Chapter

The Role of Municipal Ecological Structure in Landscape Preservation

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Abstract

The Portuguese legal system includes in the municipal urban planning instruments an institute designed to link the use and occupation of space with environmental protection. Through the municipal ecological structure, municipal master plans contribute to the integration of green infrastructures into planning. The municipal ecological structure thus favors the maintenance of ecological balance and the protection, conservation and enhancement of the environment, landscape, and natural heritage in rural and urban areas. The content of municipal ecological structures differs according to geographical location, population density, and economic activities. Regardless of these natural variations, the main objective remains the same: to contribute to the achievement of SDGs, with specific emphasis on the goal of ensuring more sustainable and resilient cities considering the pernicious effects of climate change.

Keywords: green infrastructure, landscape, municipal ecological structure, SGD, sustainability, urban planning

1. Introduction

The intention of this chapter is to illustrate how law, particularly urban planning law, can contribute to landscape sustainability. One of the purposes of urban planning, and at the same time its premise, is the mapping of territorial circumstances: identifying geographical conditions, building areas (resulting in soil impermeabilization), economic activities, and demographic spread. Changes in land use, therefore, have an impact on the landscape, affecting environmental and socio-economic systems. Monitoring these changes is important for adjusting planning instruments, using a range of methodologies, and justifying the legal rules that require their periodic revision [1–3].

In Portugal, land management instruments incorporate the protection of the landscape and include a tool specifically devoted to this purpose: the ecological structure. It can be found in the various planning instruments, but due to the general binding nature of municipal plans (self-binding and hetero-binding), we will focus on Municipal Master Plans.

What is analogous to this planning instrument in all municipal plans is the environmental protection dimension. In addition to having to incorporate the soil's situational dimensions from other instruments, the plans incorporate different green (and blue) infrastructures into the municipal ecological structure (MES hereinafter). Each municipality has its own features [1], thus its own urban planning solutions. Portugal has many municipalities, despite its small size. Although the figure of districts has organically disappeared, it is still useful as a criterion for territorial distribution, for instance, electoral districts. Thus, there will be examples of municipalities from north to south, from inland to coastal, which will enable the analysis of the most important MES. Still, even though district capitals are usually the larger municipalities, demographic distribution and territorial dimension are quite dissimilar, which may affect the full reflection of the use of the instrument. Portugal also has two island autonomous regions, whose geographical location means that urban planning must take account of the circumstance of insularity. As Lousada et al. state "island territories suffer unique challenges and are particularly vulnerable to change due to their geographic situation" [4].

Nature-based Solutions (NBS) is an elusive, extensive non-legal concept that encompasses solutions inspired by nature. It can embed nature solutions resorting to water, vegetation, or both. NBS is a set of solutions to strengthen urban resilience, by minimizing, or solving, some of the challenges posed by climate change.

There are several types of solutions and combinations. Kimic & Ostrysz [5] describe 19 Blue Green Infrastructures (BGI) solutions considering their location on the runoff troughs, grassed swales, infiltration trenches, vegetated swales, (street-side) bioretention basins, grassed retention and infiltration basins, rain gardens, wetland ponds", surface water reservoirs, retention and infiltration water reservoirs, water squares, permeable/pervious pavements, undergrounded (infiltration wells, infiltration boxes, structural tree root cells, underground water reservoirs) or above surface (blue roofs, green roofs, green walls) [5, 6].

Green Infrastructures (GI) are one of the tools used in MES. Due to the difference between the municipalities, it is relevant to identify the most used GI in the Municipal Plans of district capitals. However, when presenting the GIs, they will be accompanied by examples from other locations to reinforce their usefulness and the effects already achieved, particularly in the pursuit of the 11th and 13th SDG [7].

2. The Portuguese legal framework

2.1 Introduction

The literature acknowledges the key role of local governments in tackling adverse climate change effects through urban law, both in its planning and management dimensions [8–14], and in pursuing sustainability through urban planning within European hard and soft Law [15, 16] and the connection to the implementation of the UN SDG [2, 5, 17, 18]. It should be stressed, though, that top-down imposed solutions are not adequate, given the heterogeneity of the territories and cities, their size, geographical location, and climate circumstances [19]. The solutions must be tailored-made [20, 21]. Additionally, citizens' – as well as other stakeholders' – involvement through collaboration procedures is an important principle for both public urban policy and urban law [12, 22–27], reinforcing social actors' support for the inclusion of NBS in urban policies [28]. Still, mere local approaches without State

support may not be enough [8]. Finally, NBS monitoring and assessment included in urban planning contribute to social awareness of the respective benefits, fostering the mobilization of society to support the inclusion of these solutions [29–35].

2.2 The Portuguese local government and urban planning

In Portugal, besides the Constitution, which relates sustainability to urban planning and building (article 66 no 2), there are some relevant macro legal solutions. The Environment Framework Law – EFL (Law no 19/2014, 14th April), the Climate Framework Law (Law no 98/2021, 31st December), and the Waste Law (Decree-Law no 102-D/2020, 10th December), all enshrine sustainable solutions with reflections on urban planning law. Then, at a dedicated level, the Public Policy Framework Law on Land Use, Land Planning and Urban Planning – PPFLLUP (Law no. 31/2014, 30th May) and the legal framework for territorial management instruments (Decree-Law no 80/2015, 14th May) particularly detail that connection. There is also an important regulation regarding building requirements (Decree-Law no 555/99, 16th December).

Urban planning is a legal instrument that defines the use, the occupation, and the transformation of land, whether urban or rural. It is therefore an insurmountable tool when the objective is to make the human habitat more sustainable and cities resilient (11th SDG) [36–38] .

The EFL establishes the interdisciplinary and transversal character of the planning instruments (article 13). The Climate Framework Law, in turn, relates green taxes to urban sustainability (article 28), considers local governments as the promoting entities of sustainable management of urban spaces (article 51), and foresees State intervention with forest and green spaces to mitigate the heat island effect and promote green roofs and walls (article 57). In fact, this planning tool crosscuts all the main public interests: defense, public health, foreign policies, food, water resources, forest, energy, urban mobility... The principles enshrined in the Portuguese Climate Framework Law are very similar to those described by Monteiro, Ferreira, & Antunes, [24]: sustainable development, citizens' participation in planning instruments, articulation, integration, prevention, precaution, accountability (article 4).

The PPFLLUP also underlines sustainable development as a relevant instrument for climate action. The Portuguese legal framework is aligned with the European Green Deal and The Action Plan for the Circular Economy. It establishes the articulation principle among planning instruments (article 45) [39, 40] the planning revision principle grounded in "evolution or reconsideration of the economic, social, cultural and environmental conditions underlying their elaboration" (article 50). Furthermore, it embodies the green spaces in urban planning goals (article 2), as citizens' right and duty to preserve (articles 6 and 7); and the administrative bodies' duty to preserve green spaces as an active power (article 8). In Portugal, territorial management instruments are various and distributed, in terms of responsibility for their preparation, among the various levels of Public Administration. Portuguese law classifies such instruments in the light of various criteria, the most relevant being that of external binding nature, in the context of spatial planning and urban planning. The legal framework for territorial management instruments (Decree-Law no 80/2015, 14th May) details the preparation, amendment, and review of planning instruments. One of the most important planning instruments that binds citizens is the Municipal Master Plan (MPP), whose elaboration is mandatory. It "defines the strategic framework for territorial development of the municipality" (article 27). Therefore, local authorities have a fundamental role to play in the context of the use

of NBS, which has room in the city space as a community but also in citizens' buildings. These requirements (the distribution of services and economic activities in the city space and the requirements for the construction of buildings) should be embodied in MMP.

In our perspective, this instrument is particularly adequate for collecting all the requirements that the literature has been referring to as being fundamental.

First, because of the principles associated with this legal instrument. The Portuguese law establishes the principle of citizen participation in the elaboration of MMP through public consultation, thus summoning citizens to collaborate in the definition of solutions for their city space and on the more specific requirements of the buildings they inhabit (articles 6 and 89) [40]. In other words, the intention is that everyone contributes on a macro (city space) and micro (their dwelling) level to mitigate the adverse effects of climate change with these solutions. When consulting the material content of MMP (article 96), one can find the cross-cutting feature among urban planning and economy, transportation, culture, health, safety, energy, natural resources, drainage, waste, sustainability, urban rehabilitation... The requirements for building also contemplate some rules regarding the duty to give away space to establish green urban spaces (article 43, for instance). But the specific requirements regarding buildings are set in local government regulations.

Second, as in Portugal the MMP has a regulatory nature, the law currently requires a cost-benefit study to be carried out for the preparation of any regulation. Therefore, the incorporation of the analysis proposed by the literature regarding the inclusion of the NBS will not constitute, per se, a novelty to be incorporated by the legislator.

The Portuguese legislation can be improved through the incorporation of NBS implementation monitoring and evaluation mechanisms [41] (and even others that would also benefit therefrom), fulfilling the provisions of the CFL. It should be noted that, given the evolution of cities and demographic movements, Portuguese law already requires the cyclical re-examination of MMP solutions through review mechanisms (articles 115 and 124). On the other hand, considering the existence of other planning instruments, it is necessary to adapt MMPs and bring them into line with hierarchically superior planning instruments.

Finally, due to the articulation principle, there is room to expressly recognize multifunctionality as an urban planning principle [25, 27, 42]. Hansen et al. [41] stress that the "principle of multifunctionality alone will not be able to secure sufficient provision of green spaces in densifying cities but needs to be combined with other principles such as the conservation of valuable green spaces, securing green space quantity and quality, and increasing connectivity and the accessibility of green infrastructure" [43, 44].

2.3 The municipality ecological structure (MES)

The Portuguese urban law planning foresees MES as an important tool to address the need to protect environment issues. Article 75 of Decree-Law no 80/2015, 14th May, foresees MES as a part of MMP. Then, Article 99 also foresees it regarding Urbanization Plans. Article 107 as well, related to the Detail Plan. The Urbanization Plan develops and materializes MP and the Detail Plan "develops and concretizes in detail the proposals for the occupation of any area of municipal territory".

The Government has issued a Decree (regulation, not with legal value), where the MES is described (Regulatory Decree no. 5/2019, 27th September). In the Annex of the regulation's operative part, several urban concepts are established, and MES

is one of them. File 1–29 states: "The municipal ecological structure is a set of land areas which, by virtue of their biophysical, cultural or landscape characteristics, their ecological continuity and their organization, have the main function of contributing to ecological balance and to the protection, conservation and environmental and landscape improvement of rural and urban areas".

One of the main features is continuity between rural and urban areas. Nevertheless, in each type or area, the role and ecological design may vary:

a. rural area: "the municipal ecological structure involves the areas of land assigned to the fundamental nature conservation network in the municipality's territory, natural areas subject to risks and vulnerabilities and other areas of land that are selected and delimited according to the municipal interest, namely for environmental, landscape and natural heritage protection and enhancement reasons and ecosystem services".

b. urban areas: "[the municipal ecological structure] includes green spaces for collective use and other spaces, of a public or private nature, which are necessary for the balance, protection and enhancement of the environment, landscape and natural heritage of the urban area, particularly with regard to: (i) Regulation of the hydrological cycle (preservation of soil permeability and creation of retention areas, within the framework of urban flood prevention); (ii) Bioclimatic regulation of the city (reducing thermal amplitudes and maintaining air humidity levels); (iii) Improving air quality (reducing the concentration of atmospheric pollution in urban centers); (iv) Biodiversity conservation (maintaining habitats); (v) Ecosystem services". According to the definition enshrined in Article 43 of Decree-Law 555/99, December 16th, within MES, green spaces for collective use include parks and gardens.

3. Nature-based solutions (NBS) and their role in landscape

There are many descriptions of NBS:

a. United Nations (UN hereinafter): NBS "are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits, and recognizes that nature-based solutions". Thus aligning NBS with SDG and stating that "may contribute significantly to climate action, while recognizing the need for analysis of their effects, including in the long term, and acknowledging that they do not replace the need for rapid, deep and sustained reductions in greenhouse gas emissions, but can improve action for adaptation and resilience to and mitigation of climate change and its impact" [45].

b. European Commission: NBS "are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions" (https://

research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en accessed 10th June 2024) (**Figure 1**).

The European Union has several financed programs regarding NBS linked to urban and landscape planning. It is useful to illustrate some of these solutions already in place.

a. Within the "Re-naturing urbanization", that aims to "cover vast urban areas and mitigate the effects of climate change", the following NBS can be found: green routes, shade trees, colling trees, arboreal areas, parklets, urban carbon sink, green resting areas.

b. there are also "singular green infrastructures", such as Hydroponic green façades, green roofs and walls, Urban Garden Bio-Filters, Green filter areas, green shady structures, Electro wetlands, and vertical GI (vertical mobile gardens, green noise barriers, green fences).

c. regarding water resources, there is also a wide set of NBS: channel re-naturalization, cool pavements, cycle-pedestrian green paths, green pavements, hard drainage pavements, natural wastewater management, green filter areas, floodable parks, hard drainage-flood prevention, grassed swales and water retention pounds, urban catchment forestry, SUDs, and rain gardens.

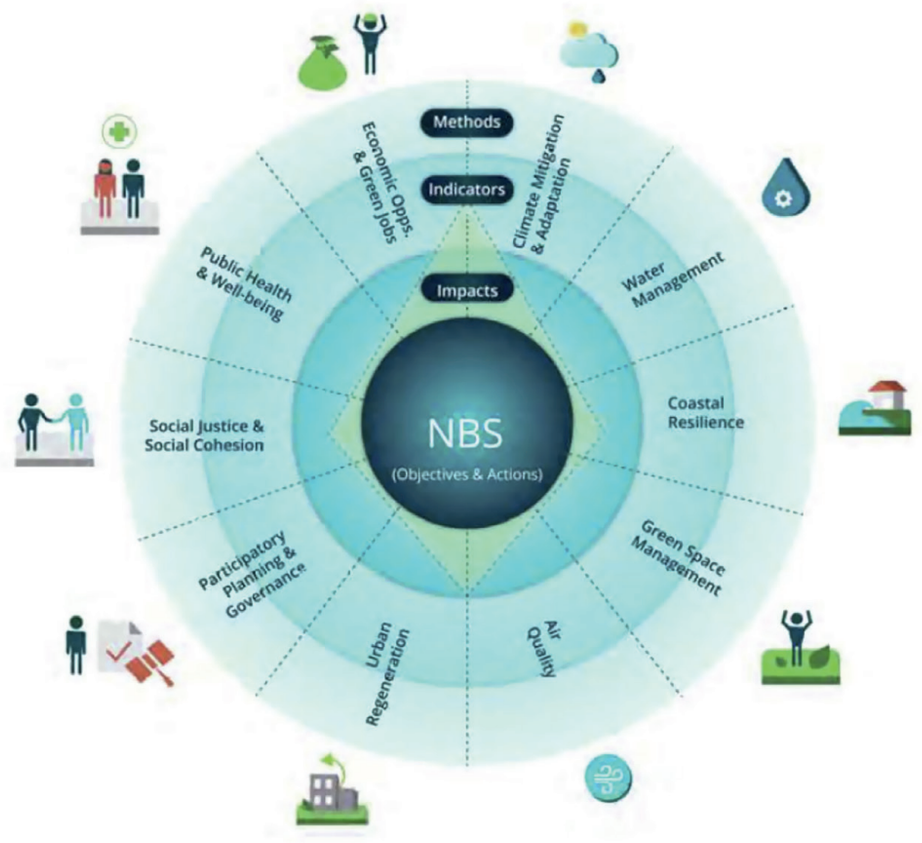

Figure 1.
EKLIPSE challenges (D1.1 - NBS CATALOG - https://www.urbangreenup.eu/insights/deliverables/d1-1---nbs-catalogue.kl accessed 10th June 2024).

Besides the role of these NBS, replacing the perception of the gray, built-up humanized landscape with the smooth, greener landscape, NBS also have a preeminent role in softening some of the most harmful climate change effects (13th SDG), such as the heat island effect, preventing droughts and floods [46–52], contributing to temperature regulation in public spaces [5, 41, 47, 53–58]. Thus, improving citizens' (individual and collective) health [59] and air quality [60–62].

The European Commission recognizes GI as "a successfully tested tool for providing ecological, economic and social benefits through natural solutions", which provides cheaper and more durable solutions in spatial planning and territorial development than constructed ones. Assuming their complexity and diversity (as NBS have been described as an umbrella concept [11, 25, 27, 63–67]), GI is defined as a "strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings". The positive outcomes of using GI cover not only ecological and environmental aspects but also health-related issues, linked to air pollution, the spread of vector-borne diseases, and community ties and networking, related to public spaces' leisure time. Furthermore, it can create "opportunities to connect urban and rural areas and provides appealing places to live and work in", associating the issue of food production through community gardens. They are recognized to be effective in fighting and/or mitigating climate change effects [68]. GI are also foreseen in "EU Biodiversity Strategy for 2030", clearly related to urban planning and management [69]: "This strategy aims to reverse these trends and stop the loss of green urban ecosystems. The promotion of healthy ecosystems, green infrastructure and nature-based solutions should be systematically integrated into urban planning, including in public spaces, infrastructure, and the design of buildings and their surroundings" [70].

The introduction of GI is related to and has different impacts depending on the territory. It may involve more land use changes in continental territories, which are not delimited by a maritime border, than in island territories. The processes of urbanization and cities' growth are much more constrained in the latter than in the former, and the influence on the landscape is therefore equally different [4].

4. Portuguese municipalities: the case study

As already stated before, Portugal is a small country but has 308 municipalities. All of them have MMP approved, even though some of them have already been revised once or even twice (**Figure 2**).

Referring to urbanization and detailed plans not only of them have them. According to official sources (General Direction for Territory https://reot.dgterritorio.gov.pt/sistema-de-gestao-territorial/pu-e-pp accessed 10th June 2024) (**Figure 3**).

4.1 The municipality ecological structure (MES) in Portugal district's capital

There are 18 district capitals in continental Portugal.

From the analysis of all 18 MMP, only Viana do Castelo (North and Coastal Municipality) and Guarda (Interior Municipality) have no information regarding MES. The first is due to the revision of MMP and Preventive Measures in force; the latter does

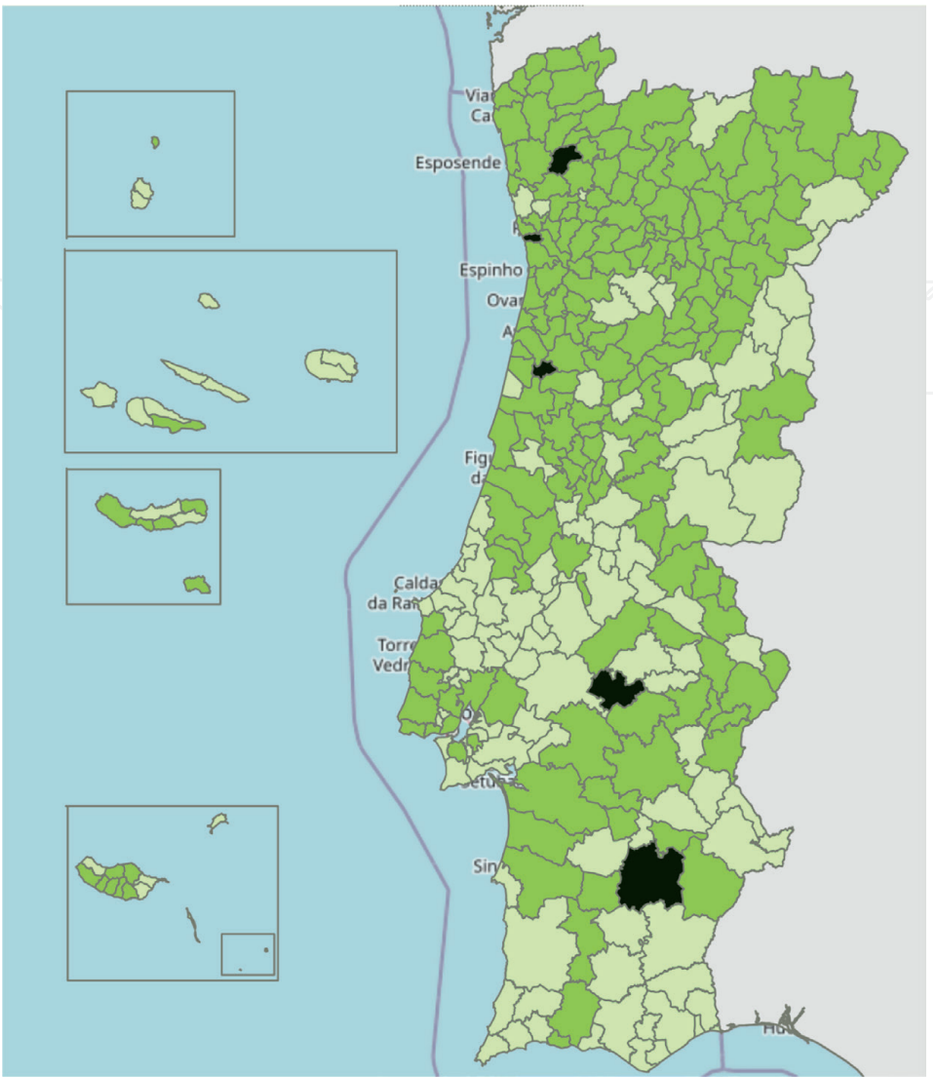

Figure 2.
Municipalities in Portugal – MMP in force by 2022 (https://reot.dgterritorio.gov.pt/sistema-de-gestao-territorial/pdm). Light green (1st publication – 114); dark green (1st revision – 189); black (2nd Revision – 5).

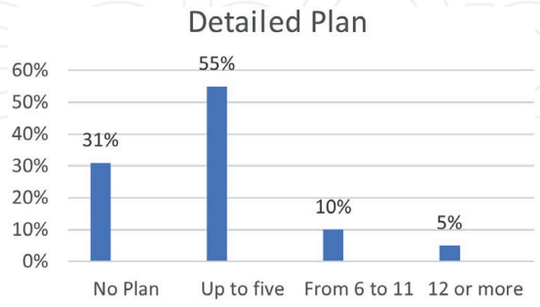

Figure 3.
Number of detailed plans.

not foresee the tool. There are two Municipalities – Castelo Branco e Santarém – that do not mention MES, but have rules regarding "protection areas" and "green spaces".

Almost all MMP enshrine the continuity principle (Aveiro, Coimbra, Évora, Faro, Leiria, Lisboa, Portalegre, Porto, Setúbal, Vila Real e Viseu). Thus, Municipalities from inland and coastland, north and south.

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Not all MES are designed in the same way. This urban planning tool, as urban planning in general, must be tailor-made [1]. Therefore, even though the elements and goals are similar, the concrete design varies. The constituents are, in general, areas identified as "the most important biophysical values", the "fundamental ecosystems based on the consideration of different biotopes", areas that aim to contribute to the ecological balance and to the protection, conservation and environmental and landscape enhancement of the territory, cultural values and resources, with continuity, considering urban and rural land, and "the protection, conservation and environmental and landscape enhancement".

Considering the tailored-made design:

a. Aveiro: "Natural Spaces, Green Spaces, Agricultural Spaces and Forest Spaces, and it also incorporates the territorial reference of the homogeneous sub-regions and the ecological corridor defined in the Centro Litoral Regional Forest Management Program (PROF CL)"; (this municipality is coastland located and has both urban and rural land);

b. Beja: "It is divided into two areas, depending on the nature of the space, namely: Urban Soil MES and Rural Soil MES"; (this municipality is inland located and mainly rural land);

c. Braga: "Fundamental Ecological Structure (FES) and the Urban Ecological Structure (UES)"; (this municipality, even though it is not near the coast, is mainly urban);

d. Bragança: "Agricultural Areas, Type I Agro-sylvo-pastoral Areas, Conservation and Protection Forest Areas, Natural Areas and Land allocated to the Urban Ecological Structure, as well as the remaining areas integrated into the National Ecological Reserve that are not covered by classified land"; (this municipality is inland located and rural);

e. Évora: "a) Core areas - Consisting of the areas classified as Sites of Community Interest - Monfurado and Évora Special Protection Area; b) Ecological connectivity areas/ecological corridors - Consisting of the main watercourses and their riparian galleries; the main headwaters of watercourses; areas threatened by floods; aquifer recharge; the municipality's reservoirs and their respective buffer strips; areas with high or very high erosion risks and/or already degraded by intense erosion processes; areas corresponding to aquifers that are highly susceptible to pollution; patches of holm oak, cork oak and mixed forests; thermophilic scrub and woodland and riparian ecosystems";

f. Faro: "Natural and Landscape Spaces, Green Spaces and Agricultural Spaces, Structuring and Connectivity Corridors and also the core areas of the Regional Environmental Protection and Enhancement Structure (ERPVA) defined in the PROT Algarve";

g. Leiria: "a) Fundamental areas - corresponding to areas of the territory with high natural value that are strategic in terms of preservation, sustainability and ecological continuity; b) Complementary areas - these cover areas of the territory with natural values and/or whose biophysical characteristics play an important

role in the ecological balance and in the protection, conservation and environmental and landscape enhancement of rural and urban land and relate to urban green spaces; c) Ecological corridors - integrate the structuring and complementary corridors and correspond to areas of the territory whose main function is to ensure connectivity between the main ecological systems";

h. Portalegre: "Rustic soil with two components: Fundamental municipal ecological structure; Complementary municipal ecological structure; the urban soils included in the spaces allocated to the urban ecological structure"; (this municipality is inland located and rural);

i. Setúbal: "Fundamental Ecological Structure, which is made up of the most important areas for the natural systems to work and integrates the areas that support the fundamental ecological systems and whose protection is essential for the sustainable functioning of the territory; Urban Ecological Structure, which aims to enhance and intensify ecological processes in built-up areas, thus constituting a structure for protection, climate regulation and support for plant production integrated into the urban fabric."; (this municipality is coastland located and urban);

j. Vila Real: "a) Natural environment areas; b) Green and community use areas; c) Green areas for protection and safeguarding; d) Green framework areas; e) Mixed green areas".

The main concerns which can be found in MMP and the specific tools (NBS, mainly GI) are:

a. protection of native flora;

b. fighting the heat island effect by afforesting streets and protecting urban parks and gardens;

c. concern about river flooding and protecting riverbanks with green solutions;

d. small surfaces to be impermeable;

e. "The design of new gardens and urban parks should promote their resilience, using permeable paving, terrain modelling that allows infiltration in situ and a vegetation structure adapted to local soil and climate conditions, with a focus on reducing installation and maintenance costs and contributing to increased biodiversity" (Coimbra);

f. "Promote the ecological continuity and articulation of the different spaces, based on existing or to be created natural physical elements, namely water lines, green spaces and tree-lined streets" (Faro);

g. "ensuring the continuity and complementarity of natural systems in the urban area, the ecological and physical sustainability of the environment, the functions of biological systems, biodiversity, the control of water flow and wind circulation, bioclimatic comfort and the enhancement of the landscape heritage" (Lisboa);

h. "The wet system includes the areas relating to open drainage lines, adjacent areas, rainwater retention basins, water resurgence areas, alluvial areas and areas subject to flooding" (Lisboa);

i. "Atlantic and riverfront areas, watercourses and retention basins and alluvial areas that make up the wet system, as well as sloping areas; priority should be given to soil permeability, safeguarding the hydrological cycle, protecting and enhancing natural resources, restoring the riverside ecosystem, promoting the riparian gallery and implementing sustainable drainage systems; (…) the use of endemic flora, the maintenance of ecologically valuable plant stands, the adoption of optimised water and energy efficiency solutions, using natural-based solutions whenever possible" (Porto);

j. "climate regulation (in order to limit extreme phenomena of temperature, cold and heat, allowing a more favourable climate for the population, namely through green spaces, tree-lined roads and bodies of water); air regulation (the extraction of gaseous substances from the atmosphere that are harmful to human health, derived from emissions from transport, industry and housing, providing the dissemination of good quality air through natural ecosystems); water regulation (extraction of substances from water bodies, derived from discharges of pollutants, ensuring and increasing the quality of water with an impact on the recharge of aquifers, the maintenance of water bodies and the supply of drinking water); control of extreme events (acting through ecosystems to mitigate the harmful effects of abnormal natural events, in particular floods, coastal erosion, heat island phenomena, forest fires and droughts); landscape value (taking landscape into account as a factor in human well-being and the quality of life of the population in general). (…) Encourage the harvesting and storage of rainwater and its reuse in irrigation systems for public or private green spaces; use of native plant species; creation of public spaces for urban horticulture; encourage the planting of vegetation adapted to the Mediterranean climate; mitigate the effect of urban heat islands, namely by planting tree and shrub vegetation in streets and public spaces; Using plant species with a higher carbon capture capacity; Creating retention basins upstream of urban settlements; Freeing up areas around water lines, flood beds and areas at risk of tsunamis and floods; Encouraging an increase in permeable areas on urban land and restricting waterproofing; Ensuring that rainwater is collected and correctly channelled." (Setubal).

k. usually, in all MES, construction is forbidden as the destruction of natural environment.

So, in Portugal's district capitals there are already several NBS implemented, mainly GI such as afforesting streets and protecting urban parks and gardens; permeable paving, tree-lined streets, rainwater retention basins, water resurgence areas, alluvial areas, promoting the riparian gallery and implementing sustainable drainage systems, use of endemic flora, the maintenance of ecologically valuable plant stands, encouraging the harvesting and storage of rainwater and its reuse in irrigation systems for public or private green spaces, creation of public spaces for urban horticulture; creating retention basins upstream of urban settlements (**Figure 4**).

GI, besides the immediate goal, can also, as the continuity principle suggests, connect natural and artificial spaces, mainly in high-density built areas. This connection makes the landscape continuous and without sectioning [71].

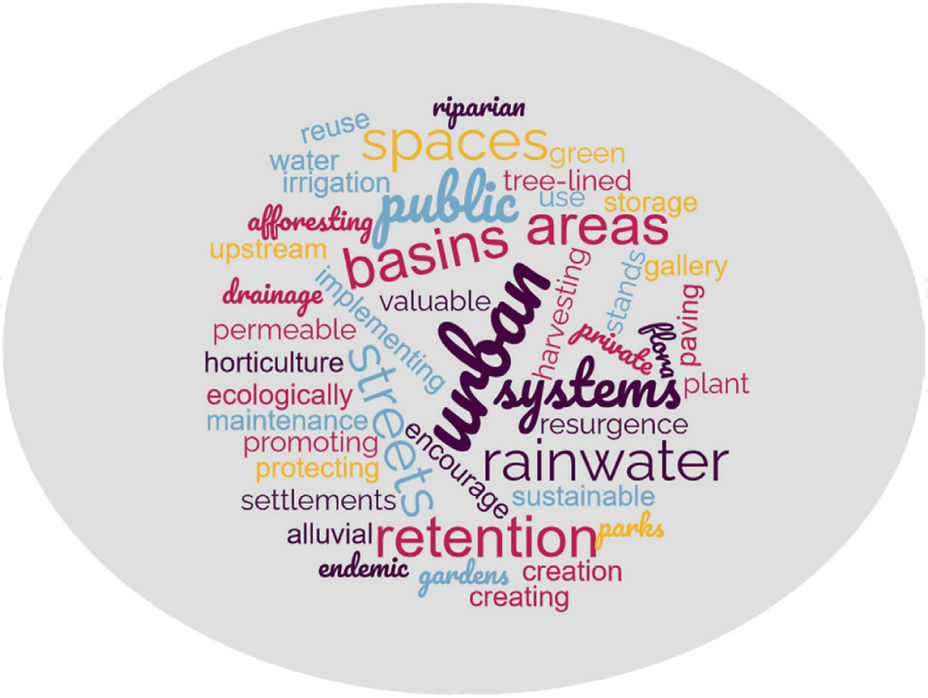

Figure 4.
Word cloud with the most common NBS concepts in the various plans.

5. Conclusions

Urban planning has a relevant role in landscape preservation. The Portuguese case of municipal planning, within the bigger municipalities that meet the district capital criterion, has shown that nature is already used in urban planning. For that purpose, Portuguese urban law has a tool – the ecological infrastructure – that must be enshrined in many planning instruments, including Municipal Master Plans.

Even though not all of them have the same design, which is comprehensible due to the different territory they apply to, they share similar concerns and solutions: afforesting streets and protecting urban parks and gardens; permeable paving, tree-lined streets, rainwater retention basins, water resurgence areas, alluvial areas, implementing sustainable drainage systems, use of endemic flora, the maintenance of ecologically valuable plant stands, and the creation of public spaces for urban horticulture.

Studies have been carried out on land use change in island and continental territories over a long period of time. In island territories, such as Madeira, there has been "stagnation in the growth of its urban fabric and change in the main vegetation" [4]. The stagnation of urban growth cannot, however, be a constant in all island territories, because not all insularity is of the same type. Therefore, as in the Canary Islands, there can be urban growth that is even unrestrained [1]. In continental territories such as Galicia, human occupation of the land has meant a decrease in forest area [3]. Similar trends have been observed in Alto Tâmega, although without the strict dimension of forest [2].

Conflict of interest

The authors declare no conflict of interest.

Notes/thanks/other declarations

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Appendix. Municipal master plans

Aveiro - https://www.cm-aveiro.pt/cmaveiro/uploads/writer_file/document/4117/regulamento_pdm_1revisao.pdf

Beja - https://geoportal.cm-beja.pt/documentos/IGT/PDM_Aviso_22168_2023.pdf

Braga - https://www.cm-braga.pt/archive/doc/RegPDMatualizado04082021.pdf

Bragança - https://www.cm-braganca.pt/cmbraganca2020/uploads/writer_file/document/64/20100715220602250332.pdf

Castelo Branco - https://www.cm-castelobranco.pt/media/3104/8%C2%AA-altera%C3%A7%C3%A3o_2017_republica%C3%A7%C3%A3o-integral-do-regulamento.pdf

Coimbra - - https://www.cm-coimbra.pt/wp-content/uploads/2023/06/Regulamento_AvisoDR_-3731_2022.pdf

Évora - https://www.cm-evora.pt/wp-content/uploads/2021/11/7.-AVISO-2174_2013.pdf

Faro - http://mapas.cm-faro.pt/geoportal/docs/pdm_2023/REGULAMENTO_Junho_2023.pdf

Guarda - https://www.ccdrc.pt/wp-content/uploads/2021/07/04_PDM_Guarda_3AltAdaptPOPNSE-public_30Jul2021-a37.pdf

Leiria - https://www.cm-leiria.pt/cmleiria/uploads/document/file/10034/1_correcaoMaterial.pdf

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