – Articles 1–5

The ICOMOS-IFLA International Committee on Historic Gardens, meeting in Florence on 21 May 1981, decided to draw up a charter on the conservation of historic gardens, to be named after that city. This Florence Charter was drawn up by the Committee and registered by ICOMOS on 15 December 1982 as an addendum to the Venice Charter, covering this specific field.

Article 1. "A historic garden is an architectural and horticultural composition which, from a historical or artistic point of view, is of public interest." As such, it should be treated as a monument.

Article 2. "A historic garden is an architectural composition whose constituent elements are primarily plant-based, and therefore living, which means that they are impermanent and renewable." In this way, its appearance reflects a constant balance between the cycle of the seasons, the growth and decay of nature, and the desire of the artist and craftsman to preserve it forever unchanged.

Article 3. As a monument, the historic garden must be preserved in accordance with the spirit of the Venice Charter. However, as it is a living monument, its preservation must be subject to specific principles, which are the subject of this charter.

Article 4. The architectural composition of a historic garden comprises: • Its layout and topography. • Its vegetation, including species, proportions, color scheme, spacing, and appropriate heights. • Its structural and decorative elements. • It’s water, whether flowing or still, reflecting the sky.

Article 5. As an expression of the direct kinship between civilization and nature, and as a place of pleasure conducive to meditation or rest, the garden thus takes on the cosmic significance of an idealized image of the world, a “paradise” in the etymological sense of the word, whilst at the same time bearing witness to a culture, a style, an era, and often also to the originality of the creative artist.

A garden, due to its fundamental plant material, is an extremely delicate and ephemeral creation. Any attempts to “stop time” or maintain the garden composition in its full, mature form are by definition ineffective, and the maintenance measures undertaken (including conservation work) can only serve to slow down the process.

Among the many gardens and parks, we can distinguish those created in geometric styles, which were therefore heavily shaped by human hands and which require particular regularity in their maintenance. It can be assumed that the more a garden is a creation of human hands, the more difficult decisions its owners have to make to keep it in good condition. More distinctive forms require decisive and often radical measures, including, for example, restoration work to return them to their original form. Individual plants that make up the distinctive forms of the garden’s composition take a back seat in this case. Adherence to strict compositional rules, the compositional and aesthetic effect of the entire layout become priorities, whilst the original historic elements (most often trees) may be preserved in specific sections of the garden’s form as “witnesses to history”.

3.2. BETWEEN THE KITCHEN GARDEN AND THE ORNAMENTAL GARDEN: THE BIRTH OF GARDEN ART

The need to create gardens has always been based on two seemingly contradictory objectives – **meeting basic life needs** (food and medicinal resources) – utilitarian aims, and **satisfying aesthetic** and recreational needs, for which we create ornamental gardens. These objectives are, however, inseparable, as can be demonstrated by analyzing both **species composition** (here one should note the variability of the dominant characteristics of individual plants – depending on the context and state of knowledge – the same plants may be viewed through the prism of their aesthetic as well as utilitarian qualities), and by considering **the "usefulness" of a garden composition** in relation to the philosophy and definition of beauty. One of the parameters of beauty is "appropriateness" [decorum] – understood as the **conformity of an object's form** (here, the garden) **to its purpose** (function, composition, and aesthetics). It is also the relationship that the creator of the object establishes with its spatial context (this relationship should be "appropriate", i.e., harmonious, and should not detract from the site's pre-existing values).

In view of the above, a key aspect of analyzing any garden – alongside identifying its constituent elements, their composition and relationship with the surroundings – is the human needs that drove the founder to create it, namely the function the garden was intended to fulfill and the benefits for the user arising from that function. A "benefit" may be either active tending of the garden or passive relaxation amidst the plants (**health benefits**); admiring the garden as a whole or its structural components – the composition and the creator's craftsmanship (**aesthetic and spiritual benefits**); obtaining food, satisfying basic life needs (**utilitarian benefits**). In this light, every garden has practical values and features.

It should be noted that the dual nature of garden plants (their beauty and utility) is illusory. Drawing a clear line between useful and ornamental plants is neither possible nor reasonable. We know of many examples of plant species that can equally be classified in both these groups. It also happens that plants initially planted for ornamental purposes (due to their distinctive appearance) were much later appreciated for their practical properties. Since time immemorial, people have surrounded their dwellings with plants. Initially, understandably, their practicality was the "key" to selection.

Subsequently, the symbolic and spiritual significance of plants became important, and only later did selection criteria based on their purely aesthetic qualities come into use. The evolution of the garden's function from utilitarian to ornamental (recreational), and the balance between utilitarian and ornamental parts, took place slowly and depended on many factors (including social and economic ones).

In early gardens (from antiquity to the 17th century), the mixed, utilitarian-ornamental function was by far the most popular. Gardens combined both these aspects within a single spatial unit. Plants, both beautiful and useful, together formed beds, mainly flower and herb beds or, later, Renaissance parterres. Fruit trees and vines provided fruit and shade; they could serve as a refuge for singing birds.

> In the gardens of ancient Egypt, the basic plants cultivated in kitchen gardens included vegetables: *Allium cepa* L., *A. sativum* L., *Cicer arietinum* L., *Citrullus lanatus* (Thunb.), *Cucumis melo* L., *Lactuca sativa* L., *Vicia faba* L., *V. lens* L. herbs: *Anthriscus cerefolium* L., *Coriandrum sativum* L., *Mentha piperita* L., *Thymbra spicata* L.; and fruit trees: *Ficus carica* L., *Malus* sp., *Medemia argun* (Mart.), *Olea europaea* L., *Phoenix dactylifera* L., *Pistacia vera* L., *Punica granatum* L. (Turner, 2005).

The medieval love of order and the desire to symbolically reflect divine perfection in human works led to the partial segregation of crops into specially designated plots, or "gardens". Within a single estate, vegetable gardens, orchards, medicinal gardens (*herbarium*, *hortus medicus – herbularius*), hop fields, and vineyards began to appear (Figure 3.1). This arrangement also had an economic dimension, linked to increased crop yields, made possible by better control of growing conditions in line with the plants' habitat requirements. The selection of plants for a kitchen garden was based on those essential for the proper functioning of the estate (whether monastic or secular).



Figure 3.1. The facsimile of one of the pictures from "De agricultura vulgare" by Pietro de Crescenzi (1511)

The choice of plants for the garden varied depending to geographical location. It is believed that in the Middle Ages, the most developed in terms of the number of cultivated species were the monastic gardens of southern and western Europe. Both native plants and those introduced earlier (in antiquity) were cultivated there, most often from areas conquered in wars or with which trade relations were maintained. In this context, the ability to improve natural conditions was crucial. Crops were grown on raised beds and in shelters made of woven twigs or ceramic pots. Fences and walls built around kitchen gardens also helped to achieve higher growing temperatures and often determined the success of the entire endeavor. It is interesting to compare the lists of plants from two medieval documents (9th century) – Abbot Walahfrid of Reichenau's poem, "Liber de cultura hortorum" (Figure 3.2), and the description from the plan of St. Gallen Abbey (concerning the *herbularius* – the garden of medicinal and aromatic plants).



Figure 3.2. The facsimile of one of the pictures from "Liber de cultura hortorum" by Walafrid Strabo from Reichenau Abbey (1512)

The list of plants found in Walahfrid's poem cannot be considered either a list of plants recommended for planting in gardens of the period or an inventory of the species cultivated by Walahfrid von der Reichenau (also known as Strabo). Nor were they the only plants available at Reichenau Abbey. However, since both documents contain significant overlap in species lists, this may confirm their commonness in monastery gardens. This selection, by modern standards, includes not only useful plants but also ornamental ones. For the most part, these were native plants or those known in Europe since antiquity, originating mostly from the Middle East, Persia, or northern parts of Africa (Dudek-Klimiuk, 2012).

Plants listed in "Liber de cultura hortorum":

1. southernwood[a] – *abrotanum*[b] (*Artemisia abrotanum* L.[c]),
2. gourd – (*Lagenaria siceraria* (Molina) Standl.),
3. wormwood – *absinthium* (*Artemisia absinthium* L.),
4. horehound – *marrubium* (*Marrubium vulgare* L.),
5. clary sage – *sclaregia* (*Salvia sclarea* L.),
6. betony– *vettonica* (*Betonica officinalis* L.),
7. common agrimony – *agrimonia* (*Agrimonia eupatoria* L.),
8. yarrow – (*Achillea millefolium* L.),
9. catnip – (*Nepeta* L.),
10. melon – (*Cucumis melo* L.),
11. celeriac – *apium* (*Apium graveolens* L.),
12. chervil – *cerefolium* (*Anthriscus cerefolium* L.),
13. opium poppy – *papaver* (*Papaver somniferum* L.),
14. radish – radices (*Raphanus sativus* L.).

Plants listed in "Liber de cultura hortorum" and shown on the St. Gallen plan:

15. costmary or broad-leaved tansy – *costo* (*Tanacetum balsamita* L.),
16. spearmint or mint – *menta* (*Mentha viridis* L.),
17. sage – *saluia* (*Salvia officinalis* L.),
18. rue – *ruta* (*Ruta graveolens* L.),
19. bearded iris or gladiolus – *gladiola* (*Iris ×germanica* L.),
20. pennyroyal – *pulegium* (*Mentha pulegium* L.),
21. lovage – *lubistico* (*Levisticum officinale* Koch),
22. fennel – *fenuclum* (*Foeniculum capillaceum* Gilib.),
23. rose – *rosas* (*Rosa gallica* L.),
24. lily – *lilium* (*Lilium*).

Plants appearing only on the St. Gallen plan:

25. watercress – *sisimbria* (*Nasturtium*),
26. cumin – *cumino* (*Cuminum cyminum* L.),
27. cowpea – *fasiolo* (*Vigna unguiculata* L.),
28. peppercress – *sataregia* (*Lepidium* L.),
29. fenugreek – *fenegreca* (*Trigonella* L.),
30. rosemary – *rosmarino* (*Salvia rosmarinus* Spenn.).

[a]common English name, [b]Latin name in original spelling, [c]Latin names (in our own compilation).
Full list of plants and original names from the St. Gallen plan available at UCLA Digital Library Collections (http://www.stgallplan.org/StGallDB/plan_components/public_list_berschin_english).

Over the years, extensive contacts with places geographically and culturally distant have contributed to the expansion of the species composition of garden plants. Often, due to their original form, scent, or color, they aroused admiration and were therefore admired for their "otherness" – their ornamental value. It was only later, whether due to their widespread adoption or a better understanding of their practical uses (edible, medicinal or industrial), that they changed their place in gardeners' "classification" and moved from showy ornamental beds and pots to vegetable patches and herb gardens (e.g. peppers, tomatoes, aubergines and other plants, which had been known in Europe since the Age of Discovery, were long regarded as ornamental; it was not until the 19th century that they began to be produced on an industrial scale as healthy food). From the 16th century onwards, a trend emerged towards organizing separate sections of gardens for practical purposes (e.g., the Italian herb garden – *giardino de semplici*). These were laid out in the immediate vicinity of a representative ornamental garden, for which they served as a complement to the composition. Analyzing the five examples of Baroque gardens included in Chapter 3 of the "La théorie et la pratique du jardinage..." (Dézallier d'Argenville, 1711), we observe that the utilitarian garden was always incorporated into the overall layout of the complex as an independent compositional element.

3.3. THE SYMBOLISM OF PLANTS IN THE GARDEN: CONNECTIONS, DIVERSITY, AND SIGNIFICANCE

One of the fundamental principles of conservation, as regards historic parks and gardens, is the recommendation to select materials (including plants) in keeping with the traditions of the era in which they were established. Plant selection was influenced by both natural factors – primarily climate (temperature and water availability, sunlight levels, etc.) – and symbolic associations – the symbolism of individual forms, compositions, and plants. Symbolism is an expression and reflection of ideas, the prevailing worldview of the era, and beliefs. It can be assumed that the importance of symbolism diminishes with the advancement of science and knowledge, accompanied by a decline in the significance of faith (Taylor, 2007).

Life, beauty, death, decay, and renewal are just a few examples of how we perceive the symbolic meaning of gardens. The conceptual and symbolic layer is inseparable from the form and content of the garden. Depending on place and time, it could embody the Garden of Eden (the Middle Ages), an expression of perfection conveyed through mathematical proportions and infinity (the Baroque), or an Arcadian land of carefree bliss (antiquity and 18th-century parks).

At the origins of the garden archetype lies the sacred garden – paradise, a special space, a spiritual representation of the world. In garden art, we find several direct references to the Garden of Eden (Figure 3.3) – these include: the monastery

courtyard, the medieval meadow garden – *viridarium* (Garden of Love, as in part an open pasture or perhaps a flowery meadow), and the Persian *chahar bagh* garden (four square garden).



Figure 3.3. “Little garden of paradise” by unknown painter (ca. 1410–1420). In *hortus conclusus*, plants grown here included violets, daisies, spring snowflakes, wild strawberries, peonies (introduced from Persia in ancient times), hollyhocks, irises, lilies (with white flowers) and lilies of the valley, culinary and medicinal herbs (e.g. lemon balm, savory, coriander, sage, mint, hyssop) (Städel Museum, 2026)

Their symbolism included: shape (the square – the perfect figure); water features – e.g. springs, pools, fountains, canals (purification and the rivers of paradise); plants – their color, shape and scent; isolation from the surroundings and enclosure by a wall (the wall – the physical and symbolic separation of the sacred and the profane, good from evil, the space protected by God and that in which Satan appears). The etymology of the word ‘paradise’ also points to a walled space (*pairi-daēza* = *pairi* [around] + *daēza* [wall]). In a monastic cloister garden, it was recommended to plant juniper / Juniper (*Juniperus communis* L.) at the garden’s geometric center, as it symbolized innocence and protected against evil (the devil). Other plants with Christian symbolism, which were often depicted in medieval painting, include lily of the valley: *Convallaria majalis* L. / Lily of the Valley (symbol of the coming of the Saviour and the purity and innocence of Mary), iris / *Iris sibirica* L. / Siberian iris (symbol of the Immaculate Conception), roses / *Rosa* sp. / Rose (martyrdom, love – attributes of souls saved in paradise), lilies / *Lilium candidum* L. / Madonna lily (purity and innocence, virginity, the image of Jesus), wild strawberry / *Fragaria* L. / Strawberries (paradise,

the Passion of Christ, the Holy Trinity), columbine / *Aquilegia* L. / Columbine (the seven gifts of the Holy Spirit – *sapientia* meaning wisdom, *intellectus* – intellect or intelligence, *consilium* – counsel, *fortitudo* – fortitude, *scientia* – knowledge, pietas and *timor* (fear of God), *carnation* / *Dianthus* L. / Carnation (flower of God, Passion of Christ), apple tree / *Malus* L. / Apple tree (symbol of the Fall of Man, original sin), cherry tree / *Prunus avium* L./ Cherry tree (the blood of Christ shed on the cross) (Impelluso, 2004; Figure 3.4).



Figure 3.4. Irises, carnations, columbines, lilies, and grain (symbol of the Eucharist) on masterpiece by Hugo van der Goes "Adoration of the shepherds" (ca. 1480) (Hagen et al., 2020)

It should be noted that most of these plants acquired their symbolic meaning as early as antiquity. The blue color of flowers (of various species) was often associated with the cult of transition and reincarnation. In ancient Egyptian culture, iris flowers served as a symbol of victory, authority, and power. The Greek word 'iris' meant rainbow, from which the name of the goddess-messenger Iris derives; she was the companion of women's souls on their journey to the other world. Therefore, the iris was a flower used to adorn graves, and this tradition persisted in the territories of present-day Turkey throughout the entire existence of the Ottoman Empire until the early 20th century. In ancient Japan, however, the blue iris (*Iris ensata* Thunb.) was a symbol of courage. Like irises, columbine flowers were also believed (in Greece) to open the door to another world (Zerling, 2007). In many ancient traditions, cornflowers symbolized rebirth and renewal. This symbolism was linked to the annual growth of cornflowers amongst sown cereals. For example, in ancient Egypt, they accompanied

the dead on their journey into the afterlife; it was believed they aided in reincarnation. The scientific name of the genus, *Centaurea* (given by Linnaeus), derives from the story of the "centaur" Chiron, Achilles's advisor. According to Greek mythology, Achilles was wounded by a poisoned arrow (fired by Heracles), and his wound was healed through the use of cornflowers. Cornflower was also used in the Middle Ages as a symbol of tenderness, fidelity, and reliability (Beuchert, 2004). Chicory is an example of a wild blue-flowered plant which was historically believed to possess apotropaic properties, i.e., to ward off evil (much like juniper). This belief persisted from the Middle Ages right up to the 17th century. It was believed that the magical powers of chicory increased vitality and enabled the soul's journey to eternal life.

It was not only the flower's color that influenced the symbolic meaning attributed to the plant. The strong and sweet scent of the flowers was surely not without significance. Native to the natural habitats of Palestine and Lebanon, the lilac (spread by the Phoenicians throughout the eastern Mediterranean) has been a symbol of wedlock since the times of the Assyrian and Egyptian empires (Song of Solomon 2:1–2), the sovereignty of kings, and virginal innocence. Lilies are also associated with the cult of Ariadne, who protected rebirth, prosperity, fertility, and the blessing of the harvest. In later Greek and Roman times, the lily was regarded as a symbol of sublime love, procreation, and glory. It was used to make ritual wedding wreaths. In Jewish tradition, lilies symbolize youth and virginity. The rose, often called the "queen of flowers", is still prized today for the shape and scent of its blossoms. It is widely used as a symbol of love and beauty. The idea of the rose as the most perfect form of flower originated in Persia, and from there spread to India, through the Middle East to Europe. The oldest known written record of the use of roses by humans comes from Mesopotamia. In ancient Greece, it became the plant of Aphrodite, the goddess of love, and for the Romans it was the flower of Venus (Aphrodite's counterpart). It symbolized spring, love, beauty, and charm, but also transience.

Regardless of time and place (culture), in many cases, the medicinal properties and belief in the metaphysical powers of plants were closely intertwined. Physical resemblance may have played an important role in the belief in a plant's specific medicinal effects (e.g., *Hepatica triloba* – the human liver, or the lichen *Lobaria pulmonaria*, which resembles the lungs in appearance).

From the 16th century onward, and especially during the Enlightenment in the 17th and 18th centuries, scientific knowledge in botany (systematics, morphology, and physiology) increased significantly; the diversity of the plant kingdom also grew. The emergence of modern medicine and pharmacology ultimately led to the loss of the transcendental background of symbolism in the 20th century.

3.4. ELEMENTS, STRUCTURES, AND FORMS OF GREENERY IN HISTORIC GARDENS

The visual character of a garden is primarily shaped by its elements and structures (both architectural and structural, as well as plant-based); their spatial relationships – the composition and the "density" of individual components – are also important.

Basic compositional elements of gardens and parks in chronological (stylistic) order

Medieval period: garden beds, bower (tunnel arbours), trellises and pergolas, wells and fountains, turf benches, solitary trees, meadows and grasslands.

Renaissance: *all'italiana parterre*, which featured strong geometric shapes, artificial hills, fountains, sculptures, grottoes, bower (tunnel arbours), avenues, hedges, and mazes.

Baroque: *parterre en broderie*, cutwork parterre and *parterre à l'anglaise*, bosquets (mainly internal), avenues, hedges, solitary trees, garden canals, sculptures and topiaries, fountains and pools, orangeries.

18th-century landscape gardens: park lawns, massifs, groups of trees, flowerbeds, garden pavilions, aha, artificial ruins, grottoes.

19th-century landscape parks: solitary trees, groups and clumps, flowerbeds, massifs, groves, lawns, carpet, arabesque and basket flowerbeds, lapidaries, bridges.

20th-century parks and gardens: lawns, perennial borders and thematic gardens, pergolas, gazebos, flower walls, bridges.

It can be observed that some garden forms are characterized by great durability – they appear across several successive eras; others, however, were used for a limited period of time (and belong to a single stylistic era). If a short-lived element is additionally characterized by a strong, distinctive form, it can be treated as a distinguishing feature of the style. Both plant elements and architectural and structural elements can serve as such a distinguishing feature – a clue in dating a garden composition.

The basic plant elements, permanent in form, are: solitary plants, avenues, rows, groups, and flowerbeds – these were used regardless of style (or period). Architectural, permanent elements that make up gardens include trellises and pergolas, sculptures, fountains, grottoes, gazebos and pavilions, and, amongst the so-called landscape features, terraces, balustrades, and stairs. We carry out a stylistic analysis of the garden's architectural elements in the same way as for works of art and architecture. Of course, an important factor in the analysis is the material used and the construction, regardless of the type of element.

Distinctive elements may include both those of an architectural and structural nature, such as garden channels (Baroque) or turf benches (Medieval), as well as living plant elements of gardens.

Among the distinctive structural plant elements, Baroque bosquets (especially those with a garden theatre) and, above all, various floral forms should be highlighted. For parterres, the distinguishing feature may be the pattern – one that is geometric for 16th-century Renaissance parterres, and another based on zoomorphic and plant motifs for Baroque parterres. With the advent of landscape parks, floral elements underwent further evolution. Freed from the rigid framework of parterre beds, as early as the 18th century, plants began to take the form of flower groups and flowerbeds, and later, more complex floral forms (flower baskets, flower carpets, arabesques). Among the latter, flower baskets deserve special mention – characteristic of mid-19th-century designs (in the British Isles from the late 18th century, in Germany from the 1830s) and flower carpets, popular at the turn of the 19th and 20th centuries. The form, size of the element, and its location in relation to the architectural focal point were important.

The individuality of floral forms in successive styles was enhanced by the varying availability of plant material, dependent primarily on availability linked to knowledge of the world's flora (resulting from geographical discoveries, and subsequently the importation and introduction of new plant species to Europe). From around the second half of the 19th century, as the list of available species expanded rapidly – thanks to their effective sourcing from new locations and the development of commercial nursery gardening – interest in botany and plant collecting grew among park owners and patrons. These were ideal conditions

for establishing thematic gardens within gardens and parks (rose gardens, iris gardens, heather gardens, fern gardens – *filicetum*). Arboreta and Victorian gardens in the gardenesque style emerged, a style created and promoted by John Claudius Loudon (1782–1843) ["Encyclopaedia of Cottage, Farm, and Villa Architecture" (1833) and "Arboretum et fruticetum Britannicum" (1838)].

The aesthetics of gardens and parks were also influenced by the development of ecology within the natural sciences. Influenced by research into the relationships between natural habitat conditions and the species composition of the organisms inhabiting them (plants and animals), "environmental" (habitat) gardens began to be created – e.g., for riparian, aquatic, or mountain environments (rock gardens). Educational publications, such as Friedrich Junge's "Der Dorfteich als Lebensgemeinschaft"(1885), played a significant role in popularizing new research theories in the natural sciences.

> Ecology, as a distinct branch of biology studying the relationships between organisms and their environment, emerged in the second half of the 19th century. The term was coined by Ernst Haeckel, who defined the subject of ecology as 'the totality of knowledge concerning the relationships between organisms and their surrounding environment' (1866, p. 286).

3.5. SPATIAL RELATIONSHIPS AS A DISTINGUISHING FEATURE: COMPOSITION, AXIALITY, RELATIONSHIPS WITH THE SURROUNDINGS

By analyzing the arrangement of elements within the garden space, their mutual relationships, and their relationships with the surroundings, one can identify the most important principles of garden (or park) composition arising from the prevailing philosophy and aesthetics of a given period.

The Middle Ages – a lack of compositional links (shared axes) between "independent" garden spaces and architectural structures (with the exception of the cloister garden) and between the garden and the surrounding landscape.

Renaissance – initially, confinement of the composition within the boundaries of the layout; clear axial symmetry of the composition and division of space based on a geometric grid. A division into smaller, compositionally independent sections – "gardens" (e.g., various types of kitchen gardens) – is visible, most often in the side sections of the garden. In the mature Renaissance and Mannerist gardens, the role of landscape elements in the immediate or wider vicinity of

the garden layout increased – extending axes beyond the garden's physical boundaries and consciously composing the garden to include vistas towards the nearest landscape landmarks (including city silhouettes).

Baroque – this is the dominance of garden composition over the natural landscape. It was characterized by a strong compositional axis, accentuated and emphasized by the layout of pathways within the garden's boundaries (or, for example, through the axial positioning of extensive garden canals) and beyond. These axes compositionally linked the dominant feature, the garden, the menagerie, and the surrounding areas, regardless of their nature (town, countryside, farmland, forest). Characteristics were radial arrangements of axes, focusing the composition on the dominant feature of the palace and garden complex.

18th-century landscape gardens – the composition, especially in the immediate vicinity of the focal point, was often still axial, though no longer always emphasized by the layout of paths. Most often, centripetal, with few or no significant links to the landscape. Often, several architectural elements took on the role of the focal point. The layout of paths is highly complex.

19th-century parks – a composition based on intertwining spaces, framing of views, and the creation of predominantly plant-based focal points (solitary trees and groups of trees).

Great importance of the terrain's topography – the park's composition adapted to natural conditions, a visible "imitation" of nature based on characteristic and distinctive generic groups or so-called environmental communities. Openness to the surrounding landscape (parks). Zoning of the garden composition, constructed in a manner analogous to landscape painting, with multiple planes and a background situated beyond the park's actual boundaries (an irregular, semi-wild forest/mountain/waterfront space with its natural vegetation).

20th century – at the turn of the 19th and 20th centuries, the division between the enclosed and formal garden space with a flower parterre and the naturalistic "wild park" was maintained. Inspiration was drawn from the abstract arts (shapes and patterns). In interior design, curved lines overlap with regular geometric shapes. Depending on function and location, compositions are connected to the surroundings (through links and views) or with a closed, centripetal composition.

3.6. THE JOURNEYS OF PLANTS

When analyzing the process of introducing plants to the European continent from the “New World”, several clearly distinguishable stages of this process should be noted. The first encompasses the earliest times of ancient cultures, when plants, along with merchants and warriors, traveled primarily by land between Egypt, Mesopotamia, Persia, and the Mediterranean cultures. The reasons for undertaking this arduous task, which stemmed primarily from the difficult and risky transport of plants, were not solely linked to utilitarian needs, but also to the desire to adorn royal gardens with extraordinary plant specimens. This period saw the first cultivation of, among others, the white lily, boxwood, cucumber, and radish in central and northern Europe (Tyler-Whittle, 1970). The period of the Crusades (11th–12th centuries) saw the spread of exotic medicinal and spice plants imported by Arab merchants from East Asian countries (including pepper, cloves, cinnamon, and nutmeg). The next stage covers the period of the “discovery” of the world by European sailors, with the search for new lands, new sea routes, and raw materials, among which spices, medicinal, and useful plants held an important place (purple coneflower, cinchona, potatoes, tomatoes, sunflowers, pumpkins, pineapples, peppers, cocoa, tobacco) (Figure 3.5).



Figure 3.5. A botanical sketch of a tomato, formerly called *Malus aurea* (Fuchs, 1542)

However, one of the most significant events that led to a veritable explosion in the collection of plants and their “successful” introduction was the construction in 1834 of the so-called Ward’s case (Figure 3.6), thanks to which not only tubers and seeds could survive the weeks-long sea voyages to Europe, but also cuttings and young specimens of living plants.



Figure 3.6. Packing plants into Ward boxes for shipment to Europe at the Buitenzorg Botanical Gardens, West Java, 1913 (Boomgaard & van Dijk, 2001)

Plant elements, alongside architecture, engineering, and technical structures, and the cultural management of agricultural areas (the layout of fields or the arrangement of settlements), can constitute an important and clear element of cultural landscape analysis. Living plants, naturalized and commonly found, can constitute a far more enduring trace of a place’s cultural past than ephemeral buildings. Particularly valuable for such considerations is the example of plants introduced early on, that is, before the 19th century, prior to the so-called great introduction of plants.

During the Renaissance, the knowledge of antiquity was still being studied and rediscovered, the flora of Europe was being explored, and newly discovered continents were being investigated. An indispensable element of the study of botany was the compilation of herbaria and illustrated works on plants. It was then that the foundations of knowledge regarding the relationships between plants, soil, and climate, as well as the phenological changes in nature throughout

the year, were established. The beginnings of this knowledge, which lies at the origins of agriculture and horticultural practice, had already developed earlier; its creators were ancient scholars, particularly Theophrastus, who described, amongst other things, the observed relationships between plant distribution and climatic factors, as well as the phenological stages and vegetation types characteristic of various regions.

Expeditions by the Portuguese and later by the Spanish, English, and Dutch (15th and 16th centuries) contributed to the spread across Europe of many exotic plant species, originating mainly from Asia (India and later China) and subsequently from the Americas. Among the plants brought to Europe at that time were: *Actinidia chinensis*, *Aralia chinensis*, *Camellia sinensis*, *Canna indica*, *Ginkgo biloba*, *Ricinus communis*, *Schisandra chinensis*, *Sophora japonica*, *Tropaeolum minus.* Throughout the 16th century, further plants of Oriental origin appeared in the then-emerging European botanical gardens. Botanical specimens aroused great interest not only as objects of trade, but also as subjects of scholarly research and artistic studies, which often went hand in hand, e.g. the 13-volume collection of botanical watercolors – Libri Picturati (Figure 3.7), dating from the 1560s, held in the collections of the Jagiellonian University Library in Kraków, or the Codex Fuchs (Codex Vindobonensis Palatinus) from 1529 with colorful illustrations of plants created in the 1530s, now in the collections of the Österreichische Nationalbibliothek in Vienna (Walter, 2008).



Figure 3.7. *Tropaeolum minus* L. – one of the earliest illustrations of this plant, which is still popular today and originates from South America (L'Écluse, 1526–1609)

Images allowed for a better representation of the immense diversity and richness of nature, particularly of the exotic kind, which was often difficult to describe in words due to the lack of appropriate terminology, which was only just beginning to take shape at that time. The first botanical gardens, established at universities during this period, were to become important centers for research, education, and the dissemination of knowledge about herbs. The Botanical Garden of the University of Padua, founded in 1545 and currently the oldest in the world, played a leading role. Established somewhat later, in 1587, the Botanical Garden of Leiden University became a center for the acclimatization of new species (Zemanek, 2009).

Alongside the "foreign" tree species commonly known to us, which were introduced from North America in the early days (e.g. *Acer negundo*, *Celtis occidentalis*, *Juglans cinerea*, *J. nigra*, *Juniperus virginiana*, *Liliodendron tulipifera*, *Pinus strobus*, *Prunus serotina*, *Robinia pseudoacacia*, *Taxodium distychum*, *Thuja orientalis*) or from southern and south-eastern destinations (including *Aesculus hippocastanum*, *Corylus colurna*, *Morus alba*), the shrub species introduced at that time played an important role in the art of gardening and in the history of shaping Europe's cultural landscape.

It can be argued that, right up until the early 19th century, parks and gardens had a "local" character, even when designed on a large scale, as the plants used were largely native, integral to the local landscape. Even vast residential parks captivated not with a wealth of plant species, but with their spatial expanse or grandeur, the solemn standard of composition, and the horticultural and design craftsmanship expressed in the elements constituting the garden or park.
In colder regions, "model" evergreen species, such as Italian or French varieties, were replaced by local, native species that could withstand both the climate and the pruning required at that time to shape trees and shrubs (in Poland, for example, these were mainly lime trees and hornbeams).

Plants introduced to Europe before the turn of the 18th and 19th centuries were, crucially, generally, self-sustaining and, in this self-sufficiency, extremely effective. They required no human assistance or difficult, sophisticated horticultural methods to reproduce. Very often they spread and multiplied – vegetatively and, a feature that is particularly striking here and continues to leave its mark on the character of the places they colonized – beyond the initial "act of introduction" – often now invisible to us, as it is usually anonymous in their case – they seemed to rely solely on runners, division, suckers, rooting of branches, etc. They formed new clumps, thickets, and gardens. They quickly became an element of the culture of rural settlements, market squares, roads, and highways. They were extremely hardy and long-lived, remaining in a "once-settled" place for many years and becoming a permanent feature of local landscapes. It is therefore to this manner of entering the landscape that we owe some of its most enduring cultural plant

elements – thickets of wolfberry (*Lycium barbarum*), clumps of lilacs (*Syringa vulgaris*) (Figure 3.8), mock orange (*Philadelphus coronarius*), spiraea and related species (*Spiraea ×pseudosalicifolia*), and "old" rose varieties (*Rosa centifolia*, *R. damascena*, *R. fœtida*, *R. majalis* 'Fœcundissima' or *R. spinosissima*) (Zieliński, 1987). All these plants are not only a lasting and extremely significant element of the vanishing "landscape culture", but also evidence of the first – alongside fruit trees, dogwoods, and mulberries – supra-regional contacts among Europeans. It is interesting to note that what became established so early in the Central European landscape usually came not from the West but from the East, though not always directly (Dudek-Klimiuk, 2013).



Figure 3.8. Ornamental shrub species introduced early on that are important to Europe's cultural landscape – *Syringa vulgaris* L. (with white and purple flowers) introduced from the Balkans and *Buxus sempervirens* L. – a species native to the southern regions of Europe, North Africa and Western Asia (Besler, 1613)

Vines and boxwood, however, reached the territories of Central and Northern Europe from the West. Boxwood, whose natural range covers the Mediterranean and Black Sea basins, reached Western Europe earlier, during the Roman conquests, thereby significantly expanding its natural distribution (Figure 3.8).

However, it was not used in the north for a long time; the first (documented) successful introduction there was probably at Rosendal Garden (Norway) in 1666 (Salvesen & Kanz, 2009; Figure 3.9).

Previously, in the harsh climate of the north, boxwood – a species so important for the construction of elements and compositions in geometric gardens – could be replaced by strips of lawn, as described by Christian Gartner in his "Horticultura" (1694). Gartner also proposed another alternative to *Buxus sempervirens* L. – which he saw in the use of banded plantings of chives (*Allium schoenoprasum* L.). André Mollet, who had been designing the royal gardens in Stockholm since 1646, also formulated a similar guideline in "Le jardin de plaisir [...]." In Chapter 11, he offered a similar suggestion: "Due to the lack of boxwood in these parts of Sweden, we may use another species of plant, which in Swedish is called *Liong-ris* [Lingon], which has leaves very similar to boxwood and is more resistant to the cold. It occurs and grows in large quantities in all the forests of this country." (Mollet, 1651). Similarly, in Russia at that time, due to the harsh climate, *Vaccinium vitis-idaea* L. was used instead of *Buxus sempervirens* L. in the Peterhof garden (designed 1710–1716 by Domenico Trezzini). Conservation work carried out between 2009 and 2012 maintained this original species selection. The parterre design was created using lingonberry (*Vaccinium vitis-idaea* L.) and juniper (*Juniperus* spp.). Native Russian plants were planted between the evergreen belts in the border , including the chalcedony pimpernel (*Lychnis chalcedonica* L.), mallows (*Malva excisa* Rchb. and *M. sylvestris* L.), columbines (*Aquilegia glandulosa* L. and *A. olympica* Boiss.), and bellflowers (*Campanula latifolia* L. and *C. persicifolia* L.) (Ignatieva et al., 2015).



Figure 3.9. In 1994, in Trondheim, to mark the 300th anniversary of the first publication of “Horticultura” by Christian Gartner (1694). The so-called “Renaissance garden” was recreated in accordance with the instructions contained in the book (NTNU Ringve Botanical Garden, 2026)

Early introductions of shrubs are interesting and important for today’s perception of the landscape, particularly in agricultural areas. In attempting to identify the significant, distinguishing features of the introduction process of certain long-established shrubs, the following elements should be noted: the period in which they first appeared in our landscape (16th–18th centuries); the characteristic resilience and “self-sufficiency” of these plants, resulting from their vegetative mode of reproduction (via root suckers and layering); it is also worth noting that these plants are characterized by a particularly strong scent – which was a key reason for the special interest in them.

In the process of introducing trees, shrubs, and perennials, there is a clear turning point marked by the turn of the 18th and 19th centuries. This turning point separates the classical era of horticulture from the modern one, though this modernity – now long past and sometimes barely discernible – is, in essence, identical to the approach to plant collection in our own time, with the pursuit of collecting species and varieties characteristic of contemporary horticultural or botanical practice, the flaunting of the vastness of one’s botanical collections, the richness of plant selections, “botanical novelties”, and the cult of speed in introducing elements that are usually irrelevant to both the composition

and its aesthetic dimension. In this respect, the practice of garden designers, as far back as the early 19th century, differs in no way from today's view of the plant world. It is precisely on the basis of this clear division, which emerged at the turn of the 18th and 19th centuries, that one can define the concept of "early introduction", which refers to the introduction of plants prior to the rapid development of horticulture, before the mass arrival of numerous exotic species of trees and shrubs imported from Asia and North America. There were certainly several reasons for the emergence of this watershed and its distinctiveness – a Romantic shift in the perception and "consumption" of the world, and thus also in the perception of the role and design of gardens and parks, closely linked to the emergence of a social need for the public gathering and collecting of plants, and the beginnings of modern tourism; and, on the other hand – a sudden "surge" in the supply of plants from the Americas and, to a lesser and slower extent, from Asia as well, combined with the emergence of modern botanical gardens, gardening magazines and societies, and finally – commercial tree nurseries.

This period of extremely intensive plant acquisition is associated not only with sailor-explorers, travelers, botanists, and "overseas" traders, but also with specialist seekers of new (or earlier, but unsuccessful) introductions – plant hunters. Their names are often commemorated in remarkable ways – through the names of plants they discovered or plants named after them by subsequent botanists in their honor. Among them are: Joseph Banks – a British naturalist and participant in James Cook's first expedition, with whom he reached Australia, amongst other places. Over 70 plants have been named after him (including *Pinus banksiana* and *Rosa banksiae*). The German botanist, physician, and author of accounts of Japan, Engelbert Kaempfer, who described, amongst others, the ginkgo (*Ginkgo biloba*) (Figure 3.10) and hostas (*Hosta* sp.) – the names *Larix kaempferi* and *Rhododendron kaempferi* are derived from his name. William Kerr (a gardener at Kew), who in the early 19th century brought the first tiger lilies, the white rose (*Rosa banksiae*), and *Kerria japonica* (so named by him). A pupil of Linnaeus, the Swede Carl Peter Thunberg – a botanist and physician – conducted botanical research in southern Africa, Japan, and the East Indies. Over 3,000 plants have the third part of their Latin name derived from his surname, meaning that he was the first to describe and systematically classify them. Names such as *Astilbe thunbergii*, *Berberis thunbergii*, *Pinus thunbergii*, *Spiraea thunbergii* are derived from his surname (Tyler Whittle, 1970).

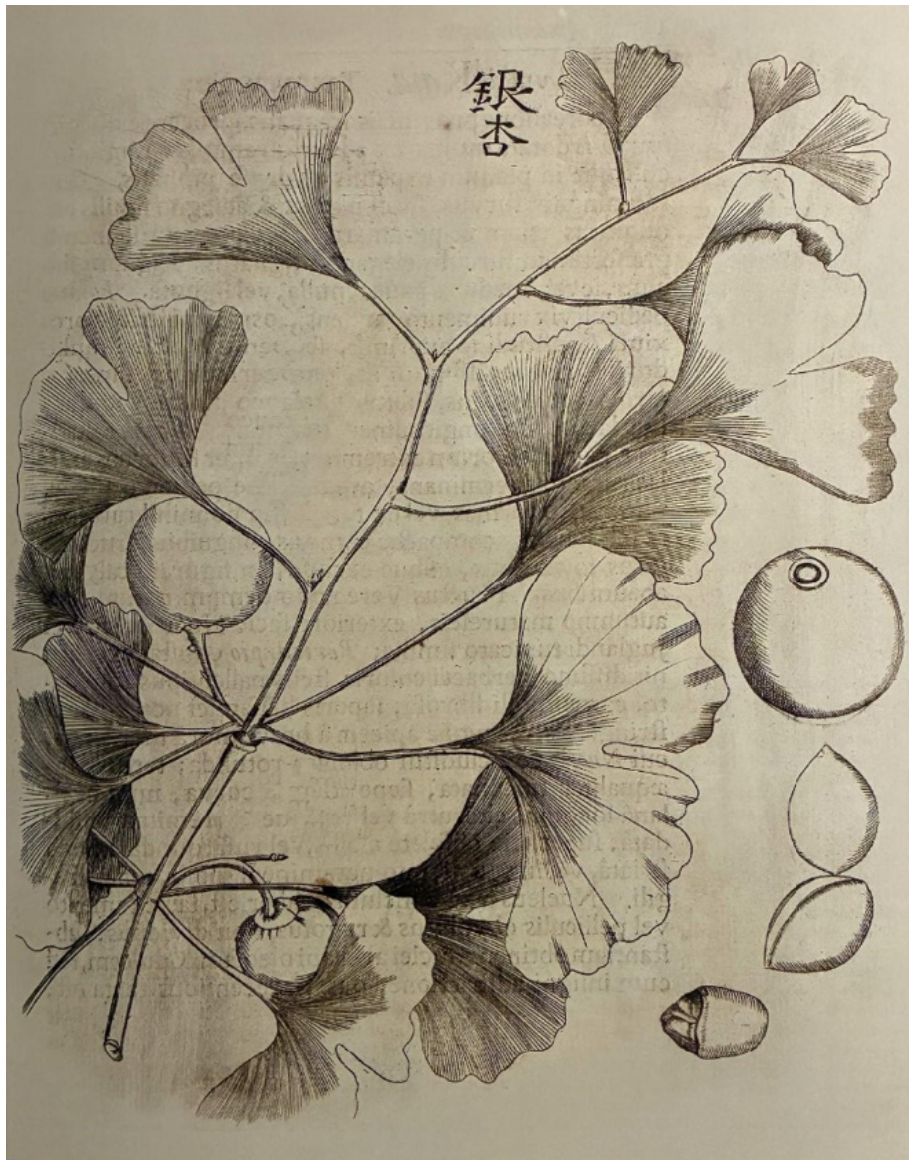

Figure 3.10. *Ginkgo biloba* L. in "Amoenitatum exoticarum politico-physio-medicarum fasciculi V [...]" by Engelbert Kaempfer (1712, p. 813) (Walter, 2008)

Review questions:

1. What factors (apart from aesthetics) are embedded in the composition of a garden and allow us to discern its historical and social context?
2. Why do plants, as the garden's primary material, make it an impermanent and changeable work over time?
3. What is the nature of the apparent dualism between the utilitarian and ornamental garden, and why can these two functions not be clearly separated?
4. How have the functions of gardens changed from antiquity to modern times in the context of the relationship between utility and aesthetics?
5. In what way did the symbolism of plants and garden elements reflect the worldview and beliefs of a given era?

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4. VERNACULAR HOME GARDENS AND THEIR DESIGN INTERPRETATIONS

What is this chapter about:
This chapter analyses changes in the concept of plant cover in European gardens, comparing vernacular gardens with those designed from the 19th century onwards. It presents the transition from vernacular gardens to ornamental gardens shaped by aesthetic ideas and cultural influences, including the impact of geographical discoveries. It discusses successive design models – Victorian, Edwardian, and Modernist – and their approaches to plant selection and composition.

What will you learn:
- What functions plants served in traditional rural gardens, and how these stemmed from the needs of everyday life.
- How major geographical discoveries and the development of horticulture influenced plant selection in Europe.
- How the main models of plant design differ: Victorian, Edwardian, and Modernist.
- How the relationship between architecture and the garden, and the role of plants in spatial composition, has changed.
- Contemporary trends in plant design are based on an ecological and naturalistic approach.

4.1. INTRODUCTION

It is well known that the image of a garden is associated almost exclusively with the plants growing within it. The concept of the garden – that is, its spatial layout, the sequence of garden spaces, small architectural forms, and sculptural decoration – seems to take a back seat. Instead, flowerbeds with plants come to the fore. Let us therefore begin by analyzing the concept of vegetation, specifically the differences in the principles governing the selection of plants for gardens. We shall trace these differences using the example of vernacular gardens, traditionally established around human dwellings, comparing them with gardens designed by architects and planners from the mid-19th century onwards.

4.2. THE TRADITIONAL RURAL GARDEN IN CENTRAL AND EASTERN EUROPE

When did the first ornamental gardens appear around houses? – We do not know. They have probably accompanied humans ever since they began to lead a settled lifestyle, that is, from the Neolithic period (in Europe around 5,500 BC). The story of plants accompanying inhabited spaces must begin with a universal rule that has applied to all peasant homesteads in Europe for centuries: every plant in the garden was meant to provide food, offer healing, or be useful in the household. The rest, regarded as wild and unnecessary, were not allowed on the premises of human dwellings.

Presumably, therefore, the first plants in gardens were culinary and medicinal herbs, brought directly from their natural habitats. They were not only useful, known for generations for their beneficial properties, but also beautiful – they attracted attention with the color of their flowers, their scent, and the lush greenery of their leaves.

Planted close to the homestead so that they would be to hand when needed. In Pharmacopoeias, that is, official lists of medicines compiled by physicians, plants dominated right up to the 18th century.

Echoes of these early gardening practices can still be found in the tradition of the rural garden in Europe as late as the first half of the 20th century. Plants that are still associated with the rural garden today include, for example, monkshood (*Aconitum napellus* L.), once used as a painkiller; mezereon (*Daphne mezereum* L.), which helped with skin problems, rashes and irritations; snowdrop (*Galanthus nivalis* L.), helpful for paralysis and stroke; ivy (*Hedera helix* L.), an expectorant administered for colds, as was the sweet violet (*Viola odorata* L.). Hawthorn (*Crataegus monogyna* Jacq.) and lily of the valley (*Convallaria majalis* L.) were used for heart problems, liverwort (*Hepatica nobilis* Mill.) – for liver and intestinal issues; periwinkle (*Vinca minor* L.) treated diarrhea in infants and helped new mothers wean their babies. Stomach aches were soothed by peppermint (*Mentha spicata* L.), dill (*Anethum graveolens* L.), and marjoram (*Origanum majorana* L.). Comfrey (*Symphytum officinale* L.) was used to make an ointment for fractures and bruises. Autumn crocus (*Colchicum autumnale* L.), like the aforementioned monkshood, was a remedy used against gout, a disease that afflicted our great-grandparents all too often. There were also plants in the gardens with rather sophisticated uses – white hellebore (*Veratrum album* L.) repelled fleas and lice, whilst a decoction of common wild ginger (*Asarum europaeum* L.), added to food or drink, caused the person consuming it (usually unwittingly) to develop an aversion to alcohol. There was also a whole range of plants used for dyeing fabrics, for example, the dyer's chamomile (*Anthemis tinctoria* L.), which still grows today in the villages of the Podkarpacie region. Boxwood (*Buxus sempervirens* L.) was used for Easter palms, and its hard wood was used to make combs and hairpins.

Rosaries were still being made at the beginning of the 20th century from the seeds of the southern snowball (*Staphylea pinnata* L.), traces of which archaeologists had already encountered in Europe at early medieval settlements.

Small Greek crosses were made from the wood of the southern snowberry, which were nailed to doors or left at the corners of fields, in the belief that they had the power to ward off demons.

Similar front gardens began to shape the rural landscape, and their image is still associated today with the idyll and tranquility of country life. Vernacular gardens beside rural homes served not only practical functions, but also social and symbolic ones. Visible from public spaces, they acted as a showcase for the farmstead, reflecting its economic condition, the diligence and aesthetic skills of the household members, particularly the women responsible for maintaining them. The selection of plants – encompassing both useful species (herbs, vegetables) and ornamental ones – was not random and could carry cultural significance linked to protection, religiosity, or ritual (Moszyński, 1929; Łuczaj, 2011; Figure 4.1). Although attempts are made in popular literature to interpret the garden as a kind of "code" indicating the stage of life of its users, there is no evidence for the existence of a uniform and universally recognizable system of such meanings; the symbolism of plants was local, variable, and ambiguous (Drożdż-Szczybura, 2018). In popular interpretations, a predominance of flowers indicated a young woman of marriageable age, herbs a young mother, and the common ragwort an elderly housewife. These interpretations, however, are local in nature and do not constitute a uniform system of signs.



Figure 4.1. A rural front garden in Bolestraszyce Arboretum, reconstruction (photo by Beata J. Gawryszewska, 2014)

Over the years, the expanding domestic herb gardens evolved into colorful front gardens, surrounded by an openwork fence, encouraging neighborly chats and the exchange of cuttings and seeds. They were home to golden flax (*Linum flavum* L.), snake's head fritillary (*Fritillaria meleagris* L.), Siberian iris (*Iris sibirica* L.), hollyhock (*Alcea rosea* L.), larkspur (*Delphinium* L.), and junipers (*Juniperus communis* L.) transplanted from the forest. The latter, along with periwinkle and boxwood, were prized for their hardiness, symbolizing longevity and the household's constant prosperity.

No home would be complete without the dog rose (*Rosa canina* L.) and later the Asian wrinkled rose (*Rosa rugosa* L.), as the housewife used to make jam from its petals, ground with sugar, to fill cakes (Kujawska et al., 2016).

> Flowerbeds, often composed of species from home gardens, also adorned shrines and wayside crosses. These sites, embedded in the everyday landscape of the village, served religious and communal functions, becoming elements of local spatial identity and marking the boundaries of the area that the rural community regarded as its own land.

4.3. WHAT CAME AFTER COLUMBUS: HOW THE VERNACULAR RURAL GARDEN CHANGED FOLLOWING THE GREAT GEOGRAPHICAL DISCOVERIES

A significant proportion of the ornamental plants found in rural home gardens in the 19th century were of non-European origin and were the result of earlier botanical expeditions to Asia and the Americas carried out from the 16th and 17th centuries onwards (see Chapter 3.6). Among the most common species were, among others, phloxes (*Phlox* spp.), rudbeckias (*Rudbeckia* spp.), zinnias (*Zinnia elegans* L.), coneflowers (*Echinacea purpurea* L. Moench), goldenrod (*Helenium autumnale* L.), sunflowers (*Heliopsis* spp.), marigolds (*Tagetes* spp.), geraniums (*Pelargonium* spp.), cosmos (*Cosmos bipinnatus* Cav.), and nasturtiums (*Tropaeolum majus* L.). This group also included more spectacular plants grown in pots, such as agaves (*Agave americana* L.) and datura, commonly known as "angel's trumpets" (*Datura stramonium* L.). These species, initially introduced as botanical curiosities, quickly gained popularity due to their decorative qualities – intense colors, abundant flowering, and striking form. Over time, it was these plants that began to define the aesthetics of the "traditional" country garden, gradually supplanting the older, utilitarian plantings of herbs and medicinal plants.

Manor houses and their gardens also played a significant role in this process, serving as centers for the dissemination of new aesthetic models and plant species. Nowadays, flowerbeds inspired by rural front gardens have become synonymous to homeliness and domesticity (Figure 4.2).



Figure 4.2. A flowerbed in the multifamily buildings' residential site, inspired by the Edwardian garden (photo by Beata J. Gawryszewska, 2015)

> Through the horticultural nurseries that developed in the 19th century – such as those in Medyka and Miżyniec in Eastern Poland – ornamental plants entered wider circulation, spreading from residential gardens into rural areas and contributing to the gradual transformation of the vernacular garden into a decorative garden.

4.4. VICTORIAN, EDWARDIAN, AND FUNCTIONAL GARDENS: DESIGNED GARDENS

When discussing ornamental gardens from the 19th century onwards, we can identify three chronologically successive concepts for designing the plant scheme. The first was the Victorian model, predating the Arts & Crafts movement. The green building blocks of the garden at that time were annuals and perennials, featuring colorful flowers, foliage, and stems.

They filled an abstract, geometrically drawn plan, devised in the privacy of a study, which filled the regular shapes of flowerbeds and borders. They were accompanied by plants displayed in pots: trees, shrubs, and perennials – palms, agaves, and aloes. The vast majority of these were exotic plants. Discovered as

a result of expeditions by plant hunters, they were particularly keenly imported from American and Asian colonies, reflecting the colonial power of Great Britain, which explains the great popularity of exotic plants. Plants were arranged on the basis of contrasting form and color (so that the abstract composition was as clear as possible), generally without regard to their natural habitat, in prepared soil (compost). They were replaced several times a season, as and when needed, and the mere fact that they had lost some of their decorative value (e.g., had finished flowering) was sufficient reason. Trees and shrubs were selected with the aim of achieving the greatest possible species diversity and arranged in a similar manner, based on the contrast of form and color (Hitchmough, 2005; Hobhouse, 2005).

The second model, which emerged as a reaction to the "inhuman" treatment of plants, as Gertrude Jekyll, co-creator of this new garden style, wrote, was the Edwardian model. It was developed on the basis of Arts & Crafts ideals and the books by the Irish gardener William Robinson, "Wild garden" (1870) and "The English flower garden" (1895), which promoted the beauty of natural English woodlands. Gertrude Jekyll's style promoted the use of perennial, native plants associated with an idealized image of rural gardens, but also those imported from the colonies, provided they were planted in accordance with their habitat requirements so that they could remain in the flowerbed throughout the growing season (Zachariasz, 2006). Plants were combined on the principle of complementarity rather than color contrast, whilst forms were arranged to create the impression of a diverse, natural-looking composition. The variation in color and composition of the flowerbeds was based on the physiological variation of plants over time – first one type bloomed, then another replaced them, whilst the first lost their appeal, followed by the next, and so on (Hitchmough, 2005; Gawryszewska, 2007). Plant compositions were created directly in the ground, designed with the natural qualities of each plant in mind. Unlike previous stylistic eras, the layout of the flowerbed was not filled with an abstract, geometric pattern, but resulted from the natural shapes of clumps of perennials arranged together. Gertrude Jekyll's garden, together with the house designed by Edwin Lutyens, with whom she collaborated, became one of the canonical examples of the English garden (the so-called English native garden). The principles of composing perennial beds developed by Jekyll – based on color harmony, gradation of plant height, and seasonal variation – are regarded as exemplary and remain an important point of reference in garden design to this day (Figure 4.3).

The concepts of plant composition developed by Gertrude Jekyll were taken up and transformed in continental Europe by designers such as Karl Foerster, Willy Lange, Hermann Muthesius, and Alina Scholz. By adapting the English model of the perennial bed, they placed greater emphasis on habitat conditions, the longevity of the composition, and the relationship between the garden, architecture, and landscape.



Figure 4.3. Upton Grey Manor House by Gertrude Jekyll (photos by Beata J. Gawryszewska, 2012)

And finally, the third and most recent model, proposed by the International Style and showcased at iconic modernist villas such as Le Corbusier's Villa Savoye (1928–1931) or Ludwig Mies van der Rohe's Farnsworth House (1945–1951). It was characterized by a smooth lawn surface, a minimal number of perennial beds (usually consisting of a single species), a predominance of monocultures of conifers forming simple spatial modules (e.g., hedges), and flowering fruit trees and ornamental shrubs set against this backdrop (Figure 4.4). This pattern of plant selection stemmed from a simple transposition of the play of light and shadow contrasting against the smooth surfaces of modern building walls onto the interplay of dark and light patches of vegetation. Large lawn areas fitted in with the concept of the "new man", who viewed the garden as a place for physical fitness and social fulfilment within the community, without unnecessary attachment to plants requiring maintenance. This model of garden also met the needs of the newly emerging lower middle class, whose members could not afford to employ staff for the daily, laborious maintenance of labor-intensive perennial and annual flowerbeds.



Figure 4.4. A garden in the 1920s. A northern white-cedar hedge is visible in the background (Muthesius, 1925)

4.5. THE PERSISTENCE OF CULTURAL PATTERNS IN PLANTING DESIGN

As a result of the introduction of new plant species to Europe in the 18th and 19th centuries, the overall range of plants changed only slightly. It should be noted, however, that the way in which plants were perceived underwent a significant transformation. Gertrude Jekyll admired plants individually, cultivated new color varieties of flowers – such as her favorite garden primroses (Jekyll, 1899) – and embraced the idea of collecting and engaging with each plant as a subject within a spatial dialogue. An analysis of contemporary show gardens and planting displays presented at garden festivals indicates that the reception of William Robinson's ideas continues to this day, and in fact finds a fuller expression in contemporary practice. It can be observed that these realizations increasingly include species characteristic of the natural landscapes of southern English woodlands, as advocated by Robinson in "The wild garden". In professionally designed show gardens, which serve a trend-setting function, planting schemes are becoming increasingly naturalistic in character.

A clear sequence of transformations in planting forms can be identified: from Victorian carpet bedding, through herbaceous borders designed according to habitat requirements in line with Robinson's wild garden concept, to the contemporary notion of spontaneous or free vegetation. As a result, plants in domestic gardens increasingly resemble communities derived directly from the landscape.

It should be emphasized that, since the mid-19th century, largely due to Robinson's influence, plant selection has been based primarily on habitat requirements and aesthetic qualities. Garrett Eckbo argued that a plant should correspond to the intended compositional effect, site conditions (including maintenance requirements), ultimate size and growth rate, as well as form, structure, texture, color, and fragrance (Eckbo, 2002).

Functionalism also had a significant impact on garden composition, advocating a reduction in maintenance labor (weeding, leaf clearing). Consequently, a simplified garden model emerged, typically dominated by extensive lawn areas and compact herbaceous borders. Plants were expected to be easy to cultivate and visually attractive throughout the year. Coniferous trees and shrubs gained popularity, as they were perceived as "non-littering" in terms of leaf fall.

A characteristic feature of functionalist practice was the so-called "species selection" approach, which involved assigning plants to graphic symbols in plan drawings. This often resulted in a discrepancy between spatial composition and the actual planting concept. It should be noted that this issue was further exacerbated by the limited availability of plant material and the delayed reception of new trends among investors, designers, and contractors (Gawryszewska, 2010).

It can be argued that the absence of a clearly defined contemporary canon of plant selection stems from its strong connection to collective memory. Garden users' choices are not determined solely by current design trends but also by culturally

embedded images and associations. The introduction of new species and cultivars is typically driven by the desire for larger flowers and more intense or novel colors.

An illustrative example is the garden pansy (*Viola ×wittrockiana*), developed in the 19th century as a hybrid of *Viola tricolor* and *V. cornuta*. This species is characterized by larger flowers and more vivid petal colors.

Similar processes can be observed in the case of marigolds, which have been present in European ornamental gardens since the Middle Ages. Gertrude Jekyll described marigolds with double, feathery petals and referred to the introduction of "African marigolds" (*Tagetes erecta*) and "French marigolds" (*Tagetes patula*) from Mexico. It may be assumed that these imported species gradually replaced traditional calendulas in ornamental planting schemes.

In planting palettes for domestic gardens, species from the *Asteraceae* family tend to dominate (Table 4.1). Alongside *Rosaceae* – particularly the rose, with its regular pentagonal floral structure – *Asteraceae* represent the archetypal form of the flower as a star, a solar symbol with protective connotations across many cultures (Misius, 2015). It may be suggested that this formal regularity and vivid coloration contributed to their popularity; rudbeckia, widely used by Gertrude Jekyll, provides a clear example.

Table 4.1. Plant species mentioned by Polish gardeners in interviews ("a plant I cannot imagine a garden without") (Gawryszewska, 2013)

Family	Genus (Latin name)	Genus (common English name)
Asparagaceae	*Convalaria*	lily of the valley
Asteraceae	*Helianthus*	sunflower
Brassicaceae	*Matthiola*	stock, night-scented stock
Iridaceae	*Iris*	iris
Magnoliaceae	*Magnolia*	magnolia
Malvaceae	*Malva*	mallow
Papaveraceae	*Papaver*	poppy
Ranunculaceae	*Delphinium*	larkspur
Rosaceae	*Malus*	apple (apple tree)
Rosaceae	*Rosa*	rose

The process of replacing native plants with cultivars, non-native species, and their equivalents began in the 19th century and continues to this day. This applies to both ornamental and utilitarian plants. It should be emphasized that plant selection by garden owners is based not only on formal characteristics but also on species recognition and their presence in cultural memory. Research conducted in 2012 among landscape architects, gardeners, and artists confirms the persistence of these patterns. Respondents most frequently identified plants typical of domestic gardens, such as roses, night-scented stock, and apple trees,

as well as other species strongly embedded in garden tradition. Their responses often referred to the “grandmother’s garden” or “family garden”.

Taking into account that the reception of new trends in domestic gardens follows a generational cycle (approximately 80 years), it can be concluded that the garden constitutes a durable carrier of tradition. The model of the domestic garden, transmitted between generations, shapes both plant selection and the perception of the relationship between humans and landscape. Many of the plants identified in early 21st-century sources are still recognized as traditional species of rural gardens (Gawryszewska, 2013; Figure 4.5).



Figure 4.5. Plants embedded in the collective memory of the garden: garden pansy (*Viola ×wittrockiana*) (photo by Marcin N., 2004), orange coneflower (*Rudbeckia fulgida*) (photo by Jörg Kopp, 2004), African marigold (*Tagetes erecta*) (photo by Imcall, 2007), and wild rose (*Rosa* spp.) (photo by Walter J. Pilsak, 2004)

4.6. GARDENS OF THE 20TH CENTURY: A SYNTHESIS

The conceptual models of vegetation differed from the architectural model, becoming mixed and losing stylistic coherence. In all the aforementioned models for creating planting concepts, the garden design was treated as secondary and subordinate to the building’s architecture, thereby contributing to the phenomenon described. The Polish designer Alina Scholz (1908–1996) wrote: “because the house lends so much character to the plot on which it stands, the garden must adapt to it” (Scholz, 1937, p. 19; Figure 4.6).



Figure 4.6. Illustration depicting a front garden in the book “Ogródki nowe” (Scholz, 1937)

In the era of the triumph of functionalism, when it was the norm for gardens to be designed by architects unfamiliar with the range of plants, whilst their selection for the finished design was handled by botanists – gardeners who could not keep up with new trends in garden art – this disconnect became particularly evident. “Old” planting concepts were applied to “new” gardens. In garden design guides from the 1930s and books showcasing the Californian style in the 1950s in the United States, we see photographs of modernist villas surrounded by Edwardian perennial borders and dry stone walls à la Gertrude Jekyll, set against the backdrop of a lawn – devoid of decoration – characteristic of functionalism (Figure 4.7, Figure 4.8). In Poland, at similar villas in Konstancin near Warsaw, we find traces of flowerbeds with a “Victorian” selection of plants based on contrast (Jankowski, 1914; Muthesius, 1925). It was probably then that the practice emerged of creating a separate conceptual drawing, reduced to the composition and layout of plantings, marked out using uniform, identical circles on a plan view. Gardens were designed by marking out spaces for plants, rather than considering their types and species. Separate lists of so-called “species selection” were drawn up, often by different people. In this way, the concept of the garden’s vegetation remained completely detached from the overall concept.

It was assumed *a priori* that the more diverse the selection in terms of species and visual appeal, the better, and most ‘selections’ were drawn up adhering to this very principle. To this day, this working method is accepted as standard by most gardeners who routinely lay out gardens.

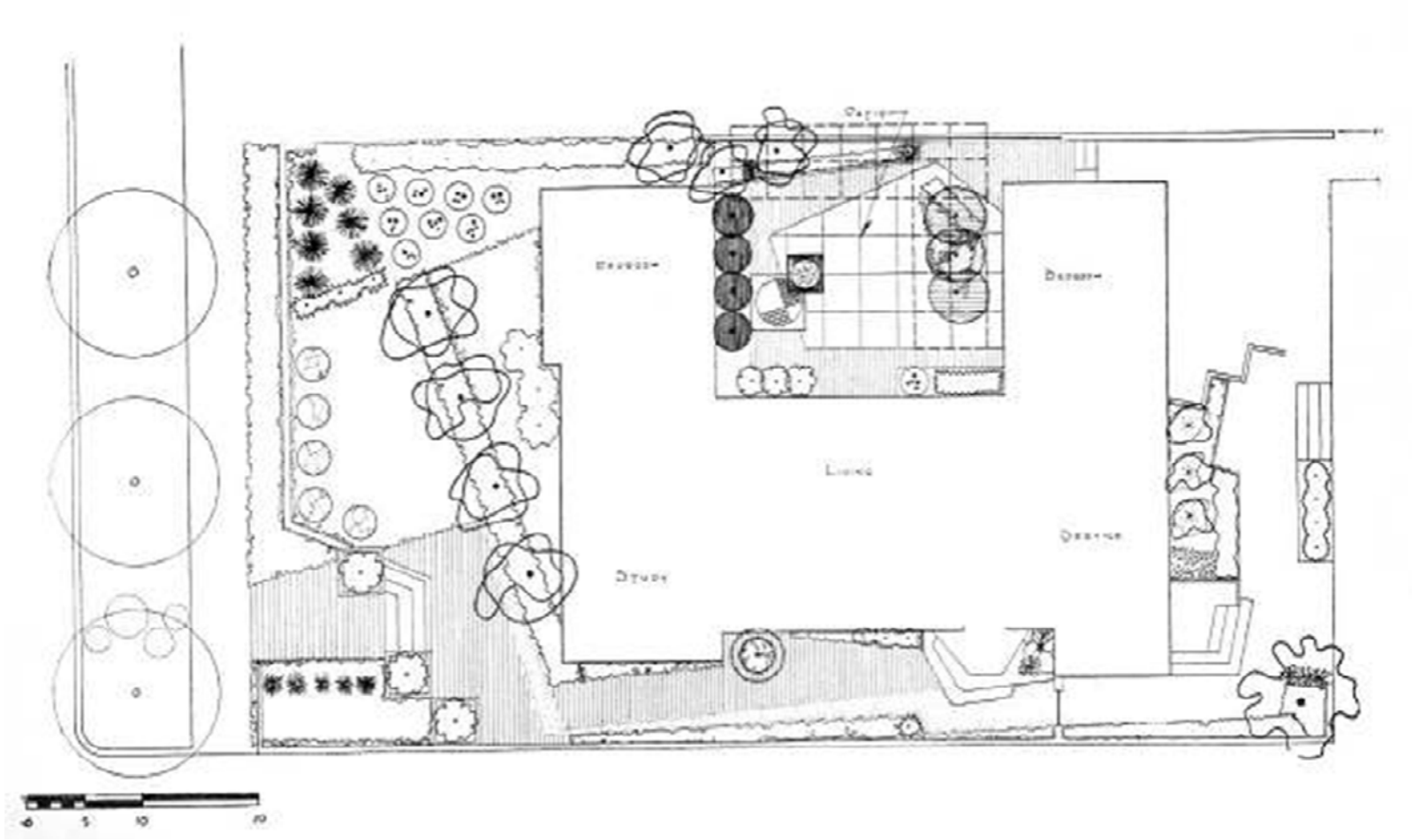

Figure 4.7. Plan of a Californian-style garden from the 1940s (Eckbo, 2002)





Figure 4.8. An Arts & Crafts-style flower wall by Markéta Roderová-Müllerová at the modernist Tugendhat Villa by Mies van der Rohe and Lilly Reich in Brno (photos by Beata J. Gawryszewska, 2019)

In the second half of the 20th century and at the beginning of the 21st century, the ideas pioneered by Gertrude Jekyll were developed towards a more ecological and dynamic approach to vegetation by designers such as Noel Kingsbury and Piet Oudolf. Their approach moves away from the static composition of flowerbeds in favor of arrangements inspired by plant communities, in which growth processes, seasonal change, and the structure of plants persisting beyond the flowering period play a key role. Oudolf's work in particular demonstrates a redefinition of garden aesthetics – the emphasis shifts from color to form, rhythm and the composition's durability over time, leading to the creation of so-called naturalistic gardens, deeply rooted in ecology, and in particular the so-called prairie beds, which represent a development of the naturalistic garden movement, inspired by the plant communities of the North American prairies. In contrast to classic perennial beds, based on color composition, their structure stems from observations of natural plant arrangements, in which grasses and perennials of varying heights and phenology play a dominant role. Of key importance here is not only the visual effect during the flowering period, but also the durability of the plants' form in subsequent phases of the season, including winter (Figure 4.9).

The development of this type of planting is linked to research into prairie vegetation and attempts to adapt it to European conditions, particularly in the context of designing low-maintenance public green spaces.



Figure 4.9. "Prairie" meadow in the Great Smoky Mountains National Park in Tennessee (photo by Rhododendrites, 2025)

4.7. CONTEMPORARY TRENDS: SITE ART AND FREE VEGETATION

Whether we regard postmodernism as a new style in garden art or as a declining variant of the modern style, it is impossible not to notice a shift in the approach to garden planting concepts, linked to a holistic treatment of the family home as opposed to the principle of the architectural garden from the Arts & Crafts era, which was intended to complement the architecture of the house. Postmodern trends in garden art, based on the ideas of land art and pop art, advocate the use of native plants in arrangements that allow the entire composition to blend perfectly into the landscape, merging with it, and potentially blurring the boundaries between the landscape and the garden. Site art, earth art, and environmentalism, emulated in domestic gardens through naturalized compositions of annuals, perennials, and pioneer trees (often with a phytoremediation function emphasized in the project's narrative), have only now made it possible to add the final chapter to Robinson's wild garden concept. Here, plants are not merely a visual medium, as was the case with Victorian flowerbeds and borders in the functional modern garden. They are treated as subjects in their own right, contributing not only to the garden's visual image but also to its layer of meaning and substance. It was only with the decline of modernism that the principles, already budding in the second half of the 19th century and described by the ideologues of the Arts and Crafts movement, could be fully developed. In recent years, the concept of free vegetation – that is the unrestricted growth of pioneer plants on prepared ground – has triumphed. Instead of "species selection", natural succession is allowed to take its course (Figure 4.10).



Figure 4.10. Garden for koala and by Koala Studio (Standler & Froschaue, 2007)

Review questions:

1. What were the basic functions of plants in traditional European country gardens, and what determined their selection?
2. How did the great geographical discoveries influence the species' composition of domestic gardens in the 19th century?
3. What are the fundamental differences between the Victorian and Edwardian models of flowerbed design?
4. How did the role of plants in modernist gardens change compared to earlier concepts?
5. How do contemporary approaches (naturalistic, ecological) reinterpret traditional garden models?

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5. PLANTING PLAN TODAY: BETWEEN DECORATIVE SCENERY AND WORKING LANDSCAPE

What is this chapter about:
This chapter explains the difference between a decorative landscape and a working landscape. It focuses on plant systems and their role in contemporary landscape design.

Plants can function not only as visual elements, but also as active parts of ecological systems. In a working landscape, plants regulate microclimate, support biodiversity, retain water, and respond to climate stress.
The chapter also introduces new design challenges related to climate change. It presents the typology of nature from the first to the fifth and explains how these concepts help us understand changing relationships between nature and culture in landscape design.
This chapter presents plant design not only as an aesthetic activity, but as an ecological and adaptive strategy.

What will you learn:
After reading this chapter, you will be able to:

- explain the difference between a decorative landscape and a working landscape,
- understand key ideas in contemporary landscape theory,
- identify major forms of climate stress,
- describe how plants respond to climate stress and recognize plant characteristics that support resilience,
- understand the main limitations of plant system design in the era of climate change.

5.1. INTRODUCTION

In the context of climate change, the traditional model of the decorative landscape is no longer sufficient. Decorative landscapes focus mainly on visual order, composition, and aesthetic control. They are usually based on static plant systems that require intensive maintenance. Such systems are often vulnerable to climate stress.

By contrast, a working landscape is understood as a dynamic ecological system. It performs environmental functions: it regulates temperature, retains and filters water, supports biodiversity, and adapts to changing conditions. This shift represents a fundamental change in design thinking. The value of landscape is no longer based only on appearance. It is based on environmental performance, resilience, and the ability to support natural processes.

The decorative landscape comes from traditions of formal and representative design. In this model, plants are treated mainly as compositional material. They are arranged according to principles such as symmetry, visual axes, rhythm, and contrast. The goal is to create a clear and controlled image of space. These landscapes are often designed as finished compositions and depend on irrigation, pruning, and continuous maintenance. Under conditions of climate change, this model shows clear limitations. Decorative landscapes are sensitive to drought, heat waves, and extreme weather events. They require large amounts of water and energy. They also respond poorly to environmental variability. As a result, they can become expensive and difficult to maintain over time.

The working landscape follows a process-based design approach. Green areas are treated as part of urban infrastructure. Plants, soil, and water form an integrated plant system. Together, they regulate microclimate, support biodiversity, improve water retention, and increase urban resilience. A working landscape accepts change. It allows seasonal variation, plant succession, and structural diversity. In this model, design does not aim at complete control. Instead, it manages change and supports natural processes. The aesthetic of a working landscape comes from visible ecological performance. Beauty is linked to water retention, shade, soil regeneration, biodiversity, and long-term stability. In the era of climate change, landscape is no longer only a background for the city. It becomes an active and functional system.

This transformation does not mean abandoning aesthetics. It means redefining it. Beauty is no longer based on visual perfection, but on resilience, regeneration, and balance between natural and cultural processes.

From this perspective, we can speak about relational ethics in landscape design. In this approach, plants are not treated as tools, but as partners within a plant system. This idea is especially important in working landscapes. There is a risk that, even in ecological projects, plants may be used only as instruments. For this reason, plant well-being must remain a primary design criterion. Even when a landscape is designed to solve environmental problems, plants should be given conditions that allow them to thrive, adapt, and regenerate.

5.2. DESIGNING PLANT SYSTEMS IN THE ERA OF CLIMATE CHANGE

When designing vegetation in urban areas under conditions of ongoing climate change, designers must pay special attention to the intensification of the urban heat island effect, increasingly frequent and prolonged periods of drought alternating with heavy rainfall events, and the rise in temperature extremes such as heat waves or sudden cold spells. An additional challenge is the degradation of urban soils: compaction, salinity, low organic matter content, limited water availability, and increased pressure from biotic stresses such as diseases and new invasive species.

Discussions about climate change in landscape design can be carried out on two parallel levels: the global and the local.

At the global scale, we refer to long-term, large-scale processes such as rising average temperatures, changes in the annual amount and distribution of precipitation, longer drought periods, more frequent extreme events, and shifts in vegetation ranges, including the forest line. Individual projects have limited influence over these processes. However, designers must consider them as a background framework for decisions about plant species and spatial composition.

At the local scale, more direct and visible phenomena appear: urban heat islands, flooding caused by sealed surfaces, periodic drought within specific districts, and changes in groundwater levels due to new construction or underground infrastructure. It is at this level that landscape architects have real tools for action – through water retention strategies, microclimate design, protection of existing water conditions and the selection of stress-tolerant species,

Awareness of both scales allows for responsible design. Global processes form a broader framework, while local phenomena create the field for concrete design intervention (Figure 5.1).

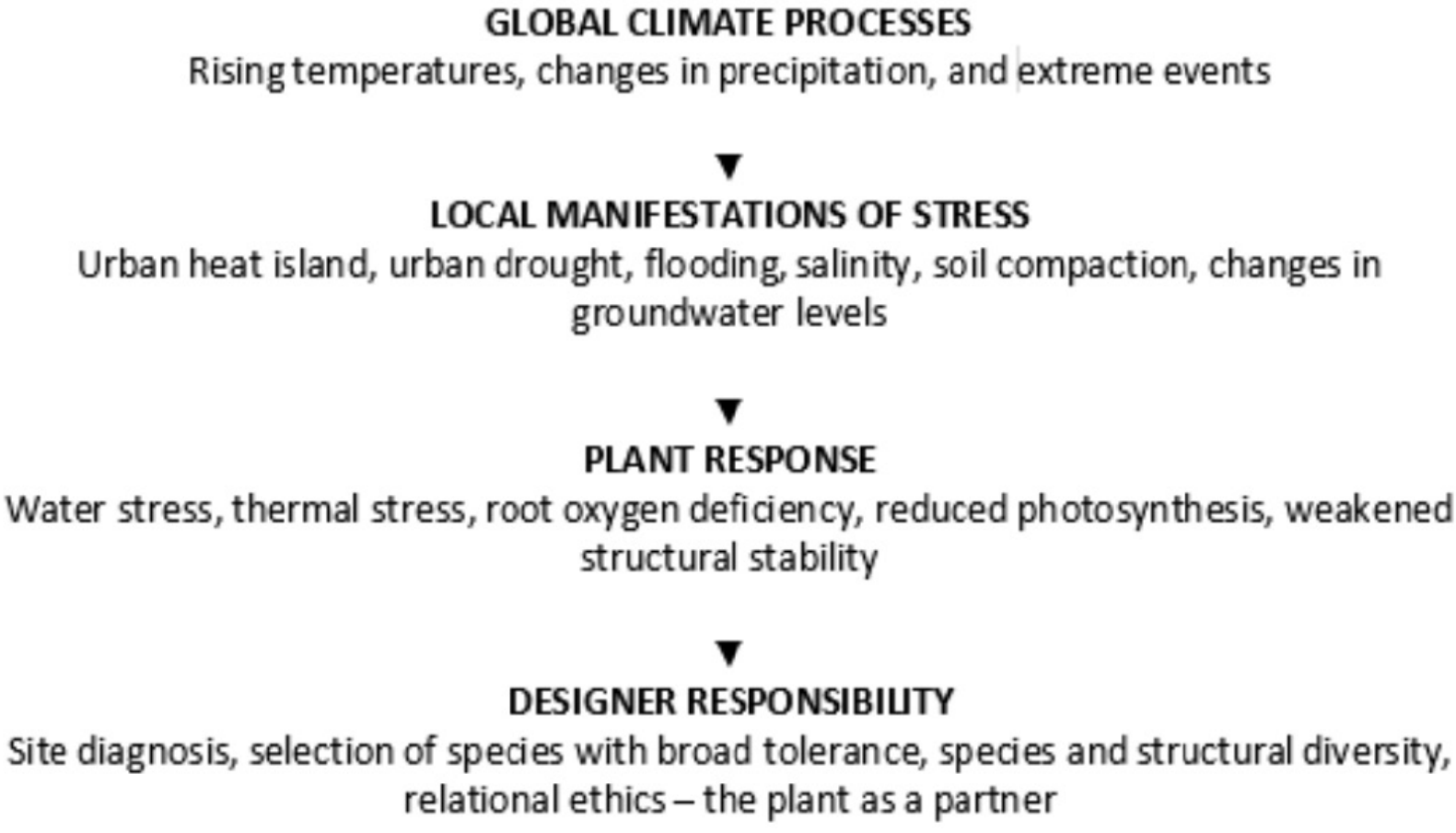

Figure 5.1. Climate stress. Plants and designers' response (own work)

5.3. PLANT RESPONSES AND DESIGN RESPONSIBILITY

Plants respond to environmental stress – such as drought, heat waves, periodic flooding, salinity, or air pollution – through a range of physiological mechanisms (Table 5.1). Climate-resilient design does not mean eliminating risk. Instead, it means creating conditions in which plants can function in the highest possible state of well-being, even under conditions of variability and uncertainty.

When discussing the responsibility of the designer, it is important to emphasize the concept of plant well-being. Without this understanding, there is a risk of falling into a paradox: in the name of ecology, plants may once again be treated instrumentally.

For this reason, plant well-being should be treated as a primary design criterion – even in projects conceived as working landscapes that aim to solve environmental problems.

Table 5.1. Plant responses to environmental stress and design response (own work)

Environmental stress factor	Typical plant response	Design response
Drought/Water deficit	Reduced transpiration, leaf drop, deeper root growth, slowed growth	Selection of drought-tolerant species; increasing soil organic matter; mulching; rainwater retention systems; reducing sealed surfaces
Heat waves/ High temperatures	Stomatal closure, leaf scorching, reduced photosynthesis	Designing shaded areas; multi-layered vegetation; use of heat-resistant species; protection of root zones
Periodic flooding/ Waterlogging	Root oxygen deficiency, chlorosis, reduced stability	Use of flood-tolerant species; improving soil structure and drainage; designing retention basins and rain gardens
Soil salinity	Leaf burn, osmotic stress, inhibited nutrient uptake	Selection of salt-tolerant species; limiting use of de-icing salts; improving soil permeability
Soil compaction	Restricted root growth, limited water and air exchange	Soil decompaction; structural soils; protection of root zones during construction
Air pollution	Reduced photosynthesis, leaf damage, weakened vitality	Selection of pollution-tolerant species; increasing species diversity; creating vegetative buffers
Invasive species/New pests	Competition, disease spread, ecosystem imbalance	Increasing biodiversity; monitoring; adaptive management strategies

Table 5.1 shows that plant stress responses are closely connected to design decisions. Climate-responsive design requires understanding plant physiology and translating this knowledge into spatial, material, and ecological strategies. The goal is not full control over environmental conditions, but the creation of resilient systems that allow plants to adapt and maintain their vitality over time.

5.4. METHODS OF LANDSCAPE DESIGN IN THE ERA OF CLIMATE CHANGE

Landscape design is based on a clear distinction between two stages: the analytical stage and the creative stage. These stages are closely connected and influence one another.

5.4.1. The analytical stage

In the analytical phase, the landscape architect should use tools that allow for an accurate recognition of real environmental conditions. These include:

- urban heat island maps,
- flood-risk maps,
- drought maps and water balance analyses,
- studies of groundwater level changes,
- inventories of existing vegetation.

Particularly important is the identification of species already present in the designed landscape. This reflects an understanding of the local biological potential. Such analysis should not be treated as a purely formal documentation requirement, but as the foundation for further design decisions.

5.4.2. The creative stage

In the creative phase, the landscape architect formulates design guidelines directly based on the recognized environmental conditions. This means, above all, using the potential of plants already present in the landscape and limiting the introduction of new species to situations that are functionally justified. In more natural landscapes, it may be appropriate to create only small enclaves of decorative planting, while allowing the largest possible part of the space to function freely as a biological system.

In this approach, it is essential to move away from a linear model of decision-making toward a cyclical way of thinking. The landscape architect should balance four key aspects:

- Ecology – defines the survival conditions of the system: habitat conditions, biodiversity, climate resilience.
- Ethics – defines the meaning and limits of intervention: partnership with plants, environmental responsibility, boundaries of interference.
- Aesthetics – builds the social relationship with landscape: composition, public perception, seasonal change.
- Economy – determines the feasibility of implementation and maintenance: construction costs, long-term maintenance costs, and availability of plant material.

These aspects are not hierarchical and are not subordinate to one another. Instead, they form a system of interdependencies in which each element influences the others. Only by balancing all four designers can create landscapes that are durable and responsible (Figure 5.2).

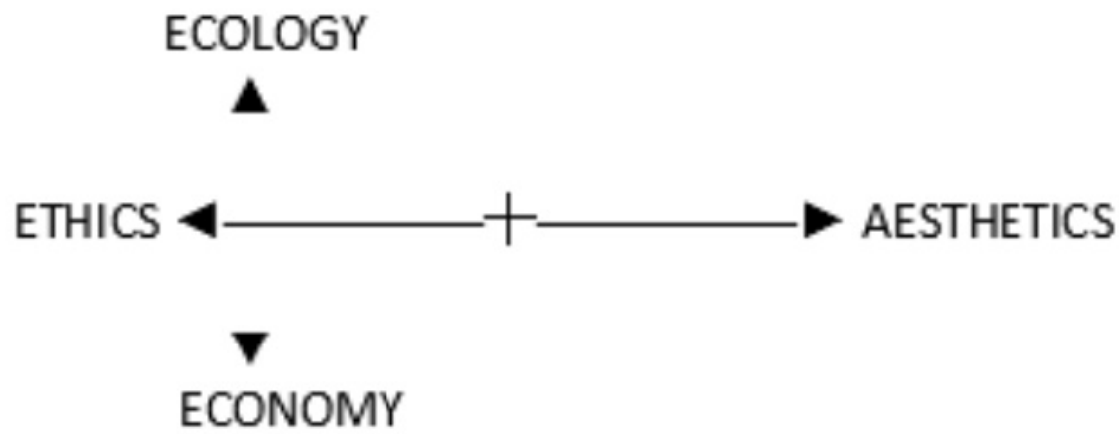

Figure 5.2. Cyclical model of conceptual relationships in green design (own work)

Figure 5.2 has a cyclical rather than algorithmic character. It does not indicate a clear starting or ending point. Each design decision should be confronted with each of these four dimensions. Responsible landscape design in times of climate changes requires continuous reflection and adjustment, rather than a single, fixed sequence of steps.

5.5. CONTEMPORARY DEVELOPMENT TRENDS IN PLANT DESIGN

Contemporary trends in plant design seek solutions that interfere as little as possible with natural ecosystems. The role of the designer is to select different plant forms and arrange them into compositions that respond to the social need for beauty – yet within a new aesthetic canon. In this approach, the key principle is the use of native plants and the strengthening of biodiversity.

5.5.1. Designing in harmony with nature

Designing in harmony with nature means shaping green spaces based on the recognition and respect of existing natural processes, local habitat conditions, and the long-term dynamics of landscape – rather than forcing them into an arbitrary formal concept. In Polish landscape architecture, this approach is clearly expressed in the idea of “reading the landscape” and analyzing its natural and cultural structure, which assumes that a project should result from understanding the existing terrain, vegetation systems, and the history of a place (Bogdanowski, 1999).

Designing in harmony with nature does not mean abandoning form or aesthetics. Instead, it means subordinating them to habitat conditions, ecological processes, and user experience, so that the landscape can function as a relational and regenerative system (Gawryszewska, 2015; Sawicka, 2018). In this perspective, the value of a project does not result primarily from visual effect, but from durability, resilience, and the ability of the landscape to coexist with natural and social processes over time.

5.5.2. Native plants and biodiversity

It is important to use native plants in design – species that developed and function in a given region without human introduction, in long-term relationship with local climate, soils, and other organisms. In landscape architecture, native plants are defined not only geographically, but also ecologically – as components of local natural systems that co-create stable and self-regulating plant communities (Hitchmough, 2011).

Native plants are usually more resistant to local climate stress, require less water and maintenance, and play a crucial role in sustaining ecological relationships, especially between plants and local fauna. Their importance is closely connected with the protection and restoration of biodiversity, understood as the diversity of species, habitats, and biological interactions. Native species form the basis of local food webs. They are essential for pollinators, birds, and invertebrates, and they enable the completion of full life cycles for many organisms.

Unlike many exotic species, native plants do not simply occupy space. They actively sustain local ecosystems. For this reason, they are one of the most important design tools in addressing biodiversity loss in cities (Tallamy, 2007; Dunnett, 2015).

In contemporary design approaches, native plants form the foundation of working landscapes, green infrastructure, rain gardens, urban meadows, and climate adaptation projects. They are also central to regenerative and biophilic design, where vegetation is treated as an active environmental component rather than neutral decoration (Dunnett & Kingsbury, 2008). In this sense, designing with native plants does not mean returning to “wild nature.” Instead, it means consciously shaping landscape as a resilient, biodiverse, locally rooted system capable of functioning under contemporary climate challenges.

5.5.3. The thesis of “Not designing plants, but designing plant systems”

A landscape architect should understand that the basic unit of design is not the individual plant, but the plant system as a whole, functioning over time and in relation to its surroundings.

The designer should be able to create plant compositions in which the form of individual plants is subordinate to the logic of the entire system – its seasonal variability, succession processes, and adaptive capacity. This means designing an aesthetic in which variability and structural diversity are values, not design mistakes. The landscape architect should also understand that the beauty of a working landscape is not limited to visual perception. It is expressed in

the benefits it generates within the ecosystem: support for biodiversity, regulation of microclimate, water retention, and the landscape's ability to regenerate over time.

5.6. FROM THE FIRST TO THE FOURTH NATURE

Landscape design has always taken place at the intersection of nature and culture. Attempts to describe this relationship form one of the fundamental themes in garden and landscape theory.

Already in ancient thought, a distinction appeared between nature understood as a primary order and nature shaped by humans. Cicero wrote about secunda natura – a world transformed by culture and human reason (45 BCE). In Renaissance thought, Jacopo Bonfadio (1541) developed this distinction by introducing the idea of terza natura. In this concept, the garden becomes a conscious synthesis of nature and art, and plants serve as carriers of meaning, form, and representation. Contemporary landscape theory returns to these concepts but interprets them in new contexts. John Dixon Hunt (2000) argues that successive "natures" are not only historical stages, but ways of thinking about the relationship between humans and landscape that reappear in different periods in different forms. Landscape can therefore be cultural heritage, a tool of representation, and a space of experience at the same time. Its "naturalness" is always relative to design intention. Similarly, Anne Whiston Spirn (1998) shifts attention from form to processes and to the language of landscape. She emphasizes that landscape – regardless of the degree of cultural transformation – functions as a system of interconnected ecological, social, and symbolic relationships. In this view, naturalness does not mean the absence of intervention, but the continuity and readability of processes that design can either support or disturb. In this context, the ideas of Gilles Clément (2004) are particularly important. Speaking about the "third landscape" and the "garden in movement," he moves away from linear classifications of nature and highlights the dynamic and process-based character of contemporary landscape. The designer does not simply shape form, but moderates relationships between nature and culture. This shift allows us to understand successive "natures" not as closed categories, but as changing states of balance. The concept of the fourth nature, developed by Ingo Kowarik (2011, 2018), refers to spontaneous vegetation appearing in heavily transformed urban and post-industrial areas. Here, plants do not serve decorative purposes. Instead, they reveal the regenerative capacity of landscape. The role of the landscape architect is to recognize and consciously integrate these processes into design rather than eliminate them. This concept forms an important link between classical levels of naturalness and contemporary ideas of the working landscape (Figure 5.3).

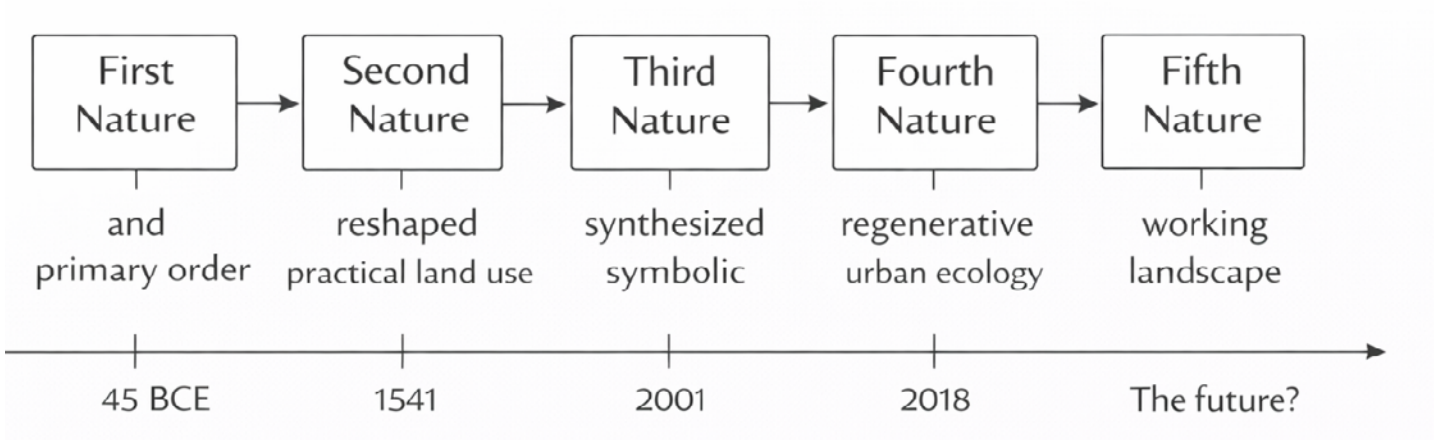

Figure 5.3. Nature's timeline (own work)

Nature in design projects

The first nature refers to the landscape perceived as primary or strongly natural. Design intervention is minimal, and the role of the landscape architect is mainly the protection and conservation of existing natural structures. If plant selection occurs at all, it follows the logic of habitat conditions. Decorative intentions are not the primary goal.

The second nature describes a landscape transformed for practical use, historically connected with agriculture, productive gardens, and cultural landscapes. Here, plant selection combines functional and aesthetic roles. Composition is based on order, repetition, and clarity of form. Decoration is allowed but remains subordinate to function and structure.

The third nature refers to formal and representative gardens where culture clearly dominates nature. Plants function mainly as compositional material. Species selection is subordinated to form, symbolism, and representation. In the context of historical parks and gardens, this model remains justified because it reflects cultural values and heritage.

The fourth nature emerges in modern urban and transformed landscapes. Design here involves reinterpretation of existing structures. Plant selection moves away from pure decoration toward functionality, resilience, and adaptability. Plants take on ecological, technical, and social roles. Composition becomes more flexible and process-oriented (Figure 5.4).

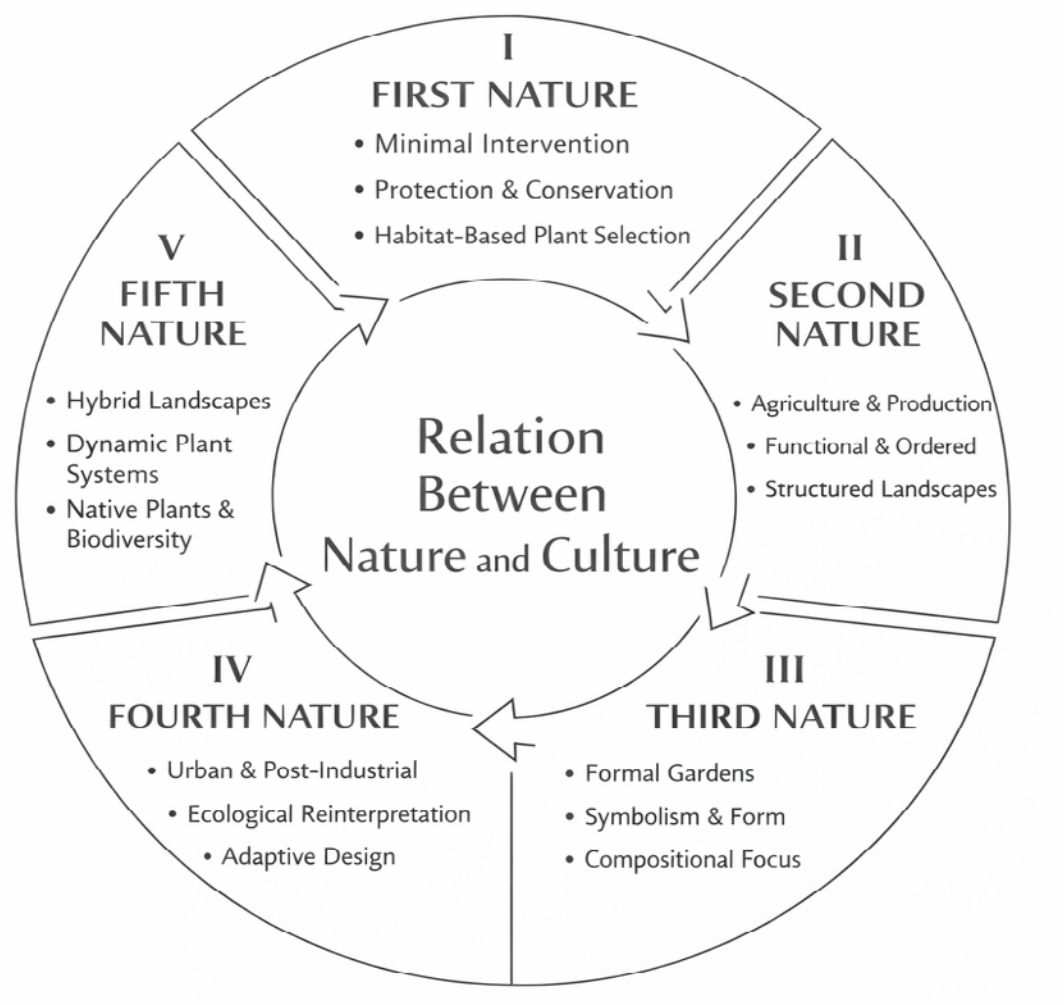

Figure 5.4. Cycle of the nature (own work)

5.7. THE FIFTH NATURE?

Is it justified to speak about the fifth nature in contemporary landscape design? The question remains open. This perspective relates to the idea of the working landscape – a hybrid condition in which the boundary between nature and culture becomes blurred. In this context, the landscape architect must design plant systems as dynamic structures based on native species, biodiversity, succession, and change over time.

Decorative qualities do not disappear completely, but they are transformed into aesthetics of performance, where beauty results from the functioning of the system rather than from the form of individual plants.

> The fifth nature may not be another closed historical stage, but rather a state of design awareness. It appears that the designer recognizes that their role is neither full control over nature nor passive withdrawal from design, but the creation of conditions

for coexistence between natural and cultural processes. In this sense, we may not be moving toward the fifth nature – we may already be living within it. We are learning how to design landscapes that allow nature to act, regenerate, and regain agency. The fifth nature, therefore, remains an open concept, developing together with design practice. Its theory does not precede action; it grows out of the experiences of designers who, in response to the climate crisis, redefine criteria of beauty, durability, and responsibility. A new aesthetic – based on variability, processes, and relationships – and a new ethic – based on partnership with plants – form the framework for this emerging concept. In this understanding, landscape architects do not only design within the fifth nature; they actively co-create it, shaping its meaning, language, and future canon.

5.8. HYBRIDIZATION OF FUNCTIONS IN GREEN AREAS

In working landscapes with hybrid functions – designed to restore environments affected by degradation – plants are given a special role. This role is clearly positioned at the opposite end of the spectrum from pure decoration.
In landscapes of the second nature and the third nature, plants primarily fulfilled aesthetic functions. They became ornaments, subordinated to human perception and visual expectations. In working landscapes, however, their presence is justified mainly by environmental performance. The decorative function loses its autonomy, and design reflection shifts toward ethics, where aesthetics alone no longer seems to be a sufficient argument for shaping landscape.

At the same time, an important tension emerges. When plants are used for phytoremediation, soil restoration, air filtration, or stabilization of degraded structures, they appear once again as “repairers” of the consequences of human activity – as if they were taking responsibility for anthropogenic destruction.
In this sense, there is a risk that plants, even when used in the name of environmental ethics, may once again be reduced to instruments. This leads to a fundamental question: in the process of restoring degraded landscapes, is it possible to establish a partnership with plants, or do we remain at the level of instrumental use of their biological capacities? The question remains open, especially since – as discussed earlier – we are in the process of shaping the fifth nature, whose meaning and boundaries are still emerging.

5.9. FUNCTIONAL PLANTS IN WORKING LANDSCAPES: LOGIC OF SELECTION

Polish urban standards emphasize the necessity of selecting plants adapted to difficult habitat conditions, including drought, salinity, and compacted soils, as well as recognizing their phytoremediation potential.

In this context, plant selection is based not only on appearance, but on ecological tolerance, adaptive capacity, and long-term resilience within specific site conditions (Table 5.2).

In degraded landscapes, functional plants are selected primarily according to their capacity to respond to:

- drought and overheating,
- periodic flooding and water retention,
- air pollution and dust contamination,
- soil stabilization and erosion control.

Table 5.2. Functional plants in Polish working landscapes (own work based on ZZW, 2026)

Environmental function/problem	Functional characteristics of plants	Latin name
Drought, heat island, urban stress	Tolerant of high temperatures, periodic drought, and compacted soil; useful in roadways and urban areas	*Acer campestre*
		Quercus palustris
		Quercus rubra
		Robinia pseudoacacia
		Tilia ×europaea 'Pallida'
Drought (perennials and groundcovers)	Resistance to periodic water deficit, the ability to create turf, and stabilize the surface	*Geranium sanguineum*
		Ceratostigma plumbaginoides
		Buglossoides purpurocaerulea
Water retention – upper zone of the rain garden	Tolerance of alternating wetness and dryness; slows down drainage	*Juncus effusus*
		Deschampsia cespitosa
		Lythrum salicaria
		Iris sibirica
		Filipendula ulmaria

Table 5.2. Functional plants in Polish working landscapes (own work based on ZZW, 2026) (cont.)

Environmental function/problem	Functional characteristics of plants	Latin name
Water retention – flooded Marshy zone	Resistance to periodic flooding, sediment stabilization	*Caltha palustris*
		Alisma plantago-aquatica
		Butomus umbellatus
		Sparganium erectum
		Typha angustifolia
Dust, NO_x, air pollution	Large leaf/needle surface, tolerance to urban pollution	*Platanus ×acerifolia*
		Tilia cordata
		Acer campestre
		Populus nigra
		Fraxinus spp.
Phytoremediation of degraded soils	High biomass production, contamination tolerance, and participation in reclamation	*Salix* spp.
		Populus spp.
		Miscanthus ×giganteus
		Sida hermaphrodita
		Helianthus tuberosus
Slope and erosion stabilization	Dense root system, quick ground cover	*Cotoneaster* ‘Coral Beauty’
		Stephanandra incisa ‘Crispa’
		Symphoricarpos ×chenaultii ‘Hancock’
		Euonymus fortunei (climbing variety)
		Vinca minor
Surface stabilization – vines	Ground/slope cover, erosion reduction	*Hedera helix*
		Parthenocissus quinquefolia
		Parthenocissus tricuspidata

> Species selection must always be adapted to local habitat conditions, climate projections, and current regional guidelines. Native species should be prioritized whenever possible to support biodiversity and ecosystem stability.

5.10. CHALLENGES AND LIMITATIONS

Designing working landscapes requires interdisciplinarity – not as an addition, but as a condition for project success. Today, the landscape architect combines composition and local tradition with ecology, hydrology, climate knowledge, and ethical and social reflection.

However, limitations appear already at the level of perception. Local communities may not be prepared for the new aesthetic of process-based landscapes – such as meadows, spontaneous vegetation, or less "tidy" arrangements – even if these are ecologically beneficial. Research shows that acceptance of biodiverse and "low-intervention" landscapes depends on whether users recognize intention and care in them. In practice, so-called "cues to care" are helpful: visible signs of order such as edges, paths, or information boards that frame ecological "messiness" (Nassauer, 1995; Fischer et al., 2020). In the Polish context, similar tensions are visible. Studies indicate that residents are more likely to accept semi-wild green areas when maintenance and management are clearly visible, and that preferences differ among social groups (Fundacja Sendzimira, 2024).

Another group of limitations results from climate uncertainty and the complexity of urban systems. A working landscape cannot be designed as a fail-safe system – fully controlled and stable – but rather as a safe-to-fail system. This means allowing variability, testing solutions at smaller scales, and being ready to adjust over time (Ahern, 2011). In practice, interdisciplinarity also includes risk management, communication with users and institutions, and the design of maintenance processes – not only spatial form. The key challenge is therefore not only what we design – a plant system – but how we design relationships between aesthetics, ethics, science, tradition, and social readiness for change.

5.11. MANAGEMENT, TECHNOLOGY, AND EXPERT TEAMS AS A DESIGN CHALLENGE

One of the main challenges in designing working landscapes is shifting from understanding the project as a product to understanding it as a process. Such landscapes require long-term management, monitoring, and adaptive maintenance. Landscapes with hybrid functions – serving aesthetic, ecological, retention, and restorative roles at the same time – cannot be designed or

maintained using uniform, schematic gardening practices. They require an interdisciplinary approach in which design, implementation, and maintenance form a continuous and interconnected process.

An important and often underestimated challenge concerns the relationship between design ideas and the realities of the nursery market. If a new understanding of design – based on interdisciplinarity, relational ethics, and partnership with plants – is to become real practice rather than only theory, the availability of plant material must be considered. Landscape architects do not design in an abstract space. They work within a concrete economic and organizational context, where what can be designed is often limited by what can be sourced. Even the most coherent concept of a working landscape may be difficult or impossible to implement if the nursery market is not prepared to supply appropriate plant species, forms, sizes, or quantities adapted to new landscape functions. This challenge concerns not only scale or price, but a deeper paradigm shift: from plants produced for immediate decorative effect to plants cultivated for long-term functioning in working landscapes.

Therefore, real cooperation between designers and plant producers becomes essential. This cooperation should not be based only on short-term market demand, but on a shared understanding of changing directions in landscape practice. It is not about simply redefining the offer, but about co-shaping trends that respond to working landscapes, climate change, and new ethical standards in design. Such transformation also requires engagement from other disciplines: research on plant adaptation, cultivation practices, nursery resilience, and methods of introducing plant material into landscapes in ways consistent with the idea of partnership.

It is important to note that this change cannot occur only among designers and producers. Visual and aesthetic culture – shaped by art, education, and public discourse – also plays a crucial role. If artists, designers, and educators consistently promote the aesthetics of the working landscape, social expectations toward green spaces will gradually change. As expectations change, the market will respond to new needs.

Review questions:

1. How do we understand the differences between decorative scenery and working landscape in the era of climate change?
2. Which climate-related phenomena must we pay particular attention to when designing plant systems?
3. How can design strategies minimize the risk of plant system failure under changing climate conditions?
4. What are the key ideas behind the typology of landscapes from the first nature to the fifth nature?
5. What do you consider the main limitations of contemporary plant design?

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6. SUSTAINABLE PLANTING STRATEGIES FOR THE MEDITERRANEAN CONTEXT: LEBANON CASE STUDY

What is this chapter about:
Landscape architecture in the Mediterranean region faces significant challenges driven by climatic pressures. In Lebanon, situated on the eastern side of the Mediterranean, the climate is described as as dry and hot, with fragile soils and seasonal extremes. Addressing these conditions requires water-sensitive, climate-responsive design strategies that prioritize native vegetation, soil conservation, microclimate management, and resilient planting palettes.

What will you learn:

- Description of Mediterranean climate, specifically the Eastern side where Lebanon is located. What are the extreme weather events as the main challenges of landscape architects in this region?
- The three main pillars for a successful design in the region are: proper plant selection, water management, and soil management.
- Proper plant selection: Characterization of local flora, and how they adapt to the climate. What are the plant communities of the regions, how have they evolved as stable, resilient systems, and how can we mimic these systems?
- Proper water management: water-sensitive design, proper techniques to save water.
- Proper soil management: How to improve poor soils to retain water and to slow down stormwater runoff.

6.1. SHIFTING PATTERNS: THE MEDITERRANEAN CLIMATE IN A WARMING WORLD

Mediterranean climates are found on the western edges of continents between 30° and 45° north and south latitude. Major regions include the Mediterranean basin, California, central Chile, South Africa’s Cape region, and southwestern Australia (Figure 6.1). These areas share a characteristic pattern of hot, dry

summers and mild, wet winters, with most rainfall occurring during the cooler months (Urdiales-Flores et al., 2024). This climate adopted ecosystems with exceptional richness, making Mediterranean regions recognized as biodiversity hotspots. Evergreen shrubs and trees typically dominate vegetation, while seasonal herbaceous plants add further variety and resilience to these landscapes (Ferreira et al., 2024).

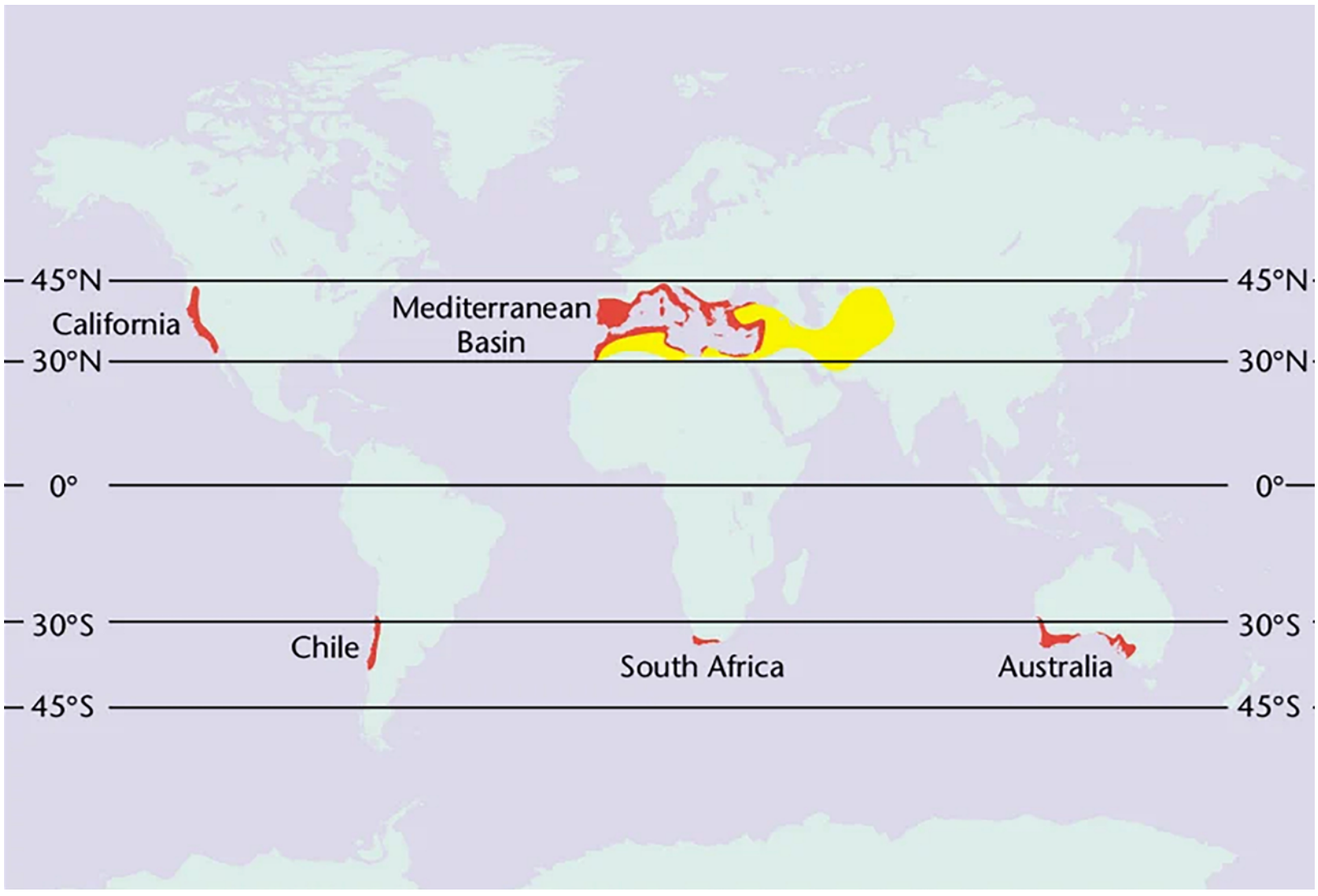

Figure 6.1. Major Mediterranean regions of the world (Joffre & Rambal, 2001)

However, these unique ecosystems now face growing threats, as the region is experiencing temperature increases that exceed the global average. For instance, the Eastern Mediterranean basin is projected to be particularly vulnerable. By 2050, temperatures are expected to rise by 3.5 to 7°C, alongside a 30–50% reduction in freshwater resources, which will place both biodiversity and human populations under severe stress. (Saade et al., 2019; Kaniewski et al., 2024). Drought in the region is becoming more frequent, prolonged, and severe. Consequently, it is projected to intensify wildfire risk, with longer fire seasons, greater fire intensity, and up to 40 additional days of high fire danger by the end of the century (Ruffault et al., 2020; Rovithakis et al., 2022). Reduced precipitation and increased evaporation are likely to cause significant declines in groundwater recharge and surface water availability, making shifts in water management essential. In response, more

efficient irrigation practices and the adoption of drought-tolerant plant species will be necessary to adapt to these changing conditions (Ertürk et al., 2014). On the other hand, flooding events are expected due to uneven precipitation and intensifying changes in rainfall patterns.

> Landscape plants in the Mediterranean region should be selected not only for their aesthetics but also for their adaptability to drought, temperature extremes, and waterlogging conditions. Emphasizing native species and traditional agroforestry systems can help maintain biodiversity and provide essential ecosystem services.

6.2. PLANTS FOR RESILIENT MEDITERRANEAN LANDSCAPES

Plants in the Mediterranean regions are adapted to survive long, hot, dry summers and mild, wet winters. They are resilient to local conditions such as heat and prolonged periods without water, and have different mechanisms (adaptive traits) to survive these stresses.

Drought-tolerant plants known as xerophytes developed many adaptation mechanisms to survive drought stress. These plants often show changes in leaf anatomy, such as smaller leaf size, increased leaf mass per area, and thicker cuticles to reduce water loss. During drought stress, plant cells accumulate osmolytes (water-soluble organic compounds that help cells maintain their internal osmotic balance) to maintain turgor pressure, ensuring that cells retain water and continue normal metabolic processes. In addition, xerophytes often increase antioxidant enzyme activity to decrease dehydration damage (Yavas et al., 2024). systems of these plants are also adapted to water stress by developing deep root systems that allow them to access water from deeper soil layers during dry periods (Sardans & Peñuelas, 2013). Genera such as oaks (*Quercus* sp.), pines (*Pinus* sp.), and strawberry tree (*Arbutus* sp.[1] – Figure 6.2) in the Mediterranean context exhibit various drought resistance mechanisms, including deep rooting patterns and embolism repair (Bussotti & Pollastrini, 2020).

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[1] For instance, *Arbutus andrachne* resists drought through a combination of mechanisms, including physiological and metabolic adaptations, such as regulating transpiration via stomatal closure, increasing the production of antioxidant compounds like flavonoids to mitigate oxidative stress, and showing high plasticity in its physiological and metabolic responses depending on the genotype and specific environmental conditions.



Figure 6.2. *Arbutus andrachne* (photo by Andrew Butko, 2008)

Besides drought, plants in this region must also adapt to salt stress, which causes ion toxicity and osmotic stress, limiting plant growth and development. Most plants cannot survive in saline environments, as high salinity interrupts their entire life cycle. However, halophytes are salt-tolerant plants that thrive in such conditions through various anatomical, physiological, and biochemical adaptations. They can store water in their tissues to dilute salt and provide support. They develop salt glands and vesicular hairs that help remove excess salts, maintaining ionic balance within their cells. Their ability to thrive under such a condition can be a viable solution to the challenges posed by climate change (Grigore & Toma, 2021). As an example (Figure 6.3), sea fennel (*Crithmum maritimum*[2]) is naturally distributed along coasts and in saline environments, making it suitable for ecological restoration, gardening, and green roof systems (Mircea et al., 2025). Another species, the sea rush (*Juncus maritimus*), thrives in saline, waterlogged environments.

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[2] A perennial halophyte native to Mediterranean coasts that grows on rocks, sandy beaches, and piers. It is an edible and medicinal plant.



Figure 6.3. *Crithmum martitimum* (Kraouia et al., 2023) and *Juncus maritimus* (photo by Zeynel Cebeci, 2016)

Mediterranean ecosystems are highly fire-prone, hence plant species in this context have developed specific adaptations to survive and thrive. Adaptations such as physical seed dormancy, which is broken by the heat from fires, low leaf area, and resprouting, allow them to regenerate quickly after a fire (Paula & Pausas, 2008). Species such as sage-leaved rock-rose (*Cistus salviifolius*[3]), also known for its drought resistance, show higher germination rates after heat shock, indicating a strong fire adaptation (Figure 6.4).



Figure 6.4. *Cistus salviifolius* (photo by Luis Fernández García, 2011)

[3] It regrows very quickly following a fire. The flowers are attractive to pollinators like bees and butterflies because of their vibrant colors and sweet scents. Additionally, the plant is self-fertile.

Plants are selectively adapted to flooding conditions, mostly those thriving in riparian zones. Riparian ecosystems are vital transitional habitats between land and water, where vegetation has evolved diverse adaptive strategies to tolerate flooding events and seasonal droughts. For instance, Lebanese willow (*Salix libanii*), native to Lebanon, Turkey, and Syria, demonstrates such adaptation by developing adventitious roots, enabling it to survive in anaerobic soil conditions caused by flooding (Stephan & Issa, 2017). Another important keystone species in the riparian ecosystem is the oriental plane (*Platanus orientalis*), which supports biodiversity and plays a crucial role in maintaining the ecological balance and health of riparian zones.

6.3. PLANTING DESIGN STRATEGIES FOR THE MEDITERRANEAN CONTEXT

To prepare for future climate challenges, landscape architects, especially in the Mediterranean region, should adopt a proactive and complex approach where planting strategies play a key role. The main goals are to adapt to extended drought periods, manage stormwater from shorter, more intense events, reduce surface runoff, and lower urban heat by using locally adapted plant species. It is also essential to integrate ecological knowledge into design to support biodiversity and strengthen ecosystem services. Effective planting strategies depend on choosing plant species that can tolerate extreme weather and survive in harsh environmental conditions.

In response to climate adaptation needs, the global horticultural trade has introduced various non-native species into new regions, giving rise to a new category known as “invasive ornamentals.” While these ornamentals have shown promising resilience to current climate pressures, their long-term ecological impacts remain insufficiently studied, calling for further research (Mircea et al., 2025).
Alternatively, using native Mediterranean plants in landscaping not only enhances aesthetics but also promotes environmental sustainability and biodiversity. These native species are naturally adapted to local climate and soil conditions, making them ideal for creating resilient, low-maintenance green spaces that can better withstand future environmental changes.

6.3.1. Planting strategies for droughts

Xeriscaping, which involves using highly drought-tolerant native plants to reduce water consumption significantly, provides a range of ecological, economic, and aesthetic benefits for planners and designers. From an environmental perspective, it helps conserve water resources, support plant and wildlife habitats, protect biodiversity, enhance soil quality, prevent erosion, limit the use

of fertilizers, and reduce groundwater contamination. Such a design could save more than 50% of both construction and annual maintenance costs in the Mediterranean context (Çetin et al., 2018). Native plants such as rosemary (*Rosmarinus officinalis*), cotton lavender (*Santolina chamaecyparissus*), goldmoss stonecrop (*Sedum acre*), and common thyme (*Thymus vulgaris*) are highly recommended as they have no invasive potential. As for woody trees: Greek strawberry tree (*Arbutus andrachne*), carob[4] (*Ceratonia siliqua*), Judas tree (*Cercis siliquastrum*), and silver berry (*Eleagnus angustifolia*) are recommended for their adaptation to the climate. Mediterranean shrublands host species such as kermes oak (*Quercus coccifera*), mastic tree[5] (*Pistacia lentiscus*), common myrtle (*Myrtus communis*), and green olive tree (*Phillyrea latifolia*), with traits like low specific leaf area and high stem specific density, which enhance drought avoidance and resilience, can also be used for xeriscaping design (Hidalgo-Triana et al., 2023).

Designing plant communities with a mixture of species, rather than a monoculture, can improve overall resilience. This approach can enhance aesthetic value, ensure survival under varying conditions, and provide essential ecosystem services (Leotta et al., 2023). Designing multi-layered plant communities with diverse morphologies can create more resilient and visually appealing landscapes. This approach increases species' richness and functional diversity, which are crucial for long-term sustainability (Rainer, 2021). For example, in the Mediterranean context, pine forests are typically low in plant diversity due to the allelopathic behavior of the tree. The mat of decaying needles on the forest floor releases chemicals that prevent the growth of most plants. Some species, such as *Cistus* and thorny broom (*Calicotome spinosa*), can usually grow in forest clearings. As a design guideline to mimic this community, it is recommended to use 80% tree cover, 10% shrubs, 10% annuals, and a few herbaceous perennials. On the other hand, oak woodlands have a different structure, allowing more understory plantation to grow in association with species such as *Pinus* sp., *Rhamnus* sp., *Pistacia* sp., *Cistus* sp., *Spartium* sp., and *Cyclamen* sp. In the oak forest design, more than half the forest area (60%) is covered with a tree canopy. Shrubs and subshrubs can cover 20–30% of the total area. Herbaceous ground covers, including perennials, bulbs, and annuals, occupy the open areas, which constitute 20–30% of the woodland.

The plant community approach will also influence soil water dynamics and help to combat the climate crisis. Different plant species and their root systems can affect

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[4] Carob pods, dry dehiscent fruits containing many seeds, are mildly sweet on their own (being roughly one-third to one-half sugar by dry weight), so they are used in powdered, chip, or syrup form as an ingredient in cakes and cookies, sometimes as a substitute for chocolate in recipes because of the color, texture, and taste of carob.

[5] This name comes from the aromatic resin, or mastic, that is harvested from the plant's trunk and branches.

water infiltration rates and soil organic matter content, which in turn impacts soil water retention. Mediterranean plants have evolved different rooting strategies to cope with soil moisture dynamics. Deep-rooted plants utilize soil moisture stored during the wet winter, while shallow-rooted plants exploit both winter storage and sporadic rainfall during the growing season; therefore, when we plant them together as a plant community, we can maximize the available water found in the soil (Viola et al., 2008). Also, when Mediterranean soils are well-managed and properly planted, they have significant potential to act as a carbon sink (Moukanni et al., 2022).

Landscape architecture projects addressing drought in the Mediterranean integrate native, drought-tolerant plants with water-efficient irrigation and management techniques. Examples include a project on the Mediterranean island of Crete that assessed the performance of over 70 native plants, and a large-scale restoration project on Stromboli, Italy, that focuses on improving water regulation through traditional hydraulic knowledge and a multifunctional landscape approach.

Read more:

Biasi, R., Collotti, F. V., & Baia Curioni, S. (2024). Returning to Integrated Landscape Management as an Approach to Counteract Land Degradation in Small Mediterranean Islands: The Case Study of Stromboli (Southern Tyrrhenian Sea, Italy). *Land*, *13*(11), 1949. https://doi.org/10.3390/land13111949

Christoforidi, I., Kollaros, D., Manios, T., & Daliakopoulos, I. N. (2022). Drought- and Salt-Tolerant Plants of the Mediterranean and Their Diverse Applications: The Case of Crete. *Land*, *11*(11), 2038. https://doi.org/10.3390/land11112038

6.3.2. Planting strategies for salty conditions

The Mediterranean region is home to a wide variety of halophytes – plants that can thrive in saline environments like salt marshes and alkali flats, which offer both sustainability and aesthetic value in landscape design. Herbaceous plants such as glaucous glasswort (*Arthrocnemum macrostachyu*[6]), sea aster (*Aster tripolium*[7]), sea fennel (*Crithmum maritimum*[8]), spiny chicory (*Cichorium spinosum*[9]), and the endemic thick leaves stock (*Matthiola crassifolia*[10]) naturally thrive in coastal and saline environments, making them ideal for ecological restoration, gardening, and green roof systems due to their natural tolerance to salinity. These species also have low invasive potential, making them safe and sustainable options for landscaping. Likewise, wavyleaf sea lavender (*Limonium sinuatum*), beach daisy (*Pallenis maritima*[11]), and sea daffodil (*Pancratium maritimum*[12] – Figure 6.5), native to Mediterranean coastal areas, Canary Islands, and Black Sea, are well adapted to saline soils and contribute to ornamental landscaping (Mircea et al., 2025). Another interesting plant, native to Lebanon, is khatmiyye (*Alcea rosea*). It is very tolerant and colonizes the soils of the coastal waste lands despite the salt spray. Although it is generally cultivated as a biennial plant in landscaped gardens, in Lebanon, it will grow for several years at a single site. Other hardy options that tolerate salt spray include oleander (*Nerium oleander*), tamarisk (*Tamarix* sp.[13]), lantana (*Lantana* sp.[14]), and bougainvillea (*Bougainvillea* sp.) all of which are suited to the Mediterranean climate's heat and drought (Figure 6.5).

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[6] Perennial shrub native to coastal regions of the Mediterranean, Red Sea, and Middle East.

[7] Also known as seashore aster (synonym *Tripolium pannonicum*), is a perennial growing up to 50 cm tall with fleshy lanceolate leaves and purple ray florets, flowering from July to September. It provides a valuable source of nectar for late-flying butterflies.

[8] A perennial halophyte native to Mediterranean coasts that grows on rocks, sandy beaches, and piers. It is an edible and medicinal plant.

[9] A perennial species common in coastal and mountainous areas of the Mediterranean region, it is also edible and used in the Mediterranean diet.

[10] A rare and fragrant endemic species found on the rocky, salty shores of Lebanon, from Beirut to Tyre.

[11] It features vibrant yellow, daisy-like flowers with darker centers and is well-adapted to coastal conditions, tolerating salt spray, drought, and sandy or rocky soils.

[12] It is a bulbous perennial with a long neck and glaucous, broadly linear leaves, evergreen, but the leaves often die back during hot summers. *P. maritimum* extract has purgative, acaricidal, insecticidal, anti-migratory, antiviral, antimicrobial, immunostimulant, analgesic, antimalarial, antitumor, antifungal, and antioxidant activities.

[13] A resilient plant that thrives in salty, well-drained soils and is drought-resistant. It blooms with multicolored flowers and attracts butterflies.

[14] Certain varieties are surprisingly salt-tolerant, though they need good drainage and should be protected from excessive salt. Although they are already well anchored in the Mediterranean landscape, it is good to remember that they are not native to the region.



Figure 6.5. *Pancratium maritimum* growing along with *Tamarix* sp. on a sandy beach (photo by Uoaei1, 2015)

A case study for a Mediterranean landscape project in salty conditions is the design of the coastal cycling infrastructure at the Porto Carras Marina in Greece. This project addresses salinity from sea spray and harsh winds by using salt-tolerant plants and durable materials. This project highlights the importance of selecting

appropriate native and aromatic Mediterranean species. It also emphasizes using ceramic tiles for the cycle track to withstand salt and red-colored asphalt for pathways to improve visibility and longevity. The plant selection strategy focused on:

- Utilize salt-tolerant and native Mediterranean species to maintain a consistent landscape aesthetic and ecological balance.
- Incorporate fragrant plants, such as *Rosmarinus officinalis*, *Myrtus communis*, and *Thymus vulgaris*, to enhance the sensory experience and mask exhaust fumes.
- Use species with intense color, like *Armeria maritima* and *Gaura lindheimeri*, to add vibrancy.
- Plant large trees like *Casuarina equisetifolia* and *Pinus pinea* for shade, windbreaks, and visual interest.

Read more:
Gkoltsiou, A. & Karampampa, M-A. (2025). A Landscape Design Approach for Coastal Cycling Infrastructure Design: The Case Study of the Kallithea–Glyfada Seafront of Athens, Greece. *Land*, *14*(9), 1843. https://doi.org/10.3390/land14091843

6.3.3. Planting strategies for flood

If we understand how the Mediterranean riparian habitat functions, we can apply this knowledge to flood prevention strategies. In a riparian habitat, plants grow along the banks of a river, stream, or wetland and contain a mixture of plant communities depending on their water needs. Most riparian tree species are phreatophytes, meaning they rely on the water table and exhibit varying tolerances to drought and flooding (González et al., 2012). Some species are more reliant on consistent water (obligate riparian), while others are more tolerant of dry periods (facultative riparian). Using plants typically found in riparian ecosystems, such as oriental plane, poplars, and willows (*Platanus* sp., *Populus* sp., *Salix* sp.), which can both adapt to wet and dry conditions, will allow us to design areas with effective flood management. Salix species also play a significant role in stabilizing riverbanks and initiating secondary succession, which improves protection from erosion and enhances riparian ecological functions (Piton et al., 2020). Also, despite their evolution in dry habitats, species such as lamb's-ear[15] (*Stachys byzantina*), lavender

[15] They are named lamb's ears because of the leaves' curved shape and white, soft, fur-like hair coating.

(*Lavandula angustifolia*), and common sage (*Salvia officinalis*[16]) have shown resilience to flooding, making them suitable for areas with unpredictable rainfall patterns (King et al., 2012).

A case study of a Mediterranean project using planting strategies for flood mitigation is the Serchio river basin in Italy, which uses nature-based solutions like buffer strips and constructed wetlands to manage floods and drought. Key planting strategies include creating vegetated buffer strips with diverse tree and shrub species along canals to reduce erosion and improve water quality, as well as developing phytodepuration (plant-based purification) wetlands to treat wastewater and manage water. These methods aim to increase the overall resilience of the region by working with natural processes.

Read more:
Phusico. (n.d.). *Serchio River Basin*, *Italy*. https://www.phusicos.eu/case-studies/serchio-river-basin-italy/ [accessed: 9.09.2025].

6.3.4. Planting strategies for urban heat

Trees play an essential role in mitigating the urban heat (UHI) effect in Mediterranean cities by reducing temperatures and enhancing thermal comfort. Effective species selection, strategic spatial configuration, and consideration of local climatic conditions are essential for optimizing the cooling benefits of urban trees. According to Smithers et al. (2018), large tree species with high albedo, rapid growth, and drought tolerance, such as *Eucalyptus* sp. and mesquite (*Prosopis* sp.), are particularly effective. Similarly, La Rosa and Li (2023) identified species suitable for Mediterranean climates, including maritime pine (*Pinus pinaster*), Benjamin fig (*Ficus benjamina*), and holly oak (*Quercus ilex*).

[16] Grown for its culinary uses, such as seasoning meats and stuffing, and for its historical medicinal properties. Sage is also a popular ornamental plant and is beneficial for attracting pollinators.

Temperature reduction in urban environments depends not only on species choice but also on tree placement. Silveira et al. (2025) found that the cooling effect is maximized when green cover exceeds approximately 35% of the total area and when the average size of green patches exceeds 200 m². Moreover, trees with dense canopies, or clusters that mix different species to create multi-layered structures, can significantly improve microclimate regulation (Grilo et al., 2020; Rahman et al., 2020).

Green roofs represent another promising approach to mitigating UHI effects and enhancing urban sustainability in Mediterranean cities. Their benefits include temperature regulation, energy efficiency, and stormwater management. Lehtihet and Bouchair (2018) found an average 18% reduction in roof surface temperature when it was covered with green roof plants. Ziogou et al. (2017) reported a 25% reduction in primary energy consumption in buildings in Cyprus with extensive green roofs. This reduction in energy demand not only lowers pollution but also helps limit temperature increases in urban areas.

In Mediterranean regions, where dry periods last 8 to 9 months per year, it is essential to select drought-tolerant, low-maintenance, yet visually appealing plant species that require minimal or no irrigation. In addition to the commonly used sedum (*Sedum reflexum*), native species such as common wormwood (*Artemisia absinthium*), Mediterranean daisy (*Asteriscus maritimus*), Mediterranean saltbush (*Atriplex halimus*), gold strawflower (*Helichrysum italicum*), cotton lavender (*Santolina chamaecyparissus*), and sea fennel (*Crithmum maritimum*) show strong potential for roof applications (Papafotiou et al., 2018; Azeñas et al., 2019). Furthermore, combinations of mixed geophyte species and succulents, including reflexed stonecrop (*Sedum reflexum*), are effective for creating new urban habitats on extensive green roofs in Mediterranean cities (Fabian & Talhouk, 2025; Figure 6.6).



Figure 6.6. *Sedum reflexum* growing along Mediterranean geophytes on Beirut green roof (photo by Monika Fabian, 2017)

To reduce the heat island effect, landscape projects should adopt a multi-layered approach, combining elements such as strategic tree planting, green roofs, trellises with climbing plants, and water features. For example, a mixed-use development in Alicante uses dense canopies for shade, green roofs to insulate

buildings, and trellises to shade facades, significantly reducing surface and air temperatures and improving comfort. Analyzing local climate factors like wind and solar radiation is crucial for success, as is using locally sourced, sustainable materials and focusing on dense vegetation in parks to create significant cooling microclimates.

KEY STRATEGIES AND EXAMPLES

Shading with trees

Strategy: Plant a dense canopy of trees to shade building surfaces and hardscape like streets and plazas.

Example: A street in Turkey showed an average daytime temperature difference of about 6°C between the side with large trees and the side without, demonstrating the immediate benefit of shade.

Scale: Larger parks with higher tree density show more significant and wider-reaching cooling effects, with a 680-hectare park extending its cooling effect up to 1 km.

Green roofs and walls

Strategy: Install green roofs to insulate buildings and reduce the temperature of the roof surface and the surrounding air roof-surface and surrounding-air temperatures. Use trellises with climbing plants on building facades to provide shade and a cooling effect.

Example: A development in Alicante added a green roof with local species to a communal building, reducing solar gain and helping to keep interior spaces cool. Trellised climbing plants on building facades provide shade and create a plant tapestry that cools rooms.

Water features

Strategy: Integrate water bodies, such as fountains or pools, to help cool the immediate environment through evaporation.

Example: Simulations showed that introducing a water body to a public square in the Mediterranean can reduce the potential evapotranspiration (PET) by up to 1.1°C, with greater reductions when combined with other design elements.

Material selection and urban form

Strategy: Use lighter-colored and “cool” materials for surfaces. Design the urban form to promote natural airflow and prevent wind tunnels.

Example: A development in Alicante was designed with a permeable fence and curved terraces that mitigate strong air currents, allowing breezes to circulate freely while preventing the formation of wind tunnels.

Combination: Research indicates that combining cool roofs with green areas provides the most comprehensive and evenly distributed thermal regulation.

Read more:

Atak, M., Kara, C., & Asilsoy, B., & Özden, Ö. (2019). The urban heat island in a coastal Mediterranean city: The case study of Kyrenia, Cyprus. *International Journal of Advanced and Applied Sciences*, *6*(8). https://doi.org/10.21833/ijaas.2019.08.001

Gilabert, J., Ventura, S., Segura, R., Martilli, A., Badia, A., Llasat, C., Corbera, J., & Villalba, G. (2021). Abating heat waves in a coastal Mediterranean city: What can cool roofs and vegetation contribute? *Urban Climate*, *37*. https://doi.org/10.1016/j.uclim.2021.100863

6.4. WATER-SENSITIVE DESIGN AND SOIL MANAGEMENT STRATEGIES

Water scarcity and degraded soils are among the most pressing challenges for landscape architects working in the Mediterranean region. The combination of prolonged droughts, short and intense rainfall events, and eroded soils calls for integrated water- and soil-sensitive approaches that support plant survival, enhance ecosystem functions, and ensure long-term sustainability.

6.4.1. Water-sensitive design

In Mediterranean climates, water-sensitive design emphasizes the efficient use and management of every drop of water within a site. It aims to capture, store, reuse, and infiltrate water rather than directing it away.

Effective strategies include:

- Rainwater harvesting through cisterns, underground tanks, or surface ponds to store water for irrigation during dry seasons.
- Bioswales and infiltration basins, which collect runoff and allow it to percolate slowly into the ground, recharging groundwater and supporting vegetation.
- Permeable pavements and green surfaces that reduce runoff, limit flooding, and allow natural infiltration.
- Greywater reuse systems, in which lightly used household water (from sinks or showers) is treated and recycled for landscape irrigation.
- Zoning plants according to water needs (hydrozoning) – placing high-water-demand species closer to water sources and drought-tolerant species farther away – to minimize irrigation.

Water-sensitive approaches not only conserve scarce freshwater resources but also reduce heat stress, mitigate flooding, and support local biodiversity by maintaining microclimatic balance. In Lebanon and similar Mediterranean contexts, combining traditional methods (such as terracing and cisterns) with modern technologies (like drip irrigation or soil moisture sensors) offers a resilient hybrid model for sustainable landscape management.

6.4.2. Proper soil management

Healthy soil forms the foundation for all successful planting strategies. In the Mediterranean region, soils are often shallow, stony, and low in organic matter, making them prone to erosion, nutrient depletion, and poor water retention. Improving soil quality is therefore critical for achieving resilience in both rural and urban landscapes.

Key soil management practices include:

- Organic matter enrichment through compost, manure, or biochar to improve soil structure, increase infiltration, and enhance water-holding capacity.
- Mulching with organic materials such as bark, straw, or gravel to reduce surface evaporation, moderate soil temperature, and suppress weeds.
- Contour planting and terracing to slow down stormwater runoff, prevent soil loss, and promote infiltration on sloped terrain.
- Planting deep-rooted native species and cover crops, which stabilize soils, reduce erosion, and enhance soil microbial activity.
- Minimal soil disturbance and reduced chemical inputs, which preserve the soil's natural structure and support beneficial microorganisms.

In the context of climate adaptation, proper soil management transforms degraded soils into living systems capable of retaining water, filtering pollutants, and storing carbon. When combined with water-sensitive design, it creates a feedback loop that enhances plant health, reduces maintenance needs, and strengthens overall ecosystem resilience.

The urban parks of Valencia provide excellent examples of how traditional water management techniques can be adapted for modern landscape architecture in a Mediterranean climate. Valencia, situated upon Turia, historically faced problems with flooding. After a significant flood, the river's course was diverted, and its original bed was converted into a linear park. The subsequent creation of new urban parks presented an opportunity to implement innovative water and soil management strategies. Landscape architects in Valencia drew inspiration from the city's agricultural heritage, incorporating traditional Mediterranean water-sensitive strategies into the design of new public parks.

Water-sensitive design strategies:

- Recreating the historic riverbed: At Cabecera Park, designers created a landscape that reinterprets the Turia's original course. The Park uses terrain modeling and dry-stone retaining walls to structure horizontal terraces that slow down rainwater runoff and encourage infiltration.

- Agricultural water elements: Parks like Hesperides Garden and Marxalenes Park incorporate archetypal agrarian features, such as canals, ditches, and irrigation ponds, for both aesthetic and functional purposes. These elements help manage stormwater while providing ecological and recreational benefits.
- Sustainable water sources: Instead of relying on potable water for irrigation, long-term solutions have focused on using alternative water systems, such as treated wastewater, to conserve resources.

Soil management strategies:

- Mimicking natural processes: The use of terraced surfaces in parks like Cabecera Park helps to retain rainwater, which prevents soil erosion and nourishes vegetation.
- Focus on native plants: Emphasizing the use of native and low-water-demand species helps create self-sufficient and resilient landscapes that require less irrigation and maintenance. Mulching also helps retain soil moisture and reduce water consumption.

Read more:

Pérez Igualada, J. (2016). Water-sensitive strategies in the new urban parks in Valencia: The agricultural Mediterranean paradigm as a pattern for landscape management and design. *International Journal of Sustainable Development and Planning*, *11*, 97–106. https://doi.org/10.2495/SDP-V11-N2-97-106

6.5. SUMMARY AND CONCLUSIONS

The Mediterranean region, and particularly Lebanon, stands at the frontline of climate change impacts – facing intensifying droughts, shifting rainfall patterns, soil degradation, salinity, and urban heat challenges. These pressures require a rethinking of planting design, moving from aesthetic-driven to ecologically informed and climate-resilient approaches.

This chapter demonstrated that sustainable planting design in Mediterranean landscapes rests on three interconnected pillars: appropriate plant selection, water management, and soil management. By studying native vegetation and its adaptive mechanisms – such as drought tolerance, salt resistance, fire recovery, and flood adaptation – landscape architects can create plant communities that mirror natural resilience. Techniques like xeriscaping, the use of halophytes in coastal zones, riparian buffer planting, and green infrastructure for urban cooling exemplify how ecological principles can be translated into practical design strategies.

The case studies presented – ranging from coastal restoration in Greece to green roof applications in Mediterranean cities – illustrate how local plant knowledge, when combined with water-sensitive design and soil conservation practices, can foster multifunctional, low-maintenance, and aesthetically rich landscapes.

In conclusion, the future of Mediterranean landscape architecture depends on embracing plant-based solutions that work with, rather than against, the climate. Designing with nature – through the careful selection of resilient species, restoration of native plant communities, and integration of ecological processes – offers the most sustainable path forward for adapting to environmental change while preserving the unique identity and biodiversity of Mediterranean landscapes.

Review questions:

1. What are the main extreme weather events in the Mediterranean, and why do they pose challenges for landscape architects?
2. Why is proper plant selection essential in this region, and how have local plant communities adapted to the Mediterranean climate? What can we learn from it?
3. What techniques can be used in water-sensitive design to reduce water consumption and improve efficiency in landscapes?
4. How do the three pillars – plant selection, water management, and soil management – work together to create resilient and sustainable landscapes?

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7. ENVIRONMENTAL MODELS FOR PLANTING IN ICELAND

7.1. INTRODUCTION

Iceland, the land of ice and fire, was formed through the dynamic interaction between the Mid-Atlantic Ridge and the Icelandic mantle plume. This unique geological setting created an island where active volcanism and extensive glaciation coexist. Over time, its surface has been reshaped by these opposing forces – lava flows and eruptions thickening the ground on one hand, and glaciers carving valleys and fjords on the other – producing a landscape of volcanic highlands, lava fields, glacial valleys, and rugged coastlines.

Broadly, the island can be divided into lowlands and highlands, each with distinct geological and ecological characteristics. Both regions are underlain by basaltic bedrock and were historically shaped by widespread lava fields and repeated glaciations. During the Ice Ages, they were both covered by an ice sheet, but the aftermath differed. As glaciers retreated, the highlands were left with loose, unconsolidated sediments highly vulnerable to wind and water erosion. In contrast, the lower-lying areas (below 400 m in elevation) became sites of sediment deposition from the highlands. These post-glacial sediments formed the unstable foundation upon which later soils would develop.

Subsequent volcanic eruptions covered much of Iceland in ash. The tephra brought by volcanic deposition characterized Icelandic soils as Andosol (Arnalds, 2015). Their unique properties, such as higher fertility, high-water retention, but fragile due to their low cohesion, made them extremely vulnerable to wind and water erosion (Arnalds, 2015). In the harsh highland environment characterized as a sub-arctic climate, where cold temperatures, strong winds, and repeated freeze–thaw cycles limit vegetation cover, these fragile Andosols are easily degraded (Arnalds, 1987; Arnalds, 2015; Arnalds et al., 2023). As a result, large areas of the Icelandic highlands have become barren or desertified landscapes. In contrast, the lowlands, with a subpolar oceanic climate, are highly vegetated (Arnalds, 1987; Arnalds et al., 2023). Higher vegetation coverage helps stabilize Andosol soils and promotes organic matter accumulation (Arnalds, 2015). This combination of fertile Andosol soils, milder climate, and greater vegetation cover made the lowlands the ideal environment for human settlement and agriculture.

Due to its short post-glacial history and isolation from other lands, Iceland has a low diversity of plant species, with only 490 vascular plant species. Among them, there are only three native tree species: birch (*Betula pubescens*), rowan (*Sorbus aucuparia*), and aspen (*Populus tremula*) (Blöndal, 1987). Of these,

only birch forms natural forests, which rarely exceed an average height of 3 m. Historically, birch forests covered 30–40% of the entire island and were primarily concentrated in lowland areas, extending from the shores to the mountains. However, starting at the human settlement, 1,100 years ago, the tree cover shrank dramatically, resulting in a decrease from 30–40% to 1% of tree cover (Sigurdsson, 1977; Snorrason et al., 2016). Humans logged the birch trees for wood and general survival. In addition, the settlers introduced sheep, with a population reaching up to 800,000. Intensive grazing suppressed forest regeneration by consuming birch seedlings and preventing the expansion of tree cover into new areas (Arnalds, 1987). In recent decades, tree cover has increased slightly from 1% to 1.5%, mainly due to land use changes and warmer climates (Snorrason et al., 2002). Today, the grazing pressure has declined due to a decreased sheep population (around 300,000). However, sheep still roam freely across most of the country (including the vulnerable highlands), inducing a strong negative impact on the current vegetation, particularly in areas where ecosystems are already degraded and less resilient. Currently, 45% of the country is considered moderately to severely degraded, and grazing inhibits the degraded habitats from recovering (Arnalds et al., 2023). Apart from the impacts of grazing, harsh environments slow down the regeneration of native vegetation species, especially due to frequent freeze–thawing cycles, where roots are likely to be lifted from the soil (Aradottir & Halldorsson, 2018).

In addition to land degradation and forest cover reduction, from 1945 to 1985, the government drained the vast majority of the country's peatlands by creating drainage ditches, converting the peatlands into agricultural land (Garðarsson et al., 2006; Arnalds et al., 2016). Currently, around 70% of Icelandic peatlands are drained (Arnalds et al., 2016). This has a great negative impact on the ecosystem health and hydrology (Arnalds et al., 2016; Nickayin et al., 2022). Ongoing research on the carbon dioxide and methane emissions in drained peatlands shows a strong contribution to Iceland's total emissions (Ólafsdóttir, 2015; Ministry of Environment, Energy and Climate of Iceland [UOL], 2018; UOL, 2020).

In order to improve soil quality and slow down soil erosion and land degradation, the governmental forestry institution introduced the species *Lupinus nootkatensis* from Alaska, USA, in 1945, making use of its nitrogen-fixing ability. Citizens were encouraged to spread the seeds across the whole country. Lupins quickly spread out in Iceland and created ecological pressure for native species, due to their fast growth and lack of predators. During the early 21st century, the invasive pattern drew ecologists' attention, and several countermeasures were employed to reduce the spread. However, lupins' ecological function in Iceland still remains a controversial topic. Additionally, in order to increase the forest cover and ecosystem stability, foresters introduced several foreign tree species, such as *Pinus contorta* and *Picea engelmannii*. These plantations were cultivated mainly

for wood production and carbon emission neutralization purposes (Snorrason et al., 2002). However, these plantations disturb natural succession by inhibiting native species from growing, due to dense needle cover, shading, and acidification of the soil. Therefore, debates on their ecological influence are ongoing.

Today, different strategies are being employed to recover the soil fertility and reduce erosion. In 2021, the Icelandic government accepted the ambitious Bonn challenge, which aims to restore natural woodlands (birch), increasing their cover to 5% (from the current 1.5%) by 2030 (UOL, 2020). Several birch forests have been further protected from grazing, with the aim of increasing the birch colonization and growth. The area Þórsmörk is a great example of how protection from grazing can improve the land condition, as now there is a full-grown, lush forest. Another important strategy to restore sustainable Icelandic ecosystems is peatland restoration. It started in 1996 and is gradually becoming a broad-scale practice to mitigate climate change following an Icelandic governmental announcement (Garðarsson et al., 2006; UOL, 2018). The common approach to rewetting is filling up the drainage ditches with the previously excavated peat material. The restoration in Iceland is more cost-effective than in other neighboring countries, as most of the land has been less intensively used and the seed bank remains in soils (Garðarsson et al., 2006). Studies have shown successful reduction of carbon dioxide gas emissions by 23% during the first four months of rewetting, and wetland birds were spotted again in the area as a sign of biodiversity return (Ecosystem Restoration Hub, n.d.).

7.2. BLUE-GREEN INFRASTRUCTURE IN URBAN PLANNING: URRIÐAHOLT CASE STUDY

In Urriðaholt, a new community with approximately 5,000 residents, blue-green stormwater infrastructure (BGI) was developed and implemented using sustainable urban drainage techniques. In the Icelandic town of Gardabaer, Urriðaholt is a hillside community that was primarily built between 2003 and 2025. Urriðavatn is a stunning and clean lake that sits beneath the hill and is encircled by marsh. The BGI was established to maintain the lake’s water level and preserve its environmental integrity, also with a careful planting design project. Rain gardens, especially were designed harmoniously in most of the public areas available, using species that are also adaptive to Iceland strong climate. The planting become really naturalistic especially close to the lake, respecting the ecological characteristics of the place. For its environmentally friendly methods, it has won numerous worldwide honors and recognitions. (Figure 7.1).



Figure 7.1. Example of BGI in Urriðaholt (photo by Daniele Stefàno, 2025)

Along with other building requirements, there are planning strategies on how to incorporate BGI into the area. Additionally, there is general information about BGI in Urriðaholt – requirements for site plans, hydrology studies, a blue-green stormwater strategy, and the Urriðaholt masterplan. The design comprises thoughtfully designed and strategically positioned landscape elements in both the public and private areas. There are green spaces and corridors beside pathways that function in a variety of ways, and stormwater is occasionally quite visible. Their presence makes Urriðaholt a verdant aspect, enhancing its walkability and permeability. At Urriðaholt, the cost of installing the rain gardens is lower than that of using conventional stormwater solutions. The expense is different, though, as hydrological studies and urban planning are required before landscape design and elements, such as rain gardens, green swales, plants, and concrete slabs, must be maintained (Figure 7.2).



Figure 7.2. Small lake in Urriðaholt (photo by Daniele Stefàno, 2025)

7.3. BLUE-GREEN INFRASTRUCTURE IN URBAN PLANNING: ELLIÐAÁRDALUR (REYKJAVÍK) CASE STUDY

This case study focuses on a main public green space in the capital, Reykjavík, which is significant due to the interaction between natural elements and the river, as well as remediation strategies, as it has implemented a reforestation program that began in recent decades. Elliðaárdalur, as explained in the introduction chapter, in common with the majority of Icelandic territory, had been deforested since its early settlements due to intensive livestock grazing, and is being protected from grazing and restored through a number of environmental initiatives as a place of biodiversity and social interaction.

Elliðaárdalur is located in Reykjavík, predominantly in the eastern part of the city, while the valley forms part of the southwestern region of Iceland. Elliðaárdalur is a valley traversed by the river Elliðaár, which rises in the eastern hills of the city and flows into the Atlantic Ocean at Hafnarfjörður Bay. Elliðaárdalur is considered the largest green area in the city of Reykjavík and is one of the most biologically diverse and popular outdoor recreation areas, as the valley offers a broad range of options for outdoor activities. Remarkable fish fauna, such as salmon, abounds in the heart of the capital. Its proximity to this natural environment is a key factor in the quality of life and gives Reykjavík a distinctive landscape character.

7.3.1. Land and water formation

The main features of the valley include a landscape that is preserved from various periods of geological history, diverse fauna and vegetation, and the Elliðaár, which gives the valley its name.

Elliðaárdalur began to form during the Ice Age, when glaciers shaped the land. As the glaciers started to retreat, the landscape carved by the ice remained. Elliðaárdalur is a U-shaped valley with gently sloping hills, gray basalt knolls, ridges, and river deltas.

At the end of the last glacial period, a glacier covered the area where Elliðavatn now lies. Glacial rivers flowed from the glacier, continuing to shape the valley. These rivers carried large amounts of sediment – silt, gravel, and sand – and at that time, the sea level was much higher than it is today, approximately 40 m higher. With the sediment, gravel beaches began to form, and as the ice melted and the land started to rise, marine terraces appeared, clearly showing the location of the ancient sea level.

Around 4,500 years ago, a large volcanic eruption occurred east of Bláfjöll, and the fluid lava (*helluhraun*) traveled long distances, reaching Þorlákshöfn. The lava known as Leitarhraun also flowed down Sandskeið and around Elliðaárvatn, covering its northern part (Rauðhólar), descending through Elliðaárdalur, and eventually reaching Elliðaárvog.

7.3.2. Elliðaárdalur timeline

The history of the valley dates back centuries, to the period when the first settlers arrived, a time when the valley was covered in forests. Elliðarárdalur has long been used as agricultural land, while in the past it belonged to the estates of seven farms. Of these, only the Ártún and Árbær farms were located in the valley itself. Records show that farming was practiced in Árbær in the 14th and 15th centuries, and this activity continued there for at least 500 years, with traces still visible today. Extensive development accompanied farming: houses and stone walls were built, and sheep, horses, and cattle were raised, altering the vegetation of the valley. The valley was used as pastureland for a long time, but, as mentioned above, around 1970, it was protected from sheep and horse grazing (Figure 7.3).

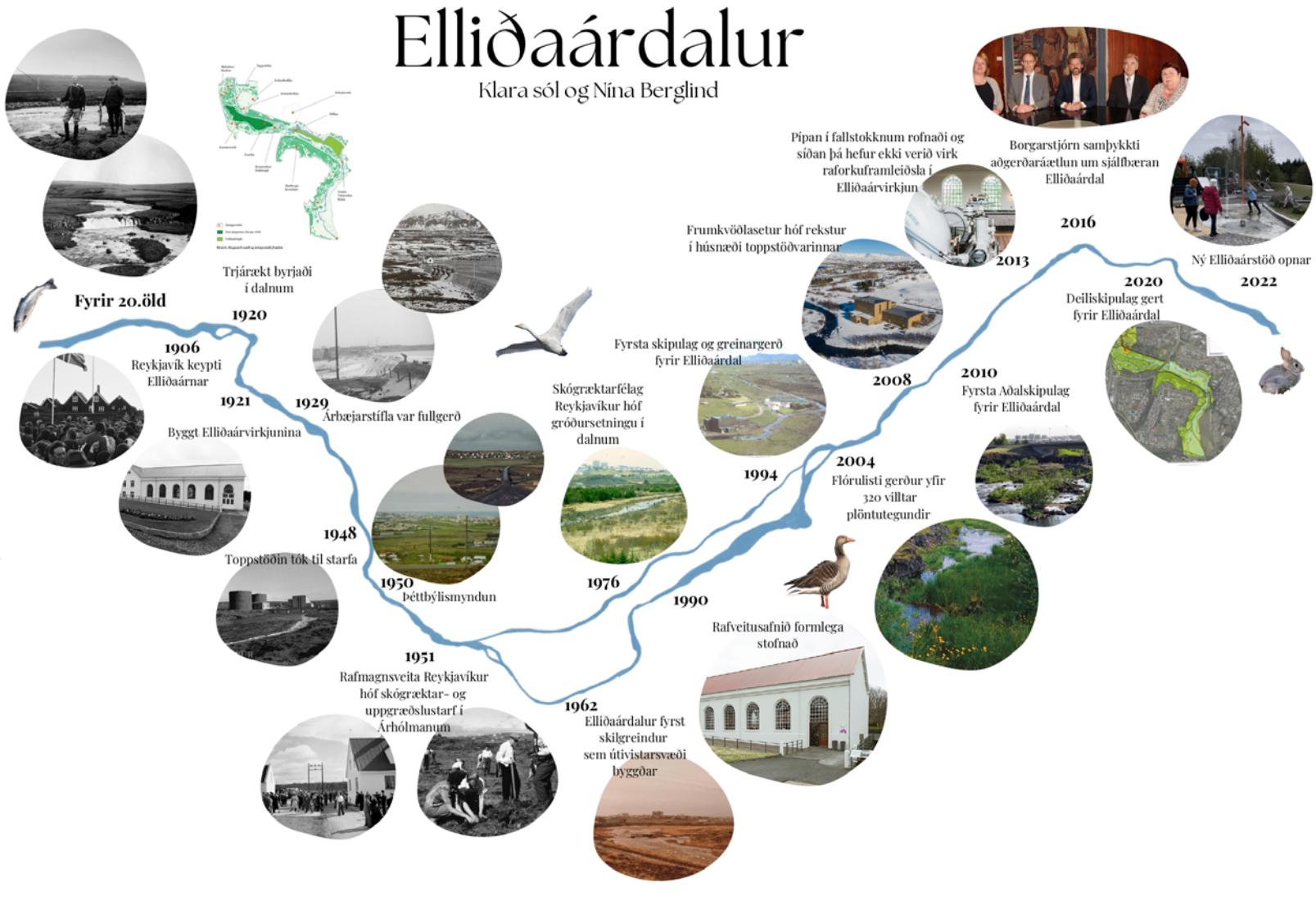

Figure 7.3. Timeline of Elliðaárdalur (work by Nína Sigtryggsdóttir and Klara Sól Freeman as part of the course LARK IV, Landscape Architecture, Agricultural University of Iceland, 2025)

7.3.3. History of Elliðaárdalur

The vegetation in Elliðaárdalur is diverse, consisting of both native and introduced species. Native species such as birch and willow are used to preserve the local ecosystems. Some were intentionally planted, while others have spread through natural regeneration. Thus, although the valley is characterized by abundant nature and greenery, it is not representative of Iceland's flora and natural landscapes in general.

The valley's vegetation types include wetlands, heathlands, and grasslands, as well as flower-rich areas and woodlands. Heathlands with heather and willow species dominate the upper part of the valley, though they are under pressure from forestry. The main planted species are birch, rowan, aspen, and conifers; in more recent years, Alaska willow, goat willow, Sitka spruce, Sitka alder, lodgepole pine, and balsam poplar have been added. The largest and oldest forest plantations are found in Árhólmi and Sveinbjarnarlundur; later, extensive afforestation was also carried out in Breiðholtshvarf and Grænugróf. Naturally regenerated birch and willow are common throughout the valley, especially above

the Árbær dam. The current forest management strategy aims to maintain and increase the diversity of tree and plant species in the valley.

Around 320 plant species have been identified in Elliðaárdalur, about half of which are believed to have spread from nearby gardens. Some species have become widespread, such as lupine on gravelly and man-made soils, while garden angelica is common along the riverbanks. In nitrogen-rich soils, species such as cow parsley and ground elder have also spread.

Ancient plant remains in the valley, found in the Elliðavogur strata, are hundreds of thousands of years old and indicate that birch forests covered the area at the beginning of warm periods; since human settlement, however, the vegetation has undergone significant changes.

The growth of urban settlements, as well as vegetation, can be observed.
It can be seen that the recovery and reforestation program began in the mid-20th century. In the current map, pasturelands have largely disappeared, though traces remain in the valley's vegetation (Figure 7.4, Figure 7.5, Figure 7.6).

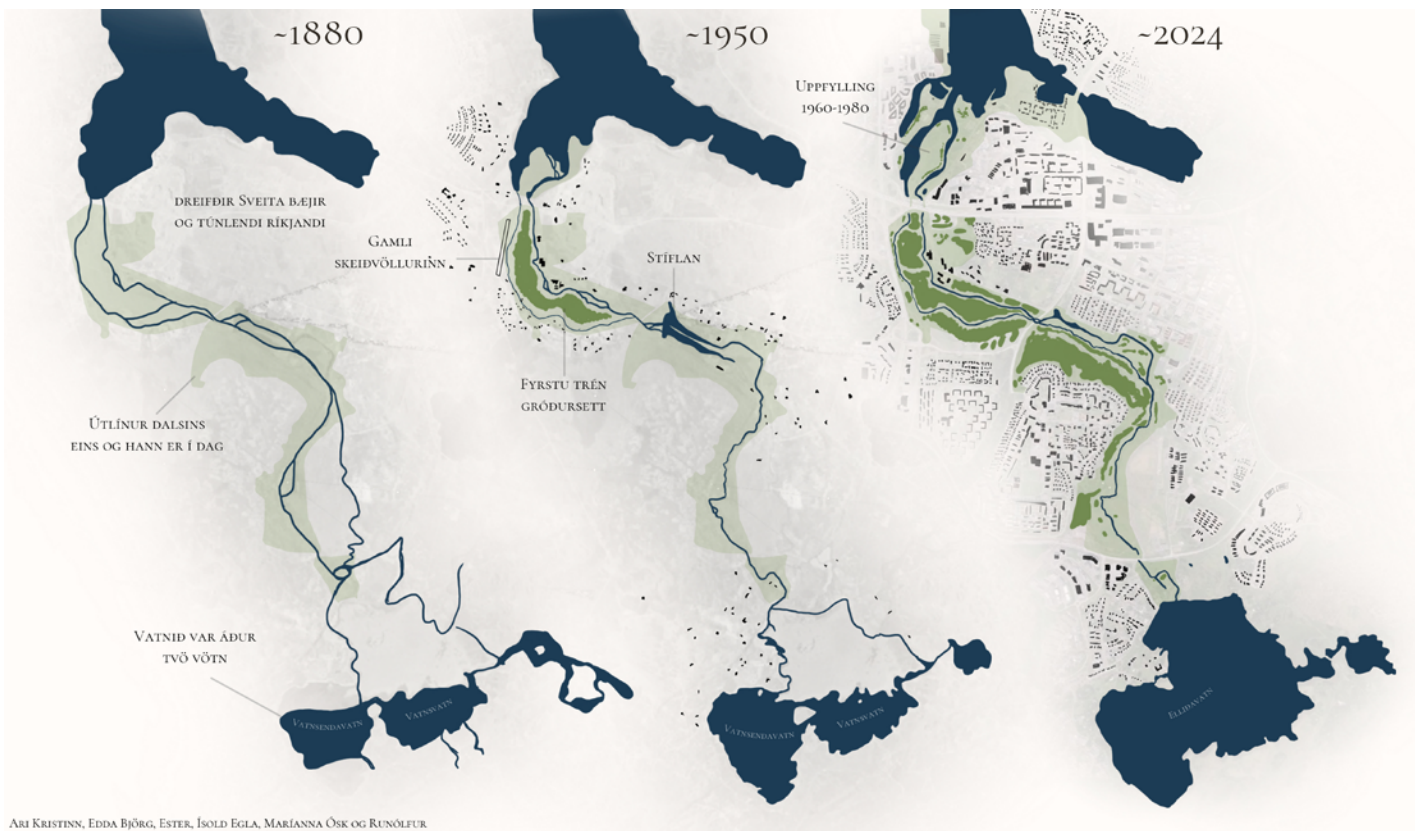

Figure 7.4. Elliðaárdalur timeline. The growth of urban settlements as well as vegetation can be observed. It can be seen that the recovery and reforestation program began in the mid-20th century. In the current map, pasturelands have largely disappeared, though traces remain in the valley's vegetation (work by Maríanna Ósk with collaboration of Ari Kristinn, Edda Björg, Ester Sveinsdóttir, Karl Björnsson as part of the course LARK IV, Landscape Architecture, Agricultural University of Iceland, 2025)



Figure 7.5. Current state of vegetation in Elliðaárdalur (work by Maríanna Ósk with the collaboration of Ari Kristinn, Edda Björg, Ester Sveinsdóttir, Karl Björnsson, 2025)

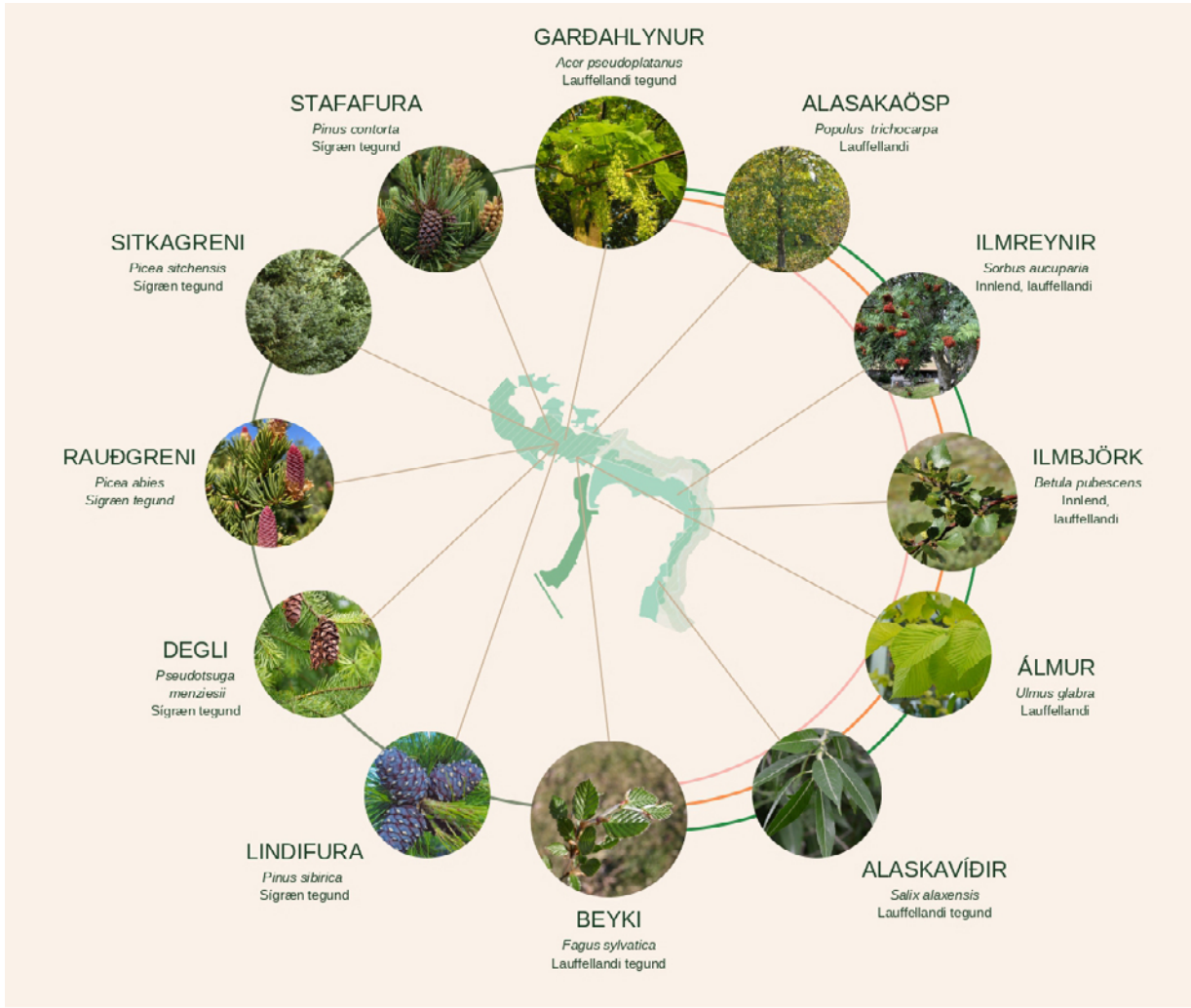

Figure 7.6. Core of the vegetation and ecosystems in Elliðaárdalur (work by of the course LARK IV, Landscape Architecture, Agricultural University of Iceland: Anna Friðriksdóttir, Anna Kolbeinsdóttir, Ingibjörg Þórðardóttir, Salka Einarsdóttir, 2025)

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8. SUSTAINABLE CONSTRUCTION MATERIALS

What is the chapter about:
This chapter presents the use of sustainable materials in landscape architecture as a strategy to combat climate change and reduce the environmental footprint. The chapter discusses the properties of the illustrated materials, highlighting good and bad practices, as well as natural (ecological) and recycled (recycled plastics) aspects, and their potential and practical applications, based on examples observed during study visits by the authors and the KATAMARAN PanPLAN group in various climatic and cultural zones. The authors analyze the use of natural resources such as local stone, wood, and bamboo, as well as innovative recycled materials obtained through upcycling and 3D printing. Comparing case studies from Europe, Asia, and South America, the text highlights how regional and local availability, as well as cultural norms, influence the selection of construction elements. The illustrated examples highlight how switching from traditional methods to ecological alternatives can improve the well-being of urban residents and air quality. Ultimately, this chapter advocates uniform design standards and smarter material management in local environments to support resilient, sustainable cities in various regions of the world for future generations, as an important element of a sustainable development approach to placemaking through landscape architecture.

The chapter highlights the environmental and economic benefits of material use, encouraging the use of local raw materials and modern methods of material recovery to create aesthetically coherent spaces that are resilient to harsh climatic conditions.

In summary, this chapter addresses the importance of an ecological and economic approach that combines tradition with cutting-edge technologies to protect natural resources and promote locally occurring materials on a broader scale.

What will you learn:
This material explains how to consciously select and use sustainable building materials in landscape architecture in an era of climate change,

reducing your carbon footprint and protecting the environment.
Here are the specific areas of knowledge the reader will gain from this material:

- Use of natural and local raw materials:
  - Wood: The properties of native species such as pine, spruce, and larch; differences in approaches to their preservation and the trend of using wood in small architectural forms (DFA) in large metropolises.
  - Bamboo: The advantages and disadvantages of its usage.
  - Stone and forgotten materials: the use of volcanic stone, terracotta, and bentonite as facade and insulation materials.
- Use of recycled materials: The importance of upcycling and downcycling plastics. The durability of urban furniture made of recycled plastic is compared to that of wooden furniture, which requires frequent maintenance and impregnation.
- Modern technologies and innovations: 3D printing: the use of waste materials, reduction of material consumption, and the role of software design in intelligent design.
- Renewable energy sources (RES): possibilities of integrating photovoltaic panels and small wind turbines with park infrastructure to combat climate change.
- Local use of natural materials: understanding the role of poorer communities in landscape design (Peru, Indonesia) through the efficient use of local raw materials, this provides a valuable lesson in sustainable development for European countries.
- Ecological and economic design approach: opportunities for avoiding “spatial chaos” and spatial disharmony in the region by using materials that naturally fit into the local landscape and reduce high transportation or production costs.

8.1. INTRODUCTION

The basic role of sustainable construction materials in the landscape architecture discipline is to reduce carbon footprint and environmental impact through creating well-designed elements of green infrastructure (Nikologianni et al., 2022). Combining these elements with good quality materials without any barriers gives us the opportunity to care for the natural environment by using natural materials such as wood, local stone found in the landscape, or recycled materials such as secondary raw materials processed from plastic, e.g., up-cycling and down-cycling (Dunnett & Clayden, 2007). Plastic waste litters our planet, and now microplastics are also being burned, especially in places where proper waste segregation restrictions have not been implemented, and nets are burned on

the streets, resulting in an increasing amount of plastic in the environment, for example, in South America, Southeastern Europe, and Asia (Kisiel et al., 2022; Pathak et al., 2023; Walaszczyk et al., 2023). It is therefore worth considering this issue and introducing more recreational facilities and small garden infrastructure in landscape architecture areas from "second hand" (Długoński, 2016). If we look at common eco-wooden materials, they mostly come from the deforestation of national forests rather than from manufactured waste, which is unfortunately widespread, especially in Africa, South America, and Asia. In Poland, the use of so-called upcycled materials is also rare. However, compared to other regions, forest management is also at a higher level, as areas are gradually being designated as natural protected areas, thereby preventing rampant tree felling (Długoński et al., 2023). Instead, new trees are being planted, a practice currently practiced in increasingly larger cities in Central Europe, such as Berlin, Prague, Warsaw, Łódź, Kraków, and Wrocław. The educational role of society is also crucial here; for example, in Western Europe, citizens are most aware of threats and pay significant attention to the environment. The effects of these actions are visible in dense urban centers, but we can also see environmental improvements, for example, in the direction of improved air quality, which is improving year by year. Therefore, these cities are becoming not only sustainable but also smart, a concept widely discussed in international debates (Green et al., 2024; Bujak et al., 2025). Earlier, the concept of biocities, or rather ecocities, and their role in creating urban society with sustainable facilities, especially important for human well-being, not only for elderly or current citizens or tourists but also the needs of future generations (Dushkova & Haase, 2022; Morganti et al., 2022; Długozima et al., 2024; Długoński et al., 2025a; Długoński et al., 2025b).

The goal of our study is to determine the range of sustainable construction materials in landscape architecture and their range of usage based on observed examples from European, southern American, and Asian regions. Since the role of a landscape architect is to work in the field, they assess the space and collect good examples but also bad applications of materials in landscape architecture spaces by selecting them appropriately in accordance with applicable guidelines, standards or ecological pressure and anomalies caused by climate change, an example of which is the growing phenomenon such as El Niño and La Niña (Długoński et al., 2025a).

8.2. SUSTAINABLE MATERIALS: SELECTED CASES

8.2.1. Overview

In this chapter, we aim to characterize sustainable material elements, including natural and recycled materials, that respond to climate change and the problems of waste sorting and improper management. Given that we are landscape

architects, we are responsible for placemaking throughout the design process (Motloch, 1990). Using tools and research methods in architecture, such as the site observation method (Niezabitowska, 2014), we described selected examples of sustainable elements of green infrastructure facilities in Poland, Peru, and Indonesia. The results of this work were preceded by a scientific Pan Plan meeting during a trip to Masuria, Mazovia, and the Małopolskie region, as well as NAWA KATAMARAN trips inside Poland and Indonesia, and others, to Bulgaria, the Czech Republic, and Peru. We observed many good examples that we believe can be implemented through local cultural wisdom and a sound management plan. On the other hand, other sustainable cases can be used in innovative and new ways, especially in those places where thinking about materials is outdated or focused on the plundering of natural resources, such as benthos or rarely occurring wood that is subject to nature protection (Lipa, 2004; Fialová, 2023; Fialová et al., 2025). We, as landscape architects, need to explore the endless possibilities of using current and new materials in real-world design. Moreover, given the current situation in the world and the problems of pollution and climate change, we try to apply ecological and so-called sustainable thinking, which teaches us pro-ecological and economic solutions. However, this may be difficult to achieve in terms of capitalizing on Europe and Asia, and consequently on profits for specific entrepreneurs focused on a 100% gain, ignoring pro-ecological thinking about the changing world (Kauf et al., 2025). Therefore, in this chapter, we plan to explore better options in Central and Eastern Europe, including Poland, the Czech Republic, East Germany, and other Asian countries such as China, Indonesia, Singapore, and Japan.

8.2.2. Eco-friendly natural wood for equipment and small infrastructure constructions

First of all, we look for landscape architecture elements like bridges and small equipment that use wood as their best material with minimal material use. In the Czech Republic and Poland, a wooden structure without impregnation can perform very well in open landscapes, such as forested areas, but wood is also becoming increasingly popular in cities due to its easy availability and eco-friendly nature. In central-eastern Poland, pine wood remains the most popular due to its lightness, widespread availability, and low prices at building supply stores. Alternatively, spruce or larch wood is used; the latter is less common but offers the best physicochemical properties and is recommended by manufacturers of wooden decks for terraces and balconies instead of traditional slabs and tiles. Despite their frost resistance, when installed on adhesive bases, the tiles do not properly drain water during autumn rainfall, which in turn leads to damage in spring after the thaw period, when frozen water causes numerous problems. This is often associated with numerous and costly repairs. Moreover, wood is frequently used in construction or as elements in benches, trash cans,

picnic tables, and playgrounds, and we see this trend strongly developing in recent years in large metropolitan cities, such as Kraków and Warsaw (Figure 8.1a). In turn, in Indonesia, Bogor Park, as one of the most relevant green areas, shows a good tendency to use cut trees for further shaping into benches and other recreational elements (Figure 8.1b). These interesting forms, rarely found especially in Central Europe, decorate meadows and the interior spaces of landscape parks, encouraging free recreation for both residents and tourists.

a b



Figure 8.1. Example of the use of wooden materials: (a) city park near the Krowodrza Park in Kraków, Poland, (b) Bogor Park in West Java, Indonesia (photos by Andrzej Długoński, 2025)

8.2.3. Bamboo material as a semi-alternative in wooden construction

When it comes to wooden elements, it is also worth paying attention to a still underappreciated material in Poland: bamboo. It can be found in building stores for garden structures such as stakes or pergolas, but it is less commonly used in structural elements. The material is extremely popular in Asian climates and dominates in Indonesia, Singapore, and China, where temperatures do not fall below 0°C. The advantages of bamboo as a construction material include rapid growth, strength, earthquake resistance (flexibility), cost-effectiveness, aesthetic appeal, a wide range of uses (versatility), and low embodied energy (Figure 8.2a). In turn, its cons may include: moisture sensitivity, pest and insect susceptibility, need for treatment, specialized construction knowledge, fire hazard, and transportation challenges.

In summary, this material is lightweight and grows quickly on plantations. It is a locally occurring raw material, and many of its properties make it good for construction (Figure 8.2b). The assembly of the elements is done using jute ropes. The bamboo poles themselves are cut at a sharp angle to interlock the connecting elements. The full range of this material’s advantages and ease of use certainly make it effective in warmer climates. The material’s properties are poor at relatively lower temperatures; thus, in Japan, it does not find application.

a b



Figure 8.2. Use of bamboo construction: (a) entrance to the Volcano Bandung Park in West Java, Indonesia, (b) garden of a single-family house as a shelter element in Peru (photos by Andrzej Długoński, 2025)

8.2.4. Natural, forgotten local stone and its ecological background abilities

Another interesting example of a natural, eco-friendly material is the use of volcanic stone and terracotta in a tropical climate (Figure 8.3a). This material is popular in Asian countries in tectonic areas like Java because it is obtained in a minimally invasive, relatively inexpensive way. In comparison, in European countries, local raw materials such as sandstone, pebbles, and even granite (despite their higher market prices) are popular in landscape design. The advantages of stone lava material, compared to well-known stone granite materials, are: it is light and has a relatively interesting color, depending on the type of material obtained from a given volcanic site, and its very unique structure. However, we can see its use in landscape interiors in warmer climates (primarily in Asian countries) in representative settings such as conference rooms and the facades of office rooms and academic halls. It is worth noting that other forgotten light facade materials, such as benthos in beige-yellow or pink-red varieties, are visible in the Czech Republic (the Moravian region). Bentonite is commonly found in pavement slabs and facades of buildings in the Balkans (Southern Europe), for example, in Bulgaria in Złatni pjasyci (Golden Sands) (Figure 8.3b), as well as an element of the facade of a government office in the old town of Prague (the Czech Republic) and Warszawa-Śródmieście train station in Warsaw (Central Poland). It is a rather forgotten, though interesting, material in terms of structure and aesthetics. Unfortunately, it requires significant effort and maintenance, especially in areas with high levels of PM2.5 and PM10 dust pollution. Bentonite, also as an insulating material, can work perfectly as a seal for the bottom of a water tank, which is known as bentonite mats. This sustainable material is rarely used as an alternative to waterproofing or PVC mats made from recycled materials.

a b

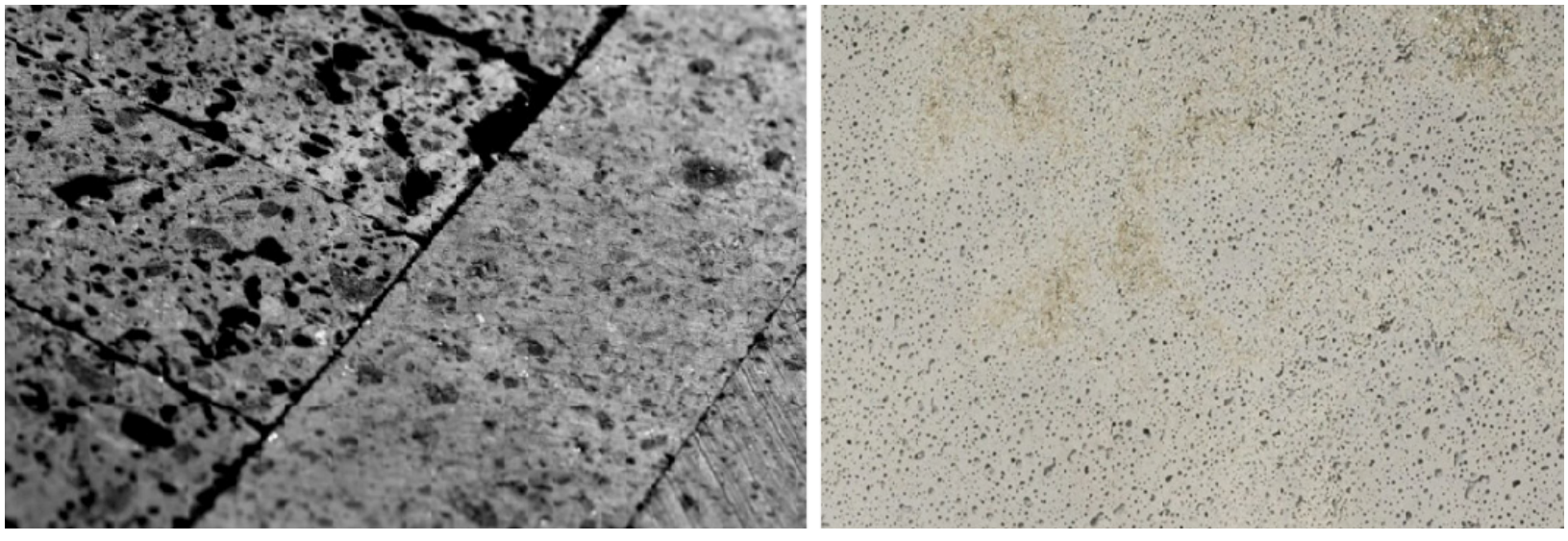

Figure 8.3. Volcanic stone (a) is commonly used as surfaces in Bandung, Indonesia, bentonite slab (b) is commonly used as a surface in Golden Sands, Bulgaria
(photos by Andrzej Długoński, 2025)

8.2.5. Recycled materials needed in equipment

When overviewing many interesting, valuable, and sometimes forgotten natural ecological resources, we must, however, draw the line when it requires destroying the natural environment, which is often under increasing protection. In addition, there are also growing amounts of waste containing large quantities of plastic and microplastics, commonly found even in the oceans and in our daily food (Kisiel et al., 2022; Walaszczyk et al., 2023). Therefore, as landscape architects, thinking about environmental sustainability, we should pay increasing attention to recycling materials and incorporating them into future landscape equipment or into design standards for future urban plans. Upcycled plastic materials in urban furniture and park infrastructure are unfortunately not commonly used in Poland, Western Europe, or Asia. Natural resources are still being extracted, leading to the deforestation of many valuable plant communities, especially those rich in naturally occurring beech, oak, and alder trees (Łukaszewska & Wysocki, 2009). Therefore, given this threat, it becomes increasingly real to introduce and implement in landscape design; German and Czech examples demonstrate this. Compressing plastic elements can produce structures similar to those of natural materials, and special eco-friendly paints made from natural raw materials provide excellent decorative effects, as well as durability and thermal performance. The material also remains in good condition longer and does not require constant repairs, unlike wooden materials, which are subject to constant impregnation, microbiological processes, and dimensional changes or warping due to humidity or drought.

8.2.6. Development of 3D printing of materials

A definitely rapidly observed trend in the sustainable materials industry is the innovations of Striatus, Phoenix, which are created from deposits of many tons of recycled materials (Regenerative materials, 2025; Striatus 3D, 2025). We can achieve this by using the remaining layers of landfill waste by deploying low-carbon materials, smart design, and circular construction (State of green, 2025).

It is worth noting the importance of smart design and 3D printing. Thanks to these solutions and a sustainable approach, we can reduce material use by up to 50% without compromising performance. There are already many examples of such construction projects, primarily in Asia, where some countries (e.g., China and Singapore) are technologically significantly ahead of European economies in terms of information technology (IT) and manufacturing development, and the rapid advancement of artificial intelligence (AI), with relatively low economic outlays.

8.3. NATURAL VERSUS UPCYCLING MATERIALS. WHICH IS THE BEST IN WHICH CASES?

In this chapter, we want to discuss whether the choice of sustainable materials depends on the given area, as well as the cultural and aesthetic values of the given landscape. It seems that there is no clear winner in this discussion. This thread is best illustrated by our credible case studies from Europe, South America, and Asia. From our practice, landscape architects consult with local authorities to decide on equipment for the area or an open site, such as parks, and then use various materials, which might also be eco-friendly. On the one hand, there is another visible tendency to use less wood and metal in construction due to sustainability requirements and the observed increase in environmental destruction from mining and forest cutting. This issue was also a main conclusion from the KATAMARAN field trip and from discussions with foresters at Spychowo Forestry in Masuria, Poland. Another concern with using wood as furniture and building material is that carbon is stored effectively, but the law regulates wood cutting and imposes restrictions on harvesting it from forest areas. The State Forests in Poland are more willing to sell their timber while ensuring rational, “healthy” forest management and nature conservation. However, we do not fully understand the reality of tree protection in protected areas in Asia or South America, as we lack reliable data on this matter. However, as observed by us, capitalization, especially in these rapidly developing regions, may lead to problems with preserving natural areas at the expense of using their raw materials for building roads, bridges, and houses, which is a more important priority for

meeting the basic needs of the population than achieving strict sustainability, as understood by European countries as well.

We see that various wood material options are available in the placemaking of a given sustainable space, not only from common sources like spruce, pine, or oak, but also from foreign (exotic) sources like bamboo. Therefore, using bamboo instead of pine for construction equipment is highly risky. The material performs well in Asian and South American climates where temperatures are not very low, and it is widely available in countries like Indonesia, China, and Peru. Bamboo grows fast; however, there is a lot of it available as a material in Europe, such as economically profitable pine wood, which could be used as well. But in countries outside Europe, it is used as a building material for garages, stairs, railings, fences, and garbage cans (Figure 8.4). We find that bamboo has a flexibility that can be bent, and some advanced and modernized applications of bamboo can be found in Bali in Indonesia. However, other Asian countries like Japan, China, and Thailand also have a creative and innovative way of utilizing bamboo, as well as due to its local and cheap material.

a b



Figure 8.4. Bamboo handrails (a), and waste bins (b) made from bamboo at the Chan Chan Archeological Zone tourist area in Trujillo, Peru (photos by Andrzej Długoński, 2025)

Furthermore, it is worth mentioning regenerative materials, though they are not common, as they are starting to be considered an alternative to natural ones to prevent the protected nature areas from deforestation and degradation, and to prevent the loss of many valuable green infrastructure areas in general.

Upcycled materials not only reduce the impact of climate change but also contribute to a positive impact on the climate, helping us avoid large deposits of garbage in a given region that cannot be stored indefinitely, both in the suburbs and in the rural landscape. The use of materials that reduce the consumption of air conditioning, lowering micro temperature, such as in tropical regions (examples), or new technologies that contribute more, such as PV panels (RES resources) like solar batteries, small turbines (Figure 8.5a), and we think can be good for climate change and periodic power outages to power the facility. It is also worth paying attention to metals such as nickel and tin, which, thanks to their occurrence in nature in Java (Indonesia), have good anti-corrosion properties and can be used in complementary equipment of these landscaping elements, which will ultimately enable the objects to be kept in good condition for many years (Długoński et al., 2025a; Kołodziej & Łukasik, 2025).

a

b



Figure 8.5. Renewable energy sources used in sustainable green areas in Młociński Park in Warsaw, Poland (a), and rare earth elements, nickel, and tin displayed at the Geology Museum in Bogor, Indonesia (b) (photos by Andrzej Długoński, 2025)

8.4. SUMMARY AND CONCLUSIONS

To sum up our work and research on sustainable materials in landscape architecture, it is worth noting the growing ecological trend toward the use of not only natural, local materials but also materials derived from second-hand

production, i.e., upcycling or downcycling. These materials do not differ in quality from natural elements, such as wood or stone. In addition, they require much less energy during production, making them eco-friendly and sustainable in protecting the natural environment. Nevertheless, it is worth returning to the attack by using native materials, but only those locally occurring in a given environment, which fit well into the landscape of a given space and do not require production costs or logistic transport problems, can be produce locally form sewages of given city area and their using in each green spaces do not cause a kind of noise or disharmony in the space. We think this may be a good tip for local stakeholders and authorities to successfully address this phenomenon, especially in Poland. We should therefore look at the Asian (Indonesia, China, Singapore) and South American (Peru) examples of how much poorer communities use their knowledge to produce sustainable materials only from local raw materials, such as bamboo, but assuming that these materials will perform well with their physicochemical properties in a given latitude. For the production of equipment elements in the future, we should look for opportunities in new methods, for example 3D printing, which is increasingly developing in industries, including architectural ones using AI and modelling software from the Autodesk or 3DSmax group, which can already be experimented in the course of learning and implementing cooperation with the economic industry on a deeper scale in the future for the sustainable development of a given region of the world (Figure 8.6).

a b

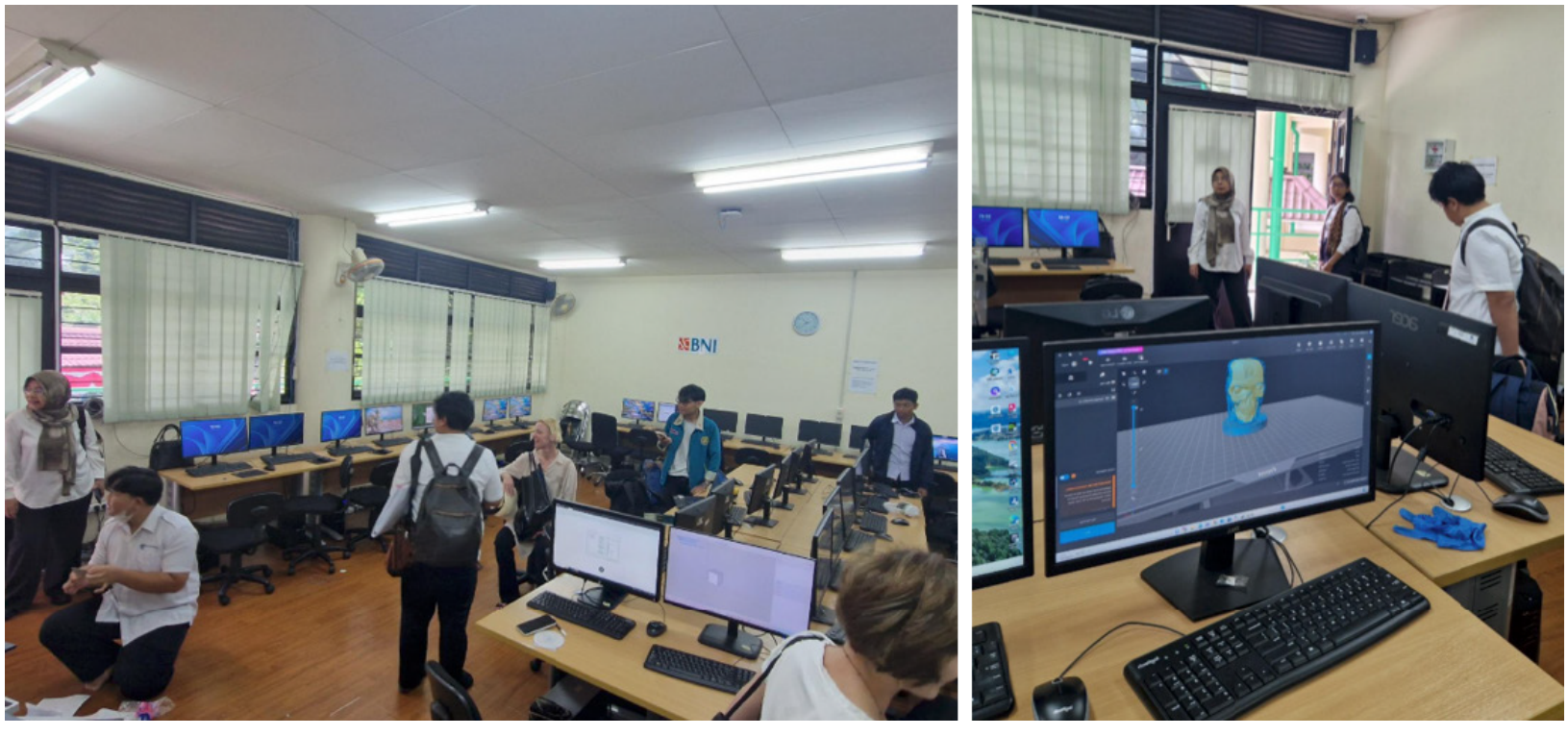

Figure 8.6. IPB LAB studio computer lecture room (a), and 3D printing software at the IPB landscape architecture facility (b) in Indonesia (photos by Andrzej Długoński, 2025)

In summary, the chapter highlights the environmental and economic benefits of using materials, encouraging the use of local raw materials and modern methods of material recovery to create aesthetically coherent spaces that are resistant to harsh climate conditions.

Review questions:

1. What are the advantages, disadvantages, and potential of the materials illustrated in this chapter, such as bamboo and local stone found in a given landscape (easily sourced), compared to materials commonly used in landscape architecture?
2. Why is bamboo not used in Japan, despite its popularity in other Asian countries?
3. What are the benefits of using recycled plastic in landscape architecture?
4. How does timber management differ between European and Asian regions?
5. What types of materials have minimal environmental impact while contributing to its positive impact on climate change?

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CASE STUDIES

9. ECO-FRIENDLY MATERIALS IN LANDSCAPE ARCHITECTURE: POLAND AND THE CZECH REPUBLIC CASE STUDIES

9.1. INTRODUCTION

Currently, we can observe rapid growth in the use of ecological materials in landscape architecture projects, including playgrounds, squares, forests, parks, and nature protection areas. This is due to the tendency or so-called “fancy” phenomenon in ecology, eco-friendly style, and the use of natural and recycled materials for ten years (Długoński, 2016). In this way, we demonstrate that we care for the environment and the factors that shape the future of young people who will set the standards and trends of their reality (Długoński et al., 2025). We can see ecological materials wherever we relax, go as tourists, or see the activities of local authorities and managers. Ecological materials include wood from local forestry, as well as stone elements such as limestone, basalt, pebbles or gravel, and wedges used in the construction of surfaces. It should be noted that natural materials, i.e., those described above, are increasingly adapted to the style of a given landscape, sometimes causing what we observed 20 or 30 years ago – a noise in the space (Bierwiaczonek, 2016).

9.2. NATURAL WOOD IN TOURIST FURNITURE

We can observe many interesting examples of natural elements, especially wooden ones, in landscape architecture areas across Poland and the Czech Republic. We evaluated many of them during the KATAMARAN study trips in Poland. In Spychowo Forestry, the expensive architectural elements, such as benches, bins, information tables, wooden railings, and other facilities of tourist objects, deserve special attention, as they are homogeneous and in the same style as the buildings that constitute their integral part. They take on the colors of wood stain or varnish, like the areas around them. The color impregnates the wood and protects it for many years from the effects of environmental factors, including microscopic fungi and abrasion (Długoński, 2020). It is worth noting here that proper protection of raw wood is important in this case. However, in Podhale, for example, no such protection is used, allowing the trees to be naturally preserved. This is due to the harsh mountain air, as some highlanders say (as we know from interviews), and to spruces, which are the main building

material and are local materials that tolerate the climatic conditions typical of mountain areas in Poland (Godet, 2008). Therefore, similarly to the Masuria region, we can observe a homogeneous placemaking approach in the facades of Podhale-style buildings, small architectural furniture, and equipment such as benches, bins, information tables, and wooden railings (Figure 9.1).

a



b

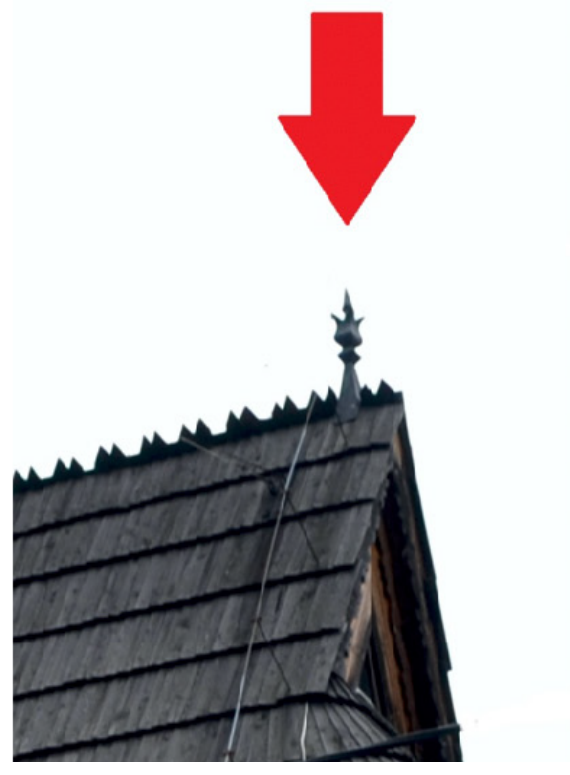

Figure 9.1. The naturally impregnated wooden facade of buildings in the Podhale region, Poland (a), the claw of a roof covered with shingles (b) on one of the old traditional villas in Zakopane. Wood is naturally protected by environmental factors, so no protective varnish is needed (photos by Andrzej Długoński, 2025)

At this point, we would like to draw attention to one important thing. We believe that this phenomenon of uniformity of development elements is crucial for the future shaping of the landscape of landscape architecture objects, especially in Poland, where, since the 1990s, we have been observing the degradation of the environment towards bad changes and the creation of spatial chaos as a result of significant changes based on acupuncture and unjustified *ad hoc* activities. Currently, students of landscape architecture, as part of practical classes, observe many green parks in the capital itself, and, unfortunately, one key issue that distinguishes them is the similar way of modernizing these facilities, where there is a huge diversity of elements that do not fit together. They are often from different eras (periods – the 1990s, the 2000s, even older, often damaged or slightly decaying), which ultimately disfigures these places and is the result of erroneous decisions made by the government or the area manager after the end of the Polish People's Republic (Polish: Polska Rzeczpospolita Ludowa, so called PRL). This phenomenon has been well illustrated in the literature, including examples from other regions and landscape scales (Kowicki, 2010; Paszkowski,

2011; Sarzyński, 2011). However, when we look at Czech or German examples, we can observe that space can be homogeneous and ordered, with the use of balanced elements, as illustrated in greater detail in this and other chapters of this manual.

9.3. NATURAL STONE IN WALKING AREAS

Stone and construction elements have been used in landscape architecture for small garden architecture for a long time. Back in the 1970s and 1980s, due to a shortage of other construction materials, such as sheet metal, concrete, and steel (during the PRL), this material was often used for fencing private houses. In particular, local raw materials were used there, such as sandstone, strongly represented in southern (Galicia) and Central-Eastern Poland (Świętokrzyskie Mountains). Therefore, this material also appeared on the facades of houses (up to 1 m AGL), protecting them against dirt and mechanical damage, as well as isolating the sometimes clayey soil, which posed a risk of moisture in the load-bearing walls of the buildings (Figure 9.1a).

Currently, due to the development of logistics in our country (Poland), stone materials are popular and available in construction warehouses, thus constituting an alternative to expensive, imported materials that are currently not valued mainly because of their high production costs and retail prices.

It is also worth noting the dramatic increase in the use of gravel or keystone in pavement construction materials (Figure 9.2). However, despite being environmentally friendly, these surfaces can be unstable due to improper design or management and often retain stormwater. It is worth noting that the condition of local rainwater storage is crucial, given climate change and the increasingly evident anomalous phenomena in Central Europe. However, the proper selection of supporting materials, such as drain grates, is crucial (the question remains whether they are even necessary). In many areas of Poland, small gravel particles often get stuck in drains, clogging them. This solution is often used, for example, in the Podhale region due to high rainfall variability (the average annual rainfall amplitude exceeds 600 mm).

Therefore, linear stone (granite) drains would be appropriate, as is common practice in mountainous areas adjacent to Poland, the Czech Republic, such as the Wilsonův les (Wilson Forest Park) area in Brno (Figure 9.3a). The use of rails without grates and the consideration of the slope help drain excess water, thereby reducing the risk of erosion and damage to permeable surfaces.

We also see the return of cobblestones in retaining walls, walls with benches, or pavements (so-called “cobblestone” surfaces), especially in historical sites in Mazovia and the Łódź region, where this material was still used in the 19th century as a hardened surface (Figure 9.3b).

a b c



Figure 9.2. Three types of permeable paved surfaces: small pebbles (a), crushed stone 15–30 mm in diameter (b), gravel 2–15 mm in diameter (c) visible in Kiry, in front of the entrance to Tatrzański Park Narodowy forest areas, Podhale region, Poland (photos by Andrzej Długoński, 2025)

In the case of this building material, the main issue is the proper construction technique, particularly for pavements, so that the sharp edges of the cobblestones are placed directly in a group or in a gravel-stone subbase. In this way, the risk of these edges appearing on the surface where cars or bicycles will travel is eliminated. This is certainly aimed at improving travel comfort and reducing the risk of punctured tyres or pedestrians tripping while crossing. Just a dozen or so years ago, there was a renewed interest in this type of pavement, although practically only poor examples of its implementation were visible, and as a result, each time it ended in pavement repair, leading to costly expenses for land managers.

a b



Figure 9.3. Linear water drainage in areas with large road slopes (a) in Wilson Forest Park in Brno, Moravia region, the Czech Republic. Stone surface made of pebbles (b) in Łagiewniki (front of the entrance to the Wawel cathedral), Galicia region, Poland (photos by Andrzej Długoński, 2025)

The observed current land use by us was slightly different, for example, in the Czech Republic, where our southern neighbors are better at using this type of implementation, which results from greater diligence and the adoption of norms and standards from Western countries such as Germany.

9.4. WOODEN SURFACES AS A SUSTAINABLE ALTERNATIVE

They are not yet as widely used in our country as in neighboring Czechia, primarily in historical buildings (Křtiny Castle, Moravia region). Even wooden surfaces are easily obtained and processed by chiseling wooden stumps into cubic blocks and properly impregnating them with vegetable oils. The effect may sometimes resemble that of non-wooden materials, but this is a forgotten solution used in palaces, monasteries, and castles in the early modern period (Figure 9.4a).

Bark or wood chips are currently an alternative to asphalt or rubber surfaces, especially on playgrounds, for maintenance work in green areas. This material has good shock-absorbing properties, sometimes better protecting the head or leg of a child playing in the playground from serious injury or fractures, and potentially hospitalization, should a fall occur. The material is ecological, natural, and therefore sustainable. However, it requires constant monitoring and re-coating, which may incur additional costs for the administrator or, after all, prioritize the needs of disabled people (Janeczko et al., 2016). However, we see that in the capital, it is chosen in forest areas, like the playground in Powsin (Southern Warsaw), to be an integral part of the landscape and to fit well with the style of the small infrastructure elements or wooden devices and toys in the playground in the forest (Figure 9.4b).

a b



Figure 9.4. Wooden pavement in the area of the castle in Křtiny, Moravia region, the Czech Republic (a), wooden surface made of tree chips as a safe material used on some playgrounds in Poland – example Bednarski Park in Kraków, Galicia region, Poland (b) (photos by Andrzej Długoński, 2025)

It is worth noting here that a similar material might be used as flowerbeds and group plants for shrubs in gardens, and less often in parks or representative areas, which is why plants die due to climate change, especially one year after they are planted in the ground, as is widely described in standards of green areas (Borowski et al., 2016).

9.5. ECOLOGICAL PLAYGROUND EQUIPMENT

Wooden material replaces steel and plastic elements in playgrounds. We see this in the capital, Warsaw, where more and more facilities, especially those located on the outskirts of forests, choose wooden materials. The entire playground is a greater attraction than the classic one available in the catalogues of playground equipment from Western companies such as Muller, and it is certainly a cheaper alternative that responds to the sustainability we write about in this book. Another advantage of wood is that it is warm and, in the event of a child's blows, it can sometimes alleviate the effects of serious injuries, so it can be said that it is safer and should be used more often in sunny playgrounds in cities, as is currently the case in large cities in the Czech Republic (Brno, Prague) or Germany (Leipzig, Berlin).

9.6. ANOTHER MATERIALS OVERVIEW RECOVERED FROM UPCYCLING OR DOWNCYCLING

The use of structural elements, e.g., recycled bench seats, is increasingly popular in Poland. Processing plastic waste enables it to be compressed, making these elements highly resistant to both mechanical (impacts, abrasions) and environmental (weather and microbiological) factors. The raw material will previously have been waste, so it gets a second life, and after using the right ecological paint, similar in color to that used on wooden materials, it gives a very positive final effect. Therefore, a bench made of such sustainable materials is aesthetically pleasing and does not differ in function from an ordinary bench made of wood (Figure 9.5a).

a b



Figure 9.5. Recycled material used in one of the ecological benches (a) in the zoo in Brno, the Czech Republic, and artificial plastic material imitating wooden boards commonly used on balconies in new buildings in Poland (b) (photos by Andrzej Długoński, 2025)

Recyclable material emitting wooden boards with milling is also increasingly available at construction yards (Figure 9.5b). The advantage of this material is its relatively inexpensive cost, no need for varnishing (as in the case of the need for wooden boards which, despite the use of pro-ecological paints, do not provide such good protection of the wood and often expose the investor to additional costs due to the need to impregnate the material that absorbs the varnish as a raw material every year).

9.7. SUMMARY

Summing up, in this chapter, we bring some new inspirations and a rethinking of small landscape architecture objects like benches, natural surfaces, and fences as sustainable materials that we observed in regions Masuria, Mazowsze, Galicia, including Kraków and Tatry Mountains, as well as Moravia region in the Czech Republic. We observe that some are still in good condition; others need better solutions for common use and maintenance, as well as for climate change mitigation and proper protection. In conclusion, not only do regenerative materials come from second-hand production, but local elements should also be sourced from the given landscape to achieve lower costs, which is both an ecological and an economic approach to sustainability rethinking.

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10. FLOODED FORESTS OF THE TONLE SAP LAKE AS A SETTLEMENT ENVIRONMENT IN CAMBODIA

“In Khmer thinking, this is according to Buddhism, humans live upon the land. Water lies below the land and supports it. In turn, water rests upon air. The Khmer terms for expressing this are:

Kyo tro tuk [air supports water]
Truk tro dei [water supports land]
Dei tro munou [land supports people]”

(as told by the abbot of Wat Knong Srok; Taylor, 2014, p. 39).

10.1. FLOW REVERSAL AND FLOODED FORESTS

The Tonle Sap Lake in Cambodia, commonly translated as referred to as “Great Lake”, is a unique “beating heart” of the dynamic lower Mekong Basin. It is a principal component of the complex hydrology of the Mekong delta and the largest lake and wetland complex in Southeast Asia, located in the central Cambodian plains (Figure 10.1). As a natural floodwater reservoir, it performs as flood protection for a large swath of the territory in the wet southwest monsoon season (May through October) and assures dry season flows (November through April) – with peak high water in August–November and peak low water in February–April – to vast areas downstream. During the dry season, the lake is about 120 km long and 35 km wide. Remarkably It is renowned for a remarkable phenomenon where during the monsoon season the massively increased flows from the Mekong reverse the direction of the Tonle Sap River and the lake’s coverage expands from 2,300 km^2 to 15,000 km^2 and from 1.33–10.30 m (Kummu, 2009). The distance of the maximum and minimum waterlines is approximately 10 km, although “waterline” is a relative term since the edge of the lake is a subtle gradation of wetness – from wetlands to reed beds to gallery forests to mud plains to sediment-heavy water – that stretches for many more kilometers and that continuously moves back and forth (Evans, 2002). Meanwhile, the bottom of the lake is only 0.5–0.7 m ASL (Kummu & Sarkkula, 2008). The nutrient-rich sediments in the floodplains are a *pars pro toto* of the larger phenomena whereby the Mekong delta is eternally replenished and re-muddied as a territory.

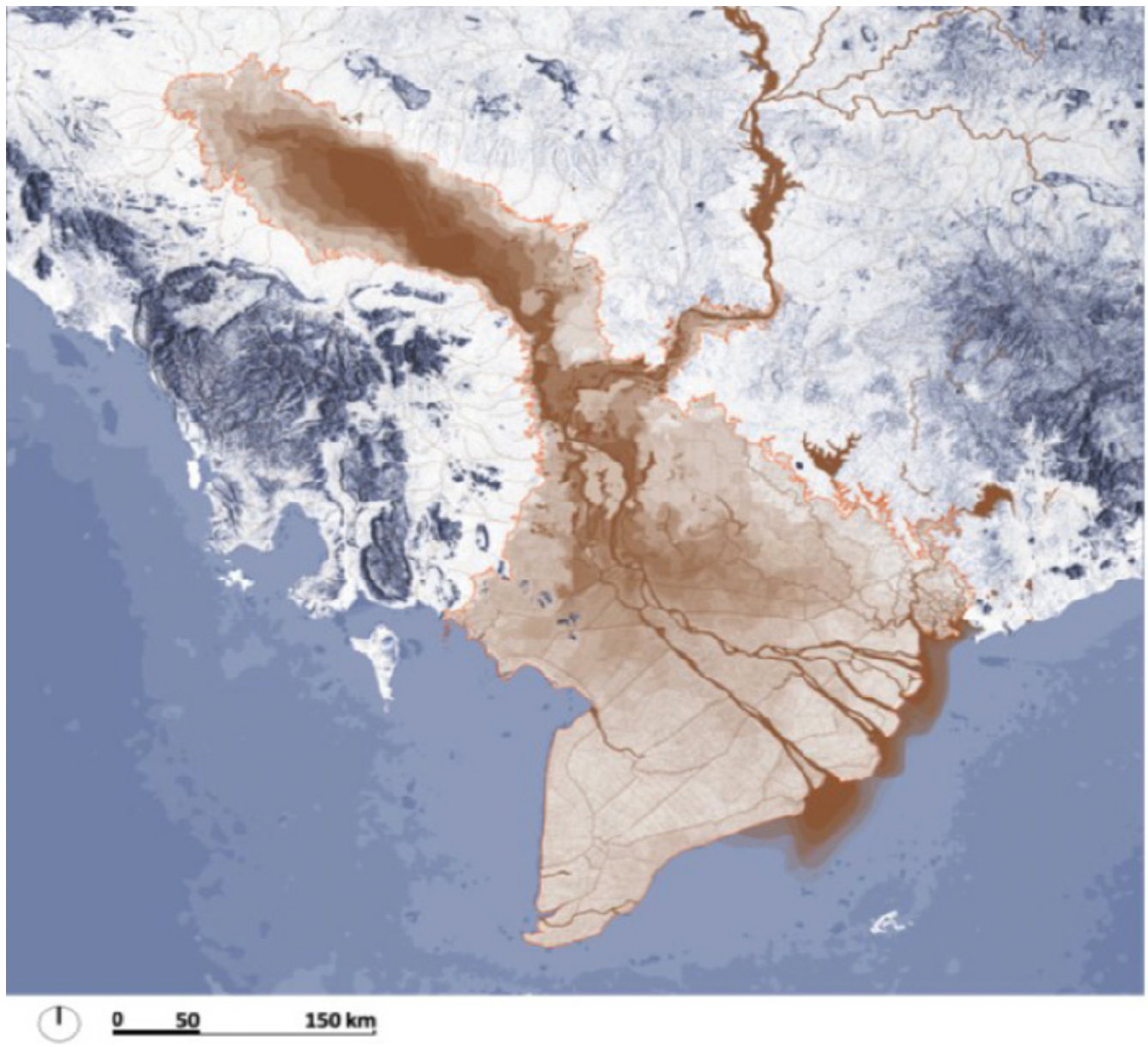

Figure 10.1. The Mekong and Saigon-Dong Nai deltas and the largest lake include the largest wetland complex in Southeast Asia, located in the central Cambodian plains. Together, the topography and bathymetry reveal the water challenges of the delta (map by Research Urbanism and Architecture, 2025)

Archaeologist and irrigation engineer van Liere has described the Tonle Sap Lake as the region's largest backswamp. Backswamps are surrounded by alluvial plains and low terraces. Back swamps act as natural flood regulators when the monsoon river rises rapidly. Contemporary researchers Okawara and Tsukawaki (2002) have dubbed the lake as "the mud ocean" due to its year-round deep reddish-brown to yellowish-brown color of the water with extremely low transparency because of suspended clayey sediments. Evidently, the Tonle Sap Lake has a unique ecology. While van Liere categorized this plain in general as a fresh water mangrove, there can nevertheless be distinguished four distinct habitat groups besides the open water (under water 12 months a year); (1) gallery forest (annual flood duration of 9 months); (2) seasonally flooded habitats dominated by shrublands and grasslands flooded 5–8 months); (3) transitional habitats, nowadays dominated by abandoned agricultural fields, receding rice/floating rice, and lowland grasslands (flooded 1–5 months); and (4) rainfed habitats, consisting mainly of wet season rice foelds and village crops (flood duration less

than 1 month) (Molyvaan, 2003; Poole, 2005; Kummu et al., 2014). The floating villages, discussed further, mainly settle along rivers in the gallery forest and on the lake (Figure 10.2). Overall, the lake provides habitats for approximately 280 fish, 42–46 reptile, 225 bird and 15 mammal species (Sithirith, 2015). The Tonle Sap is among the most productive freshwater ecosystems in the world; in 2000, its annual fishery yield was 230,000 tons, equivalent to approximately half of the country's total production (Sithirith, 2015). The dynamic hydrology of the seasonal inflow flood pulse transfers terrestrial nutrients into the aquatic system and the flood plain's gallery forest and scrublands offer rich grounds for the water-flow migration of eggs, fry and fish from the Mekong River (Kummu, 2009).

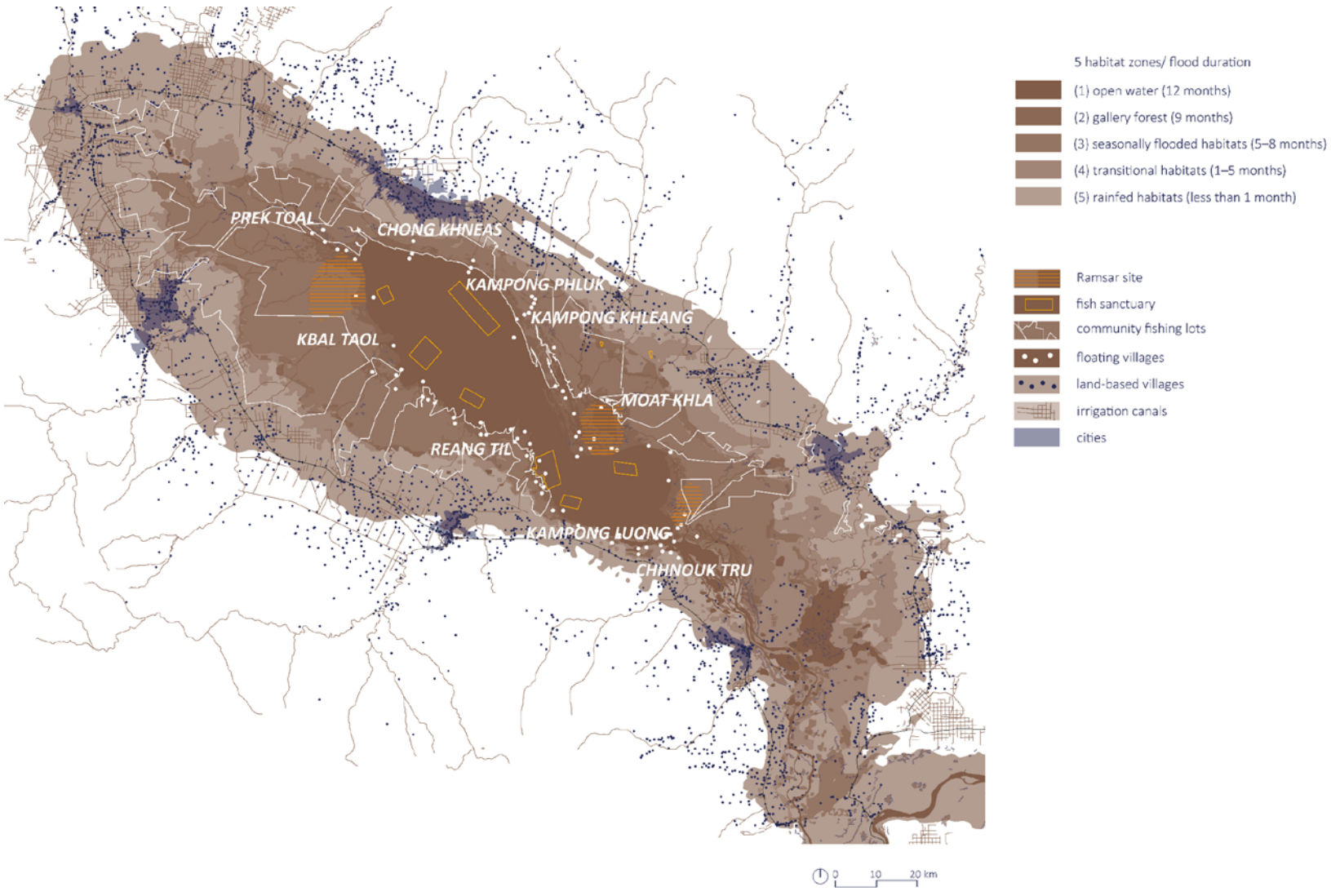

Figure 10.2. The Tonle Sap Lake is a rich aquatic landscape that transforms with seasonal dynamics and hosts a vast diversity of non-human species, with an array of wetland flora and fauna. A number of both tall stand-stilt and floating settlements thrive in relation to the common resources of the landscape (map by Research Urbanism and Architecture, 2025)

10.2. SUSTENANCE, PRODUCTION, AND WORLDVIEWS

The exceptional pulse system of the lake supports a wide variety of water-based livelihoods. In turn, livelihoods are commonly bolstered by a diversity of supplementary activities, and there are extensive seasonal migrations of animals, people, and villages. There is also a connection of cosmological worldviews to

productive landscapes, underscoring the being with, as opposed to against, the forces of nature and as found ecology. The longstanding and meaningful relation of humankind to forests is evident from the fundamental distinction by Khmers between *srok* (inhabited areas) and *prei* (forests). *Prei* are both feared and venerated. Spirit forests and/or spirit areas are related to *neak ta*, or the guardian spirit often associated with either specific trees or distinctive geographic features (Figure 10.3). Other spirits are also recognized in relation to trees, forests, and places. Resin tapping is extracted from various trees. It is used for making torches and sealing wooden boats. Freshwater mangrove (*Barringtonia acutangular*) grows 7–15 m in seasonally flooded swamps around the lake, and they provide the lightweight and water-resistant wood that villagers harvest for building housing platforms and boat hulls. Various forest plants, fruits, and bark not only provide food sources, but have remarkable medicinal potential. The undeniable link of the particularities of location assets, worldviews and modes of production is abundantly evident in the Tonle Sap Lake (Figure 10.4).



Figure 10.3. In the transition area of open waters and aquatic vegetation *neak ta* shrines are simultaneously beacons for wet season navigation and spirit houses for natural gods at Tonle Sap Lake, Pursat (photo by Research Urbanism and Architecture, August 2023)

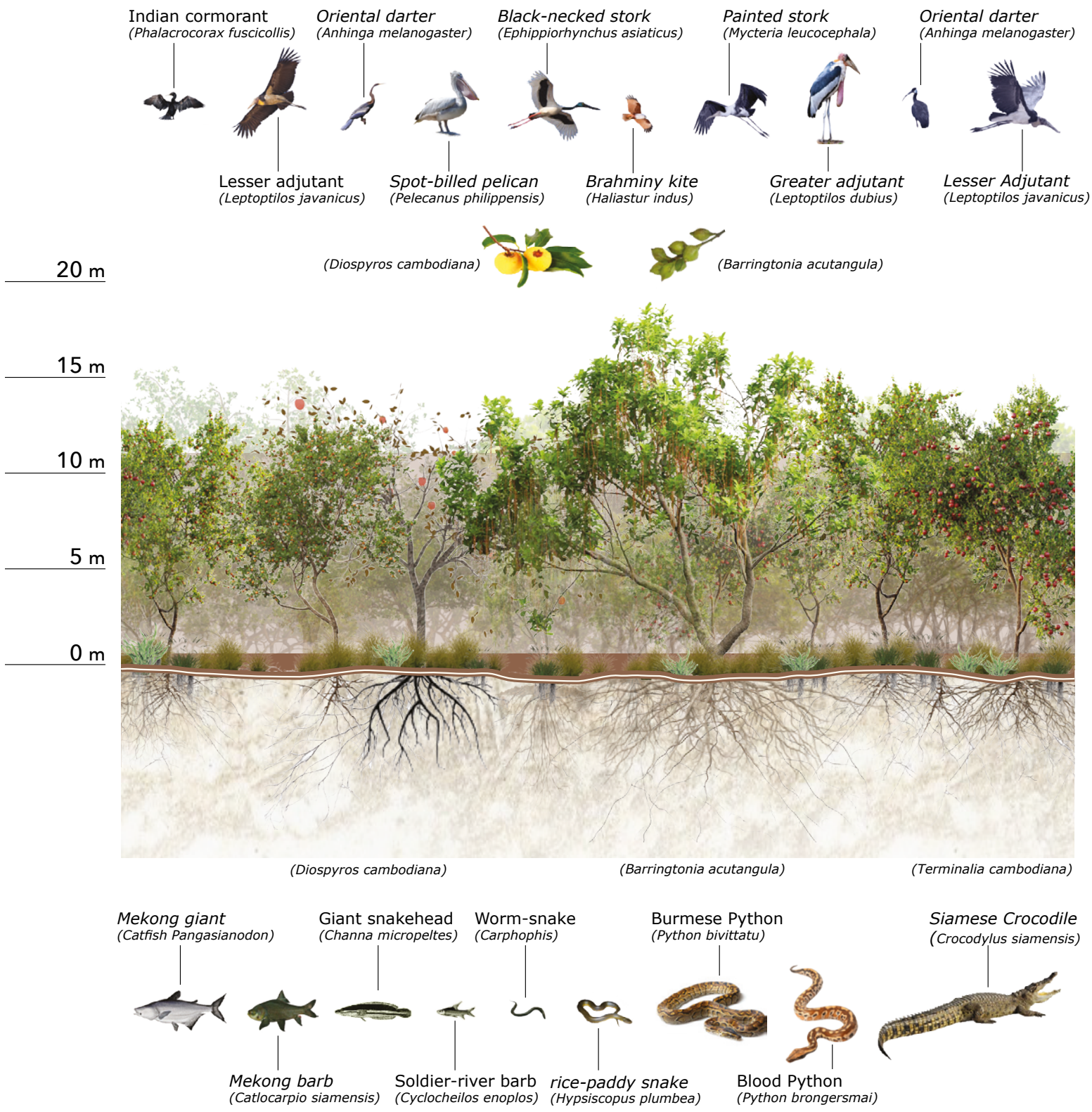

Figure 10.4. The trees of the gallery forests of the Tonle Sap Lake reach 7–15 m in height, with the tall trees spaced out with floating aquatic vegetation in between. The area supports a large assemblage of plant, fish and waterbird species, many of which are listed as rare, vulnerable, or endangered (picture by Research Urbanism and Architecture, 2026)

10.3. SETTLING WITH/IN THE LAKE

In and around the lake, displaced Vietnamese and Khmer fishermen communities live in villages called kampong (“landing place” in Malay); they operate as constellations and are interdependent with the slightly higher-land

rice-growing villages through trade. Settlement and productive landscapes on and in the environs of the lake were initially developed with various modes of indigenous knowledge systems and practices (IKSP) and which remain in numerous floating fishing villages. Throughout settlements on the lake there are a range of rituals and beliefs, known as *neak ta. Ktom neak ta* (spirit houses) are the physical embodiment or nesting places for negotiation between humans and the wild, between land and water and are strategically located in relation to water and forests. The spirit houses, always on stilts, mostly accompanied by one or several trees, not only protect the community and fishermen from the dangerous water regimes of the Tonle Sap Lake, but also serve as navigational beacons (hence their common location where river mouth and lake meet during dry season). The water depth of the lake and the ecology of plains to the east and west of the lake vary significantly due to the geological evolution and sedimentation of the territory (Carbonnel, 1972; Molyvann, 2003). In summary, Tonle Sap was read as a backswamp connected to the Mekong River via the Tonle Sap River. The area southeast of the lake accumulated massive amounts of sediment over millennia, resulting in the expansive and connective hydrology of Mekong delta since the Holocene.

For decades, floating villages of the Tonle Sap Lake have revealed an ingenuity by necessity and a way to adapt to the seasonal rhythms of nature. The floating villages can be read as examples of an ephemeral, floating urbanism, which responds to discriminatory practices of land tenure and inherently adjusts to ever-increasing water level differences, exacerbated by global warming (Figure 10.5). The water-based modes of inhabitation and livelihoods are connected with resourcefulness and use of locational assets. The modes of settlement and livelihoods suggest a pause in the neo-liberal wave of market-driven globalism that is presently overwhelming the Cambodian territory. The unique monsoon culture of high-stilt and floating villages with their culturally specific identity has forms and practices of hierarchy and heterarchy.

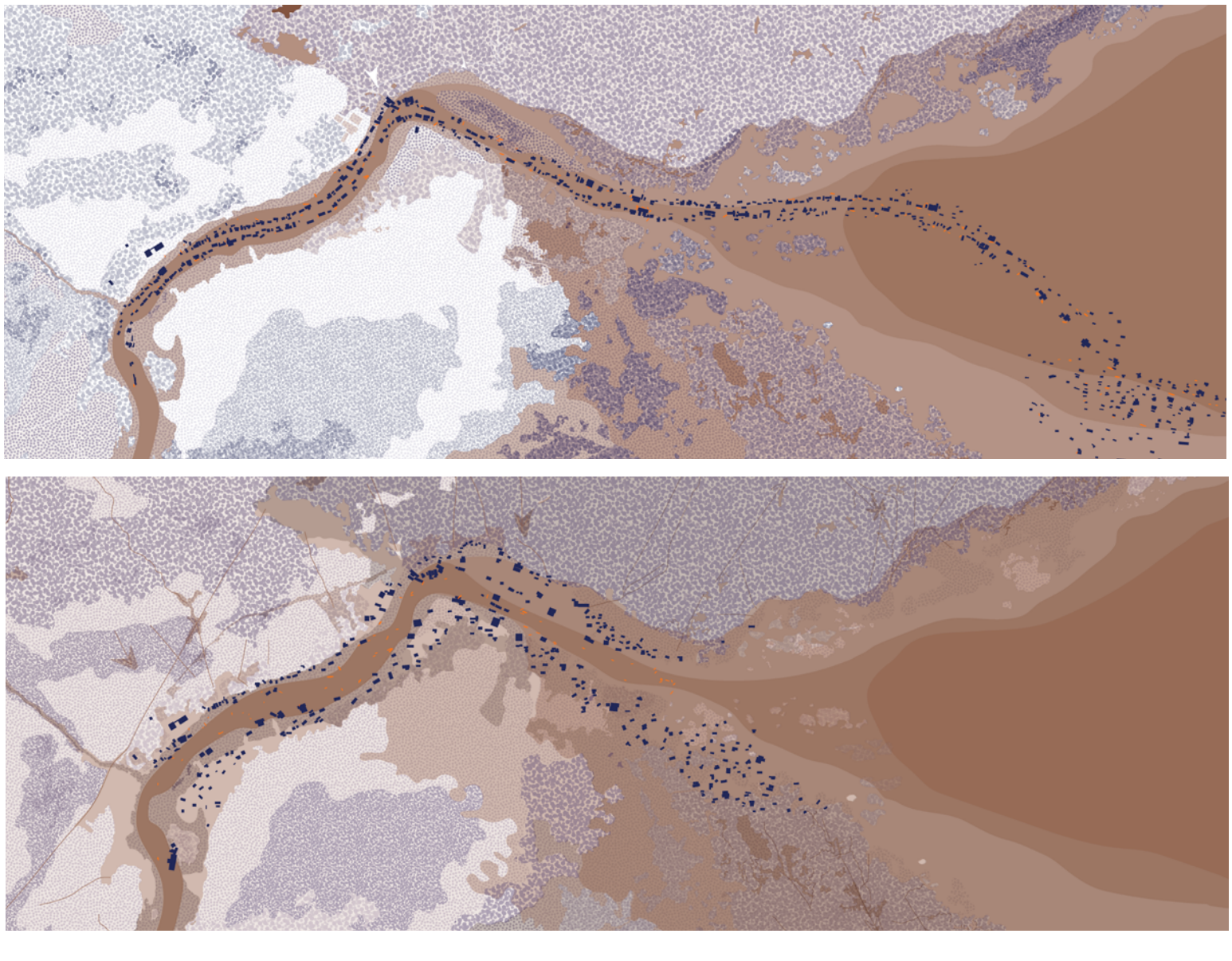

Figure 10.5. Seasonal migration in Kbal Taol in the dry season (above, March 2017) when the settlement is aligned with the river's flow and in the calm lake and wet season (below, January 2014) when the settlement retreats into vegetally protected wetlands and the river (photos by Research Urbanism and Architecture, 2021, based on Google Earth Pro imagery)

It has been speculated that the movement of trade goods across the lake and accompanying ancient ports and settlements existed since Angkorian times (802 AD–1431) (Pottier et al., 2012). Floating settlements grew with the French colonial concession system of fish lots (primarily operated by Vietnamese) and expanded with Chinese-owned commercial fish lots (Gottesman, 2004). Although they have subsequently been outlawed, there remain numerous floating villages engaged in subsistence fishing. Since their establishment, the floating villages of the Tonle Sap Lake – ranging from a few to hundreds of families – incessantly shift locations with the changing water levels. As such the floating villages went through numerous iterations of colonial and postcolonial policies, all paralleled by subversive forms of self-organization, while agilely exploiting environmental idiosyncrasies. More by nature then by plan, they are often out of reach of authorities and survive "under the radar." The Indigenous knowledge systems and practices (IKSP), that underpin village and livelihood construction result from such repeated iterations. As explained by Roshko (2011) and evidenced in fieldwork, entire villages typically move in three to six steps both into the lake and retreating to river mouths. In the dry season, the villages are loosely dispersed in the lake to optimize fishing opportunities.

Fishing occurs in and along the shores of the lake and streams as well as along the edge of protected natural areas. In the wet season, the villages retreat further and further into local tributaries of the flooded forest (to avoid the danger of storms and waves on the open water) and have a compact morphology, with fishing in all areas where the water has risen (including flooded habitats of grasslands, shrub lands and gallery forests). In the wet season, the floating houses are anchored to trees. The villages that are collectively known as Prek Toal at the mouth of the Sangkae River, north-western most area of the lake, exemplify these seasonal movements (Figure 10.6). The area is simultaneously part of one of the three core protected areas (Boeung Tonle Chhmar and Strung Sen, the other two) of the 2001-declared UNESCO Tonle Sap Biosphere Reserve and one of the most intensive fishing areas of the lake (Sithirith, 2011). During the dry season, the village linearly extends into the lake and culminates with an egg-shaped concentration favoring the south-western shore. The string of settlement begins in the west, in the river close to a *wat* (Khmer temple) and school – both on tall stilts and nestled into the gallery forest. Rhythmically spaced average-sized houses, all aligned with the direction of river's flow are punctuated by larger clusters that have commercial functions. There is a concentration of larger houses in the river's bend and mouth. A church, pulled out deep into the lake with the village marks the moment where the linear arrangement, which defines a water highway, dissolves into a dispersed pattern. During the wet season, the floating houses retreat into vegetally-protected wetlands and the river itself. The string of houses and commercial structures is more condensed and almost all houses anchor along the riverside, following the tree line. Commerce remains in the more open water of the river (obviously to profit from the passing by traffic). At the river mouth, clearings in the gallery forest accommodate clusters of houses.



Figure 10.6. Traces of corridor movement and dispersed settlement amongst wet season reed fields in Pursat, Tonle Sap Lake (photo by Research Urbanism and Architecture, August 2023)

Other villages, such as the one in Kampong Khneas (in the mid-section of the western shore), migrate less dramatically within a river mouth at the edge of a flooded forest. In the wet season, houses cluster around trees to which they are literally fastened with a rope (Figure 10.7). Some households have an additional platform adjacent to the house for work and today many houses have acquired solar panels. Commerce and services, recognizable by the size of the platform, align one trajectory of the main water route.



Figure 10.7. Settlement of Kampong Khneas amidst the flooded forest and in the river mouth where floating houses anchor themselves on trees, Tonle Sap Lake (photo by Research Urbanism and Architecture, August 2023)

10.4. HIERARCHY AND HETERARCHY

The morphology of the floating villages is simultaneously hierarchical and heterarchical, following customs and belief systems on the one hand and adjusting to the seasons and forces of water flows on the other hand. Village alignment follows social rules, where different ethnic groups (Khmer, Vietnamese, Chinese and Cham) tend to cluster nearby their respective wats, churches, temples and mosques. The material wealth of a house in Khmer settlements is secondary to “the location of a residence and its proximity to sacred sites (which) acts as more significant indicators of power and status” (Edwards, 2007, p. 43). There is a grouping of houses with extended families tethering their floating houses to one another. Small-scale fish (or crocodile) farms, floating animal pens and work surfaces as well as bamboo and/or vegetal fenced enclosures are often

close to the family clusters as are the family's fleet of various sized fishing boats and canoes. The floating houses are built atop wooden platforms, kept buoyant with steel barrels, large ceramic vessels, and bundles of plastic bottles. Their fronts typically have an open veranda, and their backs have cooking and toilet/shower facilities. There are also inhabited boat typologies. The quality of building materials and craftsmanship varies from dwelling to dwelling but are primarily post-and-beam constructions of wood, bamboo and other light-weight materials, which allow for easy mobility. The houses range from 3–8 m wide by 6–20 m long (Sithirith, 2007).

The floating settlement of Kampong Luong, the largest in the lake, reveals the ordering system, here described in the wet season. A double row of large housing with commercial areas services (shops, tailors, mechanics, barbers, etc.) align to define a fast-trafficked water highway, starting in the estuary and penetrating the lake (Figure 10.8). For this line of housing, there is no ethnic differentiation. Behind this "infrastructure" is an ethnically-grouped heterarchical assembly of house clusters that fold themselves within a creek and lake with minimal rules of neighborship such as keeping respectful distance and leaving passage. At the opposite edges of the lake, two towers navigationally mark the river and connect the village intangibly and tangibly with the world – the *neak ta*, a tree-house for the spirit world and the mobile phone antenna for 21st-century communication.



Figure 10.8. The entirety of Kampong Luong, the largest floating settlement on the Tonle Sap Lake, moves approximately 5–6 times following seasonal dynamic water flows. Many of the floating houses have an additional platform adjacent to the house for work or an occasional floating garden and evidently a number of boats are moored at the house (photo by Research Urbanism and Architecture, August 2023)

Along the northeastern shore and the Strung Sen River, there is another settlement pattern where the clustering floating houses form an indigenous type of water squares. There are two rows of buildings along each shore. The first is nestled into the shore's low-lying scrub and trees (lake's area of biologically richest vegetation). Between the houses and the scrub, large stocks of big ceramic vessels (used as float material for the houses) are stored and a smattering of clearings host vegetable gardens. A second row of houses, often accompanied by small functional buildings (workspaces, fish cages, an occasional floating garden) in front of them, is positioned closer to the center of the river. The configuration results in a rhythm of "water squares," often defined by extended family clusters (Figure 10.9). A hierarchy is evident with the largest water square defined by tall-stilt buildings (wat and school) and the largest houses of the village.



Figure 10.9. Clustered systems of water squares defined by extended family units in Kampong Svay between the main river flow and the flooded forest (photo by Research Urbanism and Architecture, August 2023)

10.5. PROJECTING FORWARD

The lake is presently facing dramatic changes and threats, particularly concerning its ecological health and biodiversity, that also severely affect its inhabitants. Today, the lake's biologically rich floodplain, home to 1.7 million people, is extremely vulnerable to the impacts of extensive and large-scale water infrastructure construction (hydropower, irrigation, flood control, and water supply) in the upper and center parts of the Mekong River. Coupled with the consequences of global warming (increasing atmospheric and water temperatures, frequency of extreme weather events, and variability of rainfall) (Nuorteva et al., 2010), changes in

the hydrology of the Lower Mekong Basin are wreaking havoc on the annual flood pulse, adversely affecting fish migration and floodplain habitats. In the lake's immediate vicinity, millennia-old settlements, multi-ethnic livelihoods, and socio-cultural practices are threatened by an increase in deforestation and monocrop cultures, a growing population, burgeoning international investment, mass tourism, and various development pressures. At the same time, the ecological vitality of the lake is endangered by increasing siltation, pollution, over-exploitation within wildlife (particularly fish and bird habitats), and the spread of non-native vegetation.

Meanwhile, local inhabitants who live in permanently floating villages on the lake and Tonle Sap tributaries are caught in a dilemma. On the one hand, socio-economic development leads to livelihood diversification (away from mere subsistence fishing) and access to modern social services, although there are already schools, churches, temples, pagodas, and a clinic boat that serves part of the Tonle Sap floating villages. On the other hand, entire villages risk disappearance altogether, as trapped sediment upstream brings a loss of fertility which undermines fish and farming livelihoods, and flooded forests are predicted to become permanently inundated (and die). The socio-cultural constructs of not only floating villages, but also the lake's stand-stilt villages are existentially threatened. Most worrying is an enormous new "smart" Cambodian-Chinese project by Danong Agricultural Development Group (DADG) that promises to transform many parts of the Tonle Sap Lake floodplain into a "Fish and Rice Corridor," an infrastructure investment of 12.7 billion USD, and to include "agro-industrial management and operations" on 750,000 ha of land in four of the lake's adjacent provinces (Battambang, Pursat, Siem Reap and Kampong Thom) (Socheata, 2023). These "agro-industrial management and operations" repeat the imposition and regulations of specific investor interests, mirroring earlier practices during the French colonial regime. Local heritage values and traditional water management practices will simply cease to exist.

In the past decade, the Cambodian government has increased regulations of common-pool resource use, primarily in response to over-fishing and as a measure to safeguard biodiversity. A flipside of the policies has been extreme inequality of access rights and other privileges that extractivist (neo-) liberal policies have enforced since the late 19th century – and which are worryingly becoming expanded in scope and scale with planned Chinese investments. It is an open question whether the floating villages that form a marginal world, in between formal and informal, legal and illegal, on and off the map, can withstand another iteration of regulatory impositions and survive with their resilient self-organization. The growing recognition, lived realities, and reinvigoration of IKSP in many parts of the globe point to the acute necessity of alternative methods of engaging humankind's settling with and in

the world – ways to very specifically engage with locational assets, culture, and the particularities of context. As such, IKSP offers a *leitbild* in the double meaning of this German term: a guiding image (as in a policy strategy or governance model) as well as a mission statement (the vision that defines actions, plans, and programs) (De Meulder & Shannon, 2022).

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- De Meulder, B., & Shannon, K. (2022). Cambodia's Tonle Sap Lake: iterating between disruptive water engineering and TEK. *Landscape Architecture*, *29*(2), 12–25. https://doi.org/10.14085/j.fjyl.2022.02.0012.14

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11. FOOD FOREST IN GUNUNG GEDE PANGRANGO, INSPIRED BY THE TRADITION OF AGRIFORESTING IN WEST JAVA, INDONESIA

“Landscape architecture? I suppose it’s a good way of bringing people closer to nature.”

Isep Kurnia
statement of 22 August 2025

11.1. INTRODUCTION

The example presented here is a mountain lodge established by local activist Isep Kurnia on his Bumi Bagja estate at the foot of Mount Gede Pangrango near Sukabumi in West Java. It is an excellent example of how local agriculture and culinary tourism can protect the environment whilst strengthening local communities. Isep Kurnia’s cuisine is based on local ingredients, produced on-site using traditional Javanese food preparation methods, such as smoking and cooking over an open fire. A semi-natural forest ecosystem has been planted on the site of a former bamboo monoculture, and the existing buildings have been constructed using both traditional materials (brick, mahogany wood, bamboo) and reused metal structural elements. A space has been created for education on sustainable development, contemplation of nature, and traditional cuisine (Martono et al., 2008).

11.2. THE BUMI BAGJA FOOD FOREST: COMBINING ENVIRONMENTAL CONSERVATION WITH LOCAL FOOD PRODUCTION

The Bumi Bagja food forest, managed by Isep Kurnia in the buffer zone of Mount Gede Pangrango National Park in West Java, combines nature conservation with local food production, acting as a “living laboratory” that uses the “diplomacy” of good cuisine to reconnect people with nature (Camsyah, 2025). The idea

combines the concepts of the food forest, described further in the text, a concept popular in Australia and the islands of South-East Asia, with the conservation of native species. The *talun* concept posits that, instead of traditional monoculture farming, which requires land clearing and the use of pesticides, the Sundanese (Central Javanese) planting method is employed, which mimics the structure of a natural forest. This allows for the growth of diverse vegetation and so-called "weeds" as ground cover to maintain soil moisture even during the dry season, as well as to protect water levels.

This method also prevents soil erosion and runoff into nearby rivers and maintains clean water sources, which is crucial in Bumi Badja due to the proximity of the national park's water sources. From a broader biodiversity perspective, the forest provides a habitat for local fauna such as lutungs, surilis, and various bird species, recognizing that forest resources are for both animals and humans (Bumiku Satu, 2024). A key conservation strategy in Bumi Badja is to change perceptions of wild plants, which are defined as *gulma* [weeds], by recognizing them as food. Isep Kurnia transforms traditional *lalapan* [raw vegetables] into "forest salads" using local wild plants such as *poh-pohan* (*Pilea melastomoides*, *P. trinervia*). The second concept is the conservation of native species by utilizing plants often considered weeds as food sources. The project prevents the eradication of these species by farmers, who might otherwise view them as a hindrance to commercial crops (Camsyah, 2025).

11.3. CONSERVATION THROUGH CULINARY CULTURE AND OPEN EDUCATION

The Asapa Isepa smokehouse serves as a culinary laboratory that utilizes traditional highland culinary culture (using wood and fire) to enhance the value of local ingredients (Figure 11.1). It is simultaneously a strategy for waste reduction and the preservation of West Javanese (Indonesian) culture. Techniques commonly used by Isepa, such as *pengasapan* [smoking], are used to preserve seasonal surpluses, such as tomatoes and chillies, transforming them into products with a long shelf life. This process takes up to 14 hours, which emphasizes the "slow living" philosophy, respecting the time and resources provided by the forest (Bumiku Satu, 2024).



Figure 11.1. Traditional Isep Kurnia’s cuisine, West Java, Indonesia
(photos by Andrzej Długoński & Beata J. Gawryszewska, 15 August 2025)

The design utilizes an open-kitchen concept, allowing guests to observe the cooking process and the origins of the dishes. This transparency aims to make visitors aware that the forest is not merely a place for research or

recreation, but a direct source of life and sustenance that must be protected. Bumi Bagja integrates with the local community to ensure that environmental protection is economically viable for neighbors.

This approach supports the local circular economy, which is vital for sustainable development and combating climate change. This is made possible through local sourcing, with 60% of food ingredients coming from the forest orneighboring farms. It also stabilizes local markets by purchasing ingredients such as pumpkins and onions directly from neighbors at stable prices. For example, Isep ensures that money stays in the village rather than flowing to “capitalists” (Bumiku Satu, 2024). Finally, this system provides local farmers with a steady market, encouraging them to retain their land and practice diversified farming, rather than selling it or switching to intensive, destructive agricultural practices that undermine the sense of community (Recy, 2015). At Bumi Bagja food forest, forest salads are creative variations on the traditional Sundanese *lalapan*. By combining wild plants growing in the forest with local sambal, Isep Kurnia uses these salads as a form of “culinary diplomacy” to introduce visitors to the natural wealth of the mountain ecosystem (Camsyah, 2025).

11.4. WILD PLANTS AND THE LOCAL PHILOSOPHY OF “ABUNDANCE”

The kitchen equipment used by Isep shows that wild plants and unique ingredients are used in the salads and other “from forest to table” dishes (Figure 11.2). The key ingredients of the forest salad are three species: *poh-pohan* (*Pilea trinervia*), *daun walang* (*Eryngium foetidum*), and *garut* (*Oenothera lindheimeri* / gaura). The first is the main ingredient in forest salads. It is a shade-loving plant that grows beneath the tree canopy; if it receives too much direct sunlight, its leaves turn yellow. When grown in the shade, it produces large, healthy, green leaves, ideal for eating raw. The second is used in salads, sambal, and as a rice condiment. This plant has a flavor profile similar to coriander. A notable feature of *daun walang* is that its unique flavor and aroma remain unchanged even when heated. Historically, locals used it to stimulate the appetite of women who had recently given birth. The third species is often dismissed by commercial farmers as a weed; *garut* is now a rarity in the region. Bumi Bagja uses it as a food source to prevent its extinction, proving that weeds can be a valuable food source (thepublicbook.id, 2024; Camsyah, 2025).



Figure 11.2. A traditional set of dishes served to guests in the kitchen forest (photos by Andrzej Długoński & Beata J. Gawryszewska, 15 August 2025)

Other wild and local edible plants demonstrate that the “living laboratory” utilizes various forest plants for specialized culinary techniques, employing them in a multi-ingredient approach. Young pumpkin leaves (which are still smooth and have no spines) are used as wrappers for *pepes* [steamed dishes]. This allows the leaves to be eaten with the dish, as they absorb the flavor of the spices whilst steaming (Bumiku Satu, 2024; Camsyah, 2025). *Kucai* [chives]

and *Lem Kio* are grown and harvested, then mixed with *pepes tahu* [steamed tofu]. Wild mushrooms are also used in the cuisine, often prepared in a smokehouse, for example, in smoked pumpkin soup. The use of these plants aims to change the attitudes of the local community and tourists. Isep notes that people often feel they have to buy vegetables such as cabbage or mustard leaves from a shop to eat a proper meal. Traditionally produced drinks made from fermented fruits and plants, resembling alcoholic beverages, can also be added to dishes. Due to cultural constraints and the Islamic faith, these are not the "typical alcoholic drinks" we are familiar with and are served only in European or American dishes (Figure 11.3).



Figure 11.3. The traditional forest drink Bumi Bagia served to guests, made from healthy, local ingredients sourced from the nearby forest (photo by Andrzej Długoński, 15 August 2025)







Figure 11.4. Buildings in Bumi Bagja (photos by Beata J. Gawryszewska, 24 August 2025)

11.5. SUMMARY

Located at the foot of Mount Gede Pangrango, Bumi Bagja is a food forest that mimics a natural ecosystem to achieve self-sufficiency and environmental resilience. In summary, by harvesting wild plants and a variety of crops, the founders are redefining the richness of the forest-garden as the ability to easily meet needs from the immediate surroundings, rather than through commercial markets. This initiative also aims to enhance the value of local resources by transforming traditional ingredients into gourmet dishes, to inspire a movement for environmental conservation and food sovereignty across Indonesia.

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12. CONCLUDING REMARKS

As you probably noticed, this is not a typical manual on materials selection in landscape architecture, much less a lexicon of materials or plants. Rather, it is an attempt to capture the changing relationships among humans, matter, and the environment – a record of the transition in which landscape design ceases to be merely an art of composition and becomes a practice of responsibility.

The aim of our handbook is to highlight the need to change approaches to material selection across different climatic zones during the climate crisis. Climate threats have existed in Mediterranean and subpolar climates for centuries, so the chapters, prepared by authors from Lebanon and Iceland, can be viewed as a guide to the directions and models to be adopted in temperate and tropical climates. What was a borderline experience elsewhere is now becoming commonplace – including in our latitudes.

The history of garden art and the chapters on new trends in shaping planting concepts point to profound changes in the relationship between people and landscape. These changes influence not only the image of garden art objects but also the way we understand and shape the human environment. In the chapter on building materials, the authors analyze the use of natural resources such as local stone, wood, and bamboo, as well as innovative materials derived from recycling, upcycling, and 3D printing. Comparing case studies from Europe, Asia, and South America, they emphasize how regional accessibility and cultural norms influence the selection of construction elements. Research shows that shifting from traditional methods to ecological alternatives can significantly improve residents' quality of life, influence city microclimates, and support public health. Ultimately, this chapter highlights the need for more conscious material management and the development of consistent design standards to enable the creation of resilient, sustainable living environments.

The practice of landscape architecture and the materials it employs are becoming a tool for nature conservation, environmental education, promoting public well-being and health, and communicating worldviews and cultural values. They are a medium through which we express our relationship to the world – both the natural and the human-transformed. In this sense, landscape design is no longer merely an aesthetic endeavor; it becomes a form of communication and a response to contemporary civilizational challenges. It could therefore be said that materials – both plant and building – are no longer passive components of composition. They are becoming active participants in ecological and social processes, co-creating space with users, climate, and time. The designer is no longer solely a creator of form, but a facilitator of relationships – someone who

initiates processes rather than simply controls them. In this context, locality takes on particular significance – not as a limitation, but as a potential. It is in local materials, native species, and traditional building techniques that we find adaptive strategies that may prove crucial in the face of global climate change. At the same time, new technologies open up possibilities that were previously unattainable, creating space for experimentation and the redefinition of existing practices. It is in these relationships – between humans, plants, materials, and the environment – that the contemporary understanding of beauty is born. And in this sense, landscape architecture remains what Charles Eliot wrote about the art as an act of creation and preservation of the beauty of the surroundings of human settlements and, more broadly, in the natural scenery of the place. However, we now know that beauty is not a permanent state, but a process that requires care, knowledge, and responsibility.

Perhaps the most important lesson from this book is relational thinking – seeing landscape not as a collection of elements, but as a dynamic system of connections.

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