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XERISCAPING – SMART LANDSCAPING WITH INDIGENOUS PLANTS ADAPTED TO DROUGHT

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ABSTRACT

Urban green spaces play a crucial role in improving environmental quality, mitigating climate change impacts, and enhancing the well-being of city inhabitants. However, water scarcity caused by global warming, population growth, pollution, and unsustainable irrigation practices increasingly threatens the sustainability of conventional landscaping models. The use of turfgrass and non-native species with high water requirements has amplified this pressure, often resulting in degraded and visually unappealing urban landscapes during summer droughts.

Xeriscaping, a concept developed in the early 1980s in Denver, USA, represents a sustainable landscaping approach based on water-efficient planning, the use of drought-tolerant plants, soil conservation techniques, and reduced maintenance inputs. This paper explores the potential of xeriscaping for urban areas in Romania, where climate change and soil aridization are becoming more pronounced. Particular emphasis is placed on the integration of indigenous flora adapted to drought conditions, which can provide ecological, economic, and aesthetic benefits.

INTRODUCTION

In the context of climate change and the intensification of aridization processes, the efficient management of water resources has become a major priority in urban landscape architecture (Xarepe & Canas 2024). Conventional practices in the design of green spaces, typically based on the use of horticultural species with high water requirements, have significant limitations (Çetin et al. 2018).

The inadequate selection of plant species and the extensive use of turf lawns result in excessive water consumption, thereby increasing the vulnerability of green spaces to drought periods. During dry summers, the absence of an adaptive landscape design leads to the emergence of desiccated areas with degraded vegetation, which lose both their aesthetic and ecological functions. Scholarly studies highlight that the majority of water resources are consumed by anthropogenic activities, which in turn affect climatic conditions on a global scale (Choiński et al. 2000). One of the major challenges for architects and urban planners is therefore to reduce operational costs while creating sustainable green spaces through integrated and efficient design approaches.

In this regard, the concept of **xeriscaping**—a method of garden design and maintenance that prioritizes plant species adapted to dry conditions and minimizes water consumption—offers a viable and innovative alternative for Romania's urban environments. Combining water conservation techniques with landscaping, xeriscaping, also known as “dry landscaping,” emerged in Colorado in 1981 as a response to prolonged drought conditions. This method is structured around seven principles: planning and design, soil analysis, the use of low-water plant species, the creation of practical turf areas, efficient irrigation, mulching, and appropriate landscape maintenance (Wade et al. 2007). Xeriscapes need not resemble arid gardens composed solely of succulents and stones. When fundamental techniques are applied, xeriscaping can generate modern landscapes that are both cost-effective and visually appealing (Kelly et al. 1991).

The implementation of xeriscaping principles in urban landscapes yields multiple benefits: reducing potable water consumption for irrigation by 15–65% (Kelly et al. 1991), fostering stable and resilient urban ecosystems, enhancing local biodiversity, and, not least, strengthening the ecological identity of cities (Çetin et al. 2018).

In contrast to the exclusive use of exotic ornamental species, the integration of spontaneous native flora—adapted to drought conditions—can contribute to the development of sustainable landscapes characterized by lower maintenance costs and aesthetics that are contextually adapted to biogeographical conditions.

In Romania, climate change has accentuated aridization processes, particularly in lowland regions but also in urban areas exposed to soil sealing and land artificialization (Nagavciuc et al. 2022). Within this framework, the use of spontaneous native flora adapted to dry conditions provides a valuable resource for the creation of sustainable urban landscapes.

Accordingly, the present study seeks to explore the applicability of xeriscaping in Romania’s urban architecture, to demonstrate the relevance of employing drought-adapted native species, and to provide a scientific foundation for the development of sustainable landscape strategies aimed at addressing current climatic and urban challenges. These proposals may lead to the creation of resilient green spaces with a positive impact on the environment, the local economy, and the overall quality of urban life.

MATERIAL AND METHODS

The selection of drought-adapted plant species was carried out on the basis of an integrated analysis of data accumulated over the past 25 years. Two major sources of information underpinned this research: observations of the plant collections at the “Dimitrie Brândza” Botanical Garden of the University of Bucharest, and field investigations conducted in Dobrogea, a region characterized by a continental-excessive climate, with arid summers and low precipitation, representing one of the most semi-arid territories in Romania.

The methodology for selecting species suitable for urban landscaping was based on the following criteria: ecological adaptability (tolerance to water deficit, high temperatures, and low-fertility soils); ornamental value (morphological features, flowering period, and aesthetic potential in landscape compositions); ecological functionality (role in maintaining urban biodiversity, attracting pollinators, stabilizing soils, and reducing erosion); and compatibility with urban environments (performance under atmospheric pollution, resistance to soil compaction, and tolerance to anthropogenic factors).

The final list includes various categories of plants employed for ornamental purposes—grasses, succulents, herbaceous perennials, trees, and shrubs—

selected to provide an optimal balance between drought resilience, aesthetic value, and ecological functionality.
For taxonomy and analysis of ecological indices, we used the FloraVeg.EU database (https://floraveg.eu).

RESULTS AND DISCUSSIONS

The application of the methodology led to the identification of a set of 33 drought-adapted native species (Table 1) with high potential for integration into urban landscapes. All species are perennial, of which 20 are hemicryptophytes, 4 are chamaephytes, and 8 are phanerophytes (comprising 2 trees and 6 shrubs).

A total of 84.84 % of the analyzed taxa (28 species) are adapted to grow on dry soils or on substrates subject to frequent desiccation. Only 15.15 % (5 species) occur predominantly on mesic soils, characterized by moderate moisture levels. Moisture indicator values confirm that the majority of taxa exhibit a preference for xeric habitats. Among them, *Sedum urvillei* and *Sempervivum zeleborii* display pronounced xerophytic traits, being viable only in sites that are regularly exposed to drying and restricted to arid substrates. Furthermore, 31 taxa are absent from moist soils, lacking the ability to tolerate permanent irrigation.

The species list comprises a variety of plants selected to provide diverse colors, textures, and forms. Their use in urban landscape designs can ensure ornamental value over an extended period throughout the year, while simultaneously providing ecological benefits and resilience to drought conditions.

The list includes:

- Perennial grasses, suitable for ground cover and the creation of natural textures, with high drought tolerance (*Festuca valesiaca*, *Koeleria macrantha*, *Melica ciliata*, *Stipa capillata*).
- Herbaceous perennials, chosen for their ornamental value and their role in attracting pollinators (*Echinops ritro*, *Galium verum*, *Haplophyllum suaveolens*, *Rosa gallica*).
- Trees and shrubs, incorporated for structural purposes, resistance to pollution, and adaptability to poor soils (*Cotinus coggygria*, *Carpinus orientalis*, *Cornus mas*, *Berberis vulgaris*).
- Succulent plants, valuable for rock gardens and green roofs (*Sedum rupestre*, *Sedum urvillei*, *Sempervivum zelebori*)

Observations conducted at the “D. Brândza” Botanical Garden highlighted the stable performance of xerophytic species under conditions of minimal irrigation and low maintenance.

Field data from Dobrogea confirmed these results, showing that the selected species naturally survive on low-fertility substrates and under conditions of limited precipitation, making them suitable for use in urban areas subject to water stress.

Compared to the use of turf lawns and exotic ornamental species (e.g., *Petunia hybrida*, *Begonia semperflorens*, *Tagetes patula*), the selected native xerophytic species offer the following advantages: reduction of water consumption for irrigation by 50–70 %; minimal requirements for fertilization and phytosanitary treatments; creation of urban microhabitats that support biodiversity, extended longevity of plantings due to adaptability to extreme conditions.

These advantages have also been confirmed by international studies (e.g., USA, Portugal, Spain, Turkey), where the transition from conventional landscaping to xeriscaping resulted in significant water savings and reduced maintenance costs (López et al. 2006; Chow & Brazel 2012; Çetin et al. 2018; Xarepe & Canas 2024).

Based on these observations, the identified species can be applied in various types of urban spaces: parks and public gardens – through mixes of grasses and flowering perennials; squares and roundabouts – where maintenance needs to be minimal; street alignments – employing shrubs resistant to pollution and drought; extensive green roofs – through the integration of succulent species.

Although the results are promising, there are several limitations to the application of xeriscaping in Romania:

- Social acceptability: the perception that a "beautiful" green space must be dominated by turf.
- Lack of official guidelines and clear regulations for the implementation of xeriscaping in urban environments.
- Need to adapt landscape design to local cultural and architectural specificities.

CONCLUSIONS

- Xeriscaping represents a viable and sustainable alternative to conventional urban landscaping models, contributing to reduced water consumption, lower maintenance costs, and increased resilience of green spaces in the face of climate change.
- Analysis of species from the collections of the "D. Brândza" Botanical Garden and from the natural habitats of Dobrogea enabled the identification of a set of drought-adapted native plants, which can be utilized in urban landscapes with minimal resource requirements.
- The selected species demonstrate ecological resilience, ornamental value, and functional performance in urban landscapes, while simultaneously providing benefits for biodiversity and soil quality.
- Integrating xerophytic species into urban spaces—parks, squares, street alignments, or green roofs—can contribute to the creation of landscapes adapted to current climatic conditions, with positive impacts on thermal comfort and overall urban quality of life.
- For the effective implementation of xeriscaping in Romania, the following are necessary: the development of guidelines and public policies promoting the use of native xerophytic species; education of the public and local administrations regarding the benefits of this type of landscaping; and the integration of the concept into sustainable urban development strategies.
- The research confirms that the use of native spontaneous flora not only provides aesthetic and economic solutions but also constitutes an essential strategy for adapting urban green spaces to current and future climatic conditions.

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Table 1

List of drought-adapted native species

No.	Family	Taxon	*Life span*	*Life form*	*Flowering period*	*Substrate humidity relationship*	*Moisture indicator value*
1.	Compositae	*Achillea setacea*	Perennial	Hemicryptophyte	May-October	Dry	2.5
2.	Poaceae	*Agropyron cristatum*	Perennial	Hemicryptophyte	April-July	Dry	2.5
3.	Berberidaceae	*Berberis vulgaris*	Perennial	Phanerophyte, Shrub	April-June	Dry	3.9
4.	Corylaceae	*Carpinus orientalis*	Perennial	Phanerophyte, Tree	March-May	Dry	4
5.	Cornaceae	*Cornus mas*	Perennial	Phanerophyte, Shrub	January-April	Mesic	4.6
6.	Compositae	*Cota tinctoria* (*Anthemis tinctoria*)	Biennial, Perennial	Hemicryptophyte	April-September	Dry	3.3
7.	Anacardiaceae	*Cotinus coggygria*	Perennial	Phanerophyte, Shrub	April-June	Dry	3.7
8.	Rosaceae	Crataegus *monogyna*	Perennial	Phanerophyte, Tree, Shrub	March-May	Mesic	4.4
9.	Compositae	*Echinops ritro*	Perennial	Hemicryptophyte	May-September	Dry	2.9
10.	Compositae	*Echinops sphaerocephalus*	Perennial	Hemicryptophyte	June-August	Dry	3.8
11.	Euphorbiaceae	*Euphorbia cyparissias*	Perennial	Hemicryptophyte	February-June	Dry	3.3
12.	Euphorbiaceae	*Euphorbia myrsinites*	Perennial	Chamaephyte	April-June	Dry	3.3
13.	Euphorbiaceae	*Euphorbia seguieriana*	Perennial	Hemicryptophyte	April-August	Dry	2.8
14.	Poaceae	*Festuca valesiaca*	Perennial	Hemicryptophyte	May-August	Dry	3
15.	Rubiaceae	*Galium verum*	Perennial	Hemicryptophyte	May-September	Dry	3.7

16.	Rutaceae	*Haplophyllum suaveolens*	Perennial	Chamaephyte, Hemicryptophyte	June-July	Mesic	4.8
17.	Compositae	*Inula oculus-christi*	Perennial	Hemicryptophyte	June-August	Dry	2.8
18.	Poaceae	*Koeleria macrantha*	Perennial	Hemicryptophyte	May-August	Dry	2.7
19.	Plumbaginaceae	*Limonium gmelinii*	Perennial	Hemicryptophyte	July-September	Mesic	6
20.	Linaceae	*Linum austriacum*	Perennial	Hemicryptophyte	April- July	Dry	3.2
21.	Poaceae	*Melica ciliata*	Perennial	Hemicryptophyte	April-June	Dry	2.4
22.	Lamiaceae	*Origanum vulgare*	Perennial	Hemicryptophyte	May-September	Dry	3.6
23.	Rhamnaceae	*Paliurus spina-christi*	Perennial	Phanerophyte, Shrub	April-June	Dry	4
24.	Rosaceae	*Potentilla pedata*	Perennial	Hemicryptophyte	May-July	Dry	3.5
25.	Rosaceae	*Potentilla recta*	Perennial	Hemicryptophyte	May-July	Dry	3.4
26.	Rosaceae	*Prunus spinosa*	Perennial	Phanerophyte, Shrub	February-April	Mesic	4
27.	Rosaceae	*Rosa gallica*	Perennial	Phanerophyte, Shrub	April-June	Dry	4.1
28.	Lamiaceae	*Salvia nemorosa*	Perennial	Hemicryptophyte	June-September	Dry	3.9
29.	Crassulaceae	*Sedum rupestre*	Perennial	Chamaephyte	April-July	Dry	2.3
30.	Crassulaceae	*Sedum urvillei*	Perennial	Hemicryptophyte	May-July	Dry	1
31.	Crassulaceae	*Sempervivum zeleborii*	Perennial	Chamaephyte	July-August	Dry	1.9
32.	Poaceae	*Stipa capillata*	Perennial	Hemicryptophyte	May-October	Dry	2.4
33.	Compositae	*Tanacetum corymbosum*	Perennial	Hemicryptophyte	May-August	Dry	4