

Article

GI Guidelines for the Metropolitan City of Cagliari (Italy): A Method for Implementing Green Areas

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Abstract: The decline of natural capital resulting from urbanization has triggered phenomena such as landscape fragmentation and loss of biodiversity. European institutions have published documents and strategies with the purpose of counteracting such phenomena. In this regard, in 2020 the European Commission released the European Biodiversity Strategy 2030, which defines biodiversity conservation objectives and promotes the implementation of green infrastructures (GIs) designed to supply ecosystem services, which can increase people's well-being. The scientific literature has scarcely dealt with methods for drafting guidance documents (guidelines) to support public administrations in the implementation of GIs. In this study, we aim at designing and applying a method for drafting GI guidelines. We apply the method to the Metropolitan City of Cagliari, the main urbanized area—which partially includes the former Province of Cagliari—of Sardinia (Italy). According to the findings, a proposal of GI guidelines should be rooted in context analysis and consistency checks and should be tailored to specific geographical and institutional contexts. The preliminary guidelines described in this study are designed to provide public administrations with GI guidelines based on scientific, technical, and cultural considerations, and are aimed at supporting an effective implementation of GIs and a GI network.

Keywords: green infrastructures; guidelines; spatial planning; Italy



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1. Introduction

The increase of world population [1] has increased the demand for areas of land for urbanization and agriculture, to the detriment of natural capital [2,3]. As a consequence, phenomena such as landscape fragmentation, loss of habitats, and ecosystem alteration [4,5], as well as the impoverishment of urban green areas [6], characterize large areas of the planet. With respect to such phenomena, Green Infrastructures (GIs) represent a strategic solution [7,8]. In 2013, the European Commission released the so-called EU Strategy on Green Infrastructures, where 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” [9].

GI concepts stem from the broadening of ecological network issues: while the rationale of ecological networks has mainly been referred to the defragmentation of habitats and the protection of ecosystems, GIs show functionalities related to ecological and socio-economic activities involving cultures and communities [10]. In fact, the importance of GIs lies in their ability to provide ecosystem services understood as the interconnections of common benefits [11] that arise from interactions that are able to increase people's wellbeing [12].

In Europe, GIs have been addressed in official documents and strategies [9,13]. The European Union considers GI an important tool for achieving the objectives set in the European Biodiversity Strategy for 2030, which “aims to ensure that Europe’s biodiversity will be on the path to recovery by 2030 for the benefit of people, the planet, the climate and our economy, in line with the 2030 Agenda for Sustainable Development and with the objectives of the Paris Agreement on Climate Change” [13].

In Italy, the Ministry of the Environment and Land and Sea Protection issued a document concerning the thematic areas ‘Environmental’, ‘Nature’ and ‘Protected Areas’ [14]. National bodies have sparsely drafted specific GI guidelines. Until 2019, the regional and provincial documents in force (for example, guidelines for designing GIs in the cities of Novara and Torino) contributed to steer the design of potential GI components, i.e., ecological networks, public parks, urban green spaces, Natura 2000 sites, forests, etc. [15]. In 2020, the Metropolitan City of Genoa published guidelines to GIs for adaptation to climate change [16]. The Italian legislation rarely refers to GIs explicitly [16], but it mainly focuses on GI components (i.e., ecological networks, urban green, and protected areas), which are often part of the landscape, and cultural and environmental heritage. Detailed analyzes of GI policies and planning tools are currently lacking. The European Commission calls for promoting the adoption of GIs. Therefore, there is a need to develop simple tools, such as GI guidelines useful in the context of spatial planning and land management, as they can help to steer a successful implementation of GIs at different geographical scales [17].

Scholars have scarcely investigated, proposed, and applied methods for drafting guidelines aimed at designing and implementing GIs at a sub-regional scale. Thus, in this work we aim at filling in this research gap. Following De Montis et al. [18], in this paper we develop a method for leading processes of designing GI guidelines and propose a possible implementation in the context of the Metropolitan City (MC) of Cagliari, Italy. The method includes operational phases, presents strengths and weaknesses, and can be applied in other European metropolitan cities. The research question is: is the method proposed by De Montis et al. [18] applicable in practice? The paper unfolds as follows. In the second section, we introduce the scientific elements that are the basis for the methodological approach described in the third section. In the fourth section, we show the findings. Finally, in the fifth and sixth sections we respectively discuss the findings and make our concluding remarks.

2. The Scientific Elements: A State-of-the-Art Analysis

The main scientific foundations of this work consist of three pillars: (i) a review of the scientific literature, (ii) a review of the grey literature (guidelines, manuals, guidance documents) concerning GIs, and (iii) reference to international, European, or national documents that define a framework for the implementation of GIs in Italy.

The first aspect of the research study concerns the theory of GI guidance documents. Some studies have focused on the design of GI guidelines, or guidelines for designing GI components. Ibáñez Gutiérrez and Ramos-Mejía [19] aimed at promoting GIs in local policies and focused on the design of GI guidelines concerning the implementation of green roofs in the urban context of Bogotá (Colombia). The authors propose six steps for the drafting of the guidelines, which include a scrutiny of the grey literature, the involvement of stakeholders, and approval of the guidance document grounded on a wide consensus [19]. Klemm et al. [20] proposed guidelines developed according to a ‘research through design’ methodological approach. The drafting of GI guidelines included three main phases, ranging from the draft of the document, based on considerations emerging in the scientific literature, to a review of the draft. Klemm et al. [21] remarked that the lack of practical guidance aimed at the promotion of green roofs made available to policy makers. After performing a spatial screening by Multicriteria Decision Analysis, the authors proposed a spatial screening model with the purpose of steering municipalities in the planning process of GI. According to Lennon et al. [22], the mainstreaming of GIs in the planning process requires stakeholders’ involvement.

As for the second pillar, we analyzed GI guidelines or guidelines concerning GI components to figure out how planners deal with the implementation of GIs or GI network in practice. Scholars commonly use qualitative analysis of documents to point out strengths, weaknesses, and propose criteria or suggestions for improving theoretical or practical planning approaches. De Montis et al. [23] scrutinized the scientific literature and strategic environmental assessment (SEA) guidelines to propose key elements that should be part of effective SEA guidelines. Ledda et al. [24] distilled a set of criteria rooted in the scientific literature and adaptation to climate change strategies with the purpose of scrutinizing planning and programming tools with respect to adaptation issues. Cortinovis and Geneletti [25] applied contents analysis with the purpose of scrutinizing Italian urban plans and assessing the inclusion of ecosystem services. Di Marino et al. [26] performed the qualitative contents analysis of regional planning documents for assessing the integration of GIs and ecosystem services in land use planning. Grădinaru and Hersperger [27] also applied a similar approach regarding strategic plans released in European cities, in different countries, for investigating the integration of GIs into spatial planning.

Below, we summarize the main features of the guidelines selected and described. In 2007, the Provincial Council of Novara adopted guidelines aimed at implementing the ecological network and the Provincial Territorial Plan [28]. The implementation of an ecological network is approached through five issues: (i) general reasons, (ii) geographical context, (iii) tools, (iv) time schedule, (v) stakeholders to be involved, and (vi) technical actions. In 2010, the Council of the Province of Turin adopted the guidelines for the Green System, which included 'Guidelines for Ecological Networks' aimed at supporting 35 municipal administrations in the design of an ecological network [29]. The guidelines report on: (i) a description of the ecological network; (ii) priorities concerning the implementation objectives; (iii) requalification of the current ecological network; (iv) operational guidance to translate planned actions into practice; (v) maintenance of the ecological network. In 2015, the Italian Institute for Environmental Protection and Research released the guidelines for Sustainable Urban Forestry in Rome [30]. The document provides the local administration with a technical support for designing and planting new forests in urbanized areas [30]. The guidelines are consistent with ecological and environmental sustainability issues and imply two phases: (i) design, with the specification of objectives, geographical context, guidance, target and vector species, and propagation material; and (ii) implementation, with the definition of preparatory activities, plants, and a maintenance plan. In 2018, the Green City Network (Italy) released guidelines for Green Cities with the purpose of promoting the green development of Italian cities. The document defines objectives concerning policies and measures for the development of sustainable cities [31]. Finally, in 2020 the Metropolitan City and University of Genoa published GI guidelines developed in the context of the Interreg Maritime Project—Italian–French PROTERINA—3Evolution. Such a document focuses on the role of GIs in adaptation to climate change, and specifically addresses the sustainable management of urban rainwater in the north-western Mediterranean area [16].

Finally, the third pillar refers to international, European, national, or regional documents, which should be considered for drafting GI guidelines consistent with paramount international and national greening strategies. In this regard, it is possible to set a reference framework by recalling the concepts and indications contained in international, European, and Italian strategies. Thus, we aim at identifying key documents and summarizing objectives and targets that a proposal of GI guidelines should meet. The framework refers to the 2030 Agenda [32], the European Biodiversity Strategy 2030 [13], and the National Strategy for Sustainable Development [33]. The 2030 Agenda "is a plan of action for people, planet and prosperity [and it] also seeks to strengthen universal peace in larger freedom" [32], and consists of 17 Sustainable Development Goals and 169 targets. Italy officially introduced the principles and contents of the 2030 Agenda in 2017 through the National Strategy for Sustainable Development [33]. The EU Biodiversity Strategy for 2030 is a long-term and comprehensive plan aimed at protecting nature and restoring degraded ecosystems. The

EU Biodiversity Strategy aims at building a more resilient society against the effects of climate change, disease outbreaks, etc. [13].

The scrutiny of the scientific (first pillar) and grey literature (second pillar) allows us to consider two perspectives: the first one focuses on basic aspects rooted in the scientific literature, while the second has an operative scope. Instead, the third pillar needs to be considered to propose guidelines that include supranational and national sustainability principles and GI strategies according to a top-down approach.

3. A Method for Drafting Green Infrastructure Guidelines

Based on the pillars described above, after De Montis et al. [18], we propose a method for drafting GI guidelines. We focus on the following three steps (see Table 1): (i) context analysis, (ii) a consistency check, and (iii) the drafting of GI guidelines. De Montis et al. [18] included two other phases: (iv) stakeholder's participation and (v) final approval of the guidance document; however, we will not be focusing on these steps in this paper.

Table 1. Method proposed for the drafting of GI guidelines (after De Montis et al. [18]).

N	Phase	Description	References
i	Context analysis	Objectives and actions tailored to a specific context by considering the findings of a SWOT analysis	Ibáñez Gutiérrez and Ramos-Mejía [19]; Langemeyer et al. [21].
ii	Consistency check	Sustainability objectives used as a framework to perform a consistency check	UN [32]; European Commission [13]; Ministero dell'Ambiente e della Tutela del Territorio e del Mare [33].
iii	Draft of GI guidelines	The guidelines are drafted and tailored to targeted geographical and institutional context	Ibáñez Gutiérrez and Ramos-Mejía [19]; Klemm et al. [20]; Langemeyer et al. [21].

The first phase is intended to identify environmental priorities and ease the design of context-specific GIs. Context analysis describes the environmental, economic, social, and political factors related to the GIs, and includes a SWOT analysis concerning strengths, weakness, opportunities, and threats regarding the metropolitan city. Context analysis is developed according to Langemeyer et al. [21], who identify priority areas by mapping those that require specific ecosystem services, and which thus should be part of the GI network.

The second phase refers to the consistency check (Table A1, Appendix A): we define objectives of the GI guidelines which are consistent with the ones issued at international, European, and national levels. Finally, we propose key elements that should be part of a proposal of GI guidelines tailored to the specific context: the MC of Cagliari. According to the European Commission [13], GIs are strategies to meet sustainability objectives in terms of biodiversity conservation, and, for the purpose of this study, a proposal of GI guidelines should be consistent with principles and objectives internationally and nationally acknowledged, such as those acknowledged by the UN [32], the European Commission [13], and the Ministero dell'Ambiente e della Tutela del Territorio e del Mare [33]. The consistency check ensures that the GI guidelines refer to clear high-level (international, European, national, and regional) objectives and define ad hoc sustainability objectives that can be met by implementing a GI project.

The third phase focuses on the GI guidelines draft. In this phase, key elements emerging from the grey literature are being included in the guidance, i.e., objectives, annexes, in-depth boxes, and regulatory tools.

4. Application and Results: A Proposal of GI Guidelines for the Metropolitan City of Cagliari

In this section, we apply the methodological framework described in Section 3 to the design of guidelines for the project of a GI located in the MC of Cagliari.

The Sardinian spatial planning system currently does not include the GI as a means of integrating ecological connectivity and ecosystem multifunctionality. The identification of a regional GI embracing habitat patches and ecological corridors requires huge spatial datasets, which are largely produced and maintained by public bodies (e.g., the Region of Sardinia, the Ministry of the Environment and Land and Sea Protection, the European Agency of the Environment) and are available through spatial data infrastructures. Sometimes useful data (e.g., updated orthophotos) are not freely available for download.

As reported in the Territorial Analysis Report of the Strategic Plan [34], the MC includes 17 municipalities. It was established by the regional law 2/2016 [35]. The population consists of about 430,000 inhabitants. The employment rate is lower than the national average but higher than the regional one. The MC offers excellent services in terms of public transport, including cycle paths, car and bike sharing, and electric mobility.

We focused on the MC of Cagliari, which was chosen as a typical example of urban settlement in a coastal Mediterranean environment. This case study has been investigated from May 2019 to June 2021, in the context of a research project (Project “Rural landscapes of Sardinia: planning green and blue infrastructures and spatial complex networks”, Regional Law 7/2007, Fund for Development and Cohesion, Autonomous Region of Sardinia). The MC is the main conurbation located in the south of Sardinia, which is the second largest island in the Mediterranean basin (Figure 1).

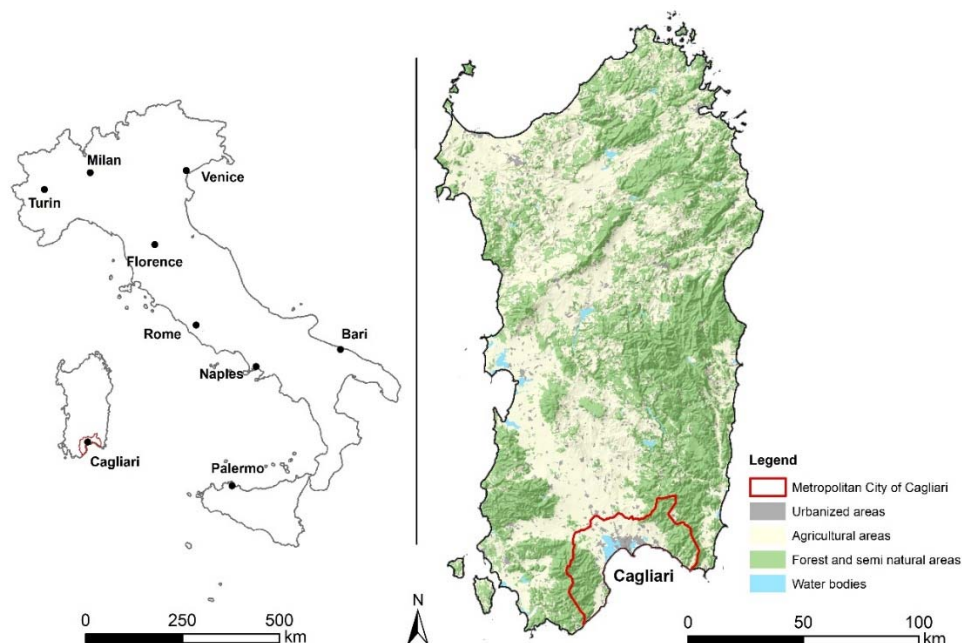


Figure 1. Location of the case study in the Italian and Sardinian context: the red line bounds the Metropolitan City of Cagliari.

4.1. Context Analysis

According to Ibáñez Gutiérrez and Ramos-Mejía [19] and Langemeyer et al. [21], we performed a context analysis concerning the MC of Cagliari.

The MC includes marine and coastal zones, wetlands of international importance, hilly, mountain and forest areas of considerable value, Natura 2000 sites, and mosaics of landscapes in part well preserved. The wetland system is one of the most important in Italy and in the Mediterranean basin, and is an integral part of social, cultural, and economic

activities. The context analysis has been developed through a SWOT analysis (schematized in Figure 2) by the MC of Cagliari in its strategic plan [34].



Figure 2. Metropolitan city of Cagliari: SWOT analysis.

The SWOT analysis focused on four main themes: environment, society, economy, and infrastructure. In this study, we consider the strengths and weakness relating to the environmental theme. The strengths include a high ecological value due to different protected areas, such as Special Areas of Conservation (SAC) and Special Protection Areas (SPA), sites set by Directive 92/43/EEC “Habitats” and 79/409/EEC “Birds”. The main weaknesses concern the governance of adaptation to climate change and the need for improving coordination among the stakeholders involved in the adaptation planning. The MC of Cagliari also has to focus on adequate management and enhancement of wetlands, which are often affected by hydrogeological risk. In addition, the wetlands of the MC of Cagliari include abandoned and ruined buildings that could be restored and used to host research centers and eco-tourism activities [34].

The findings of the SWOT analysis suggest the need to focus on Natura 2000 sites, geological and hydrological risk zones, and areas affected by landscape fragmentation, since they can be included in a GI (Figure 3).

In order to describe the sub-regional geographical context under investigation, we consider the following datasets concerning: (i) areas affected by flood and landslide hazard, (ii) Natura 2000 sites, and (iii) landscape fragmentation.

The administrative boundaries of the MC of Cagliari, partially or totally, include eight landscape units set by the Regional Landscape Plan (RLP) of Sardinia: Serpeddì– Monte Genis, Sulcis, Valle del Cixerri, Nora, Parteolla Trexenta, Golfo Orientale di Cagliari, Basso Campidano, and Golfo di Cagliari (Table 2).

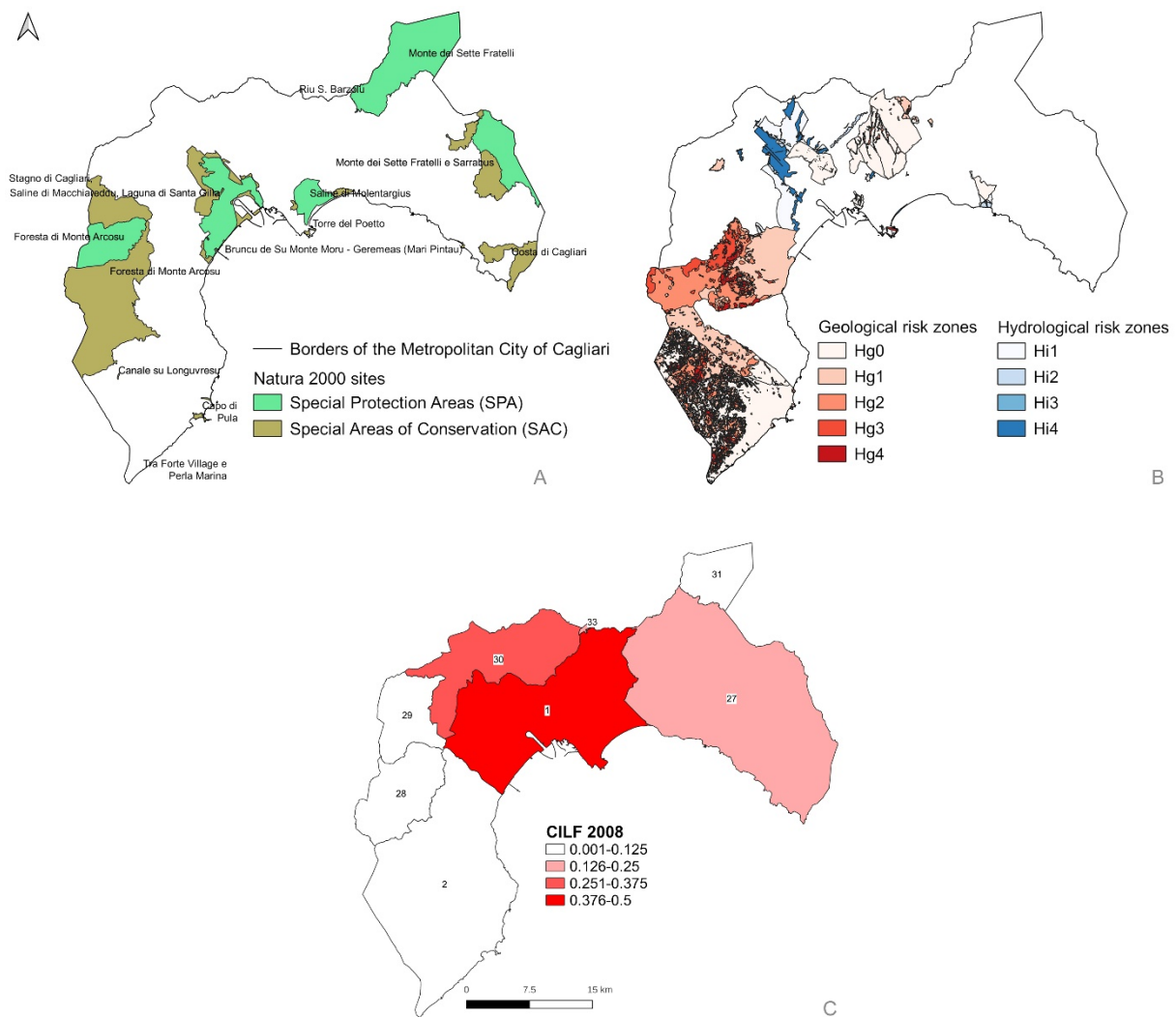


Figure 3. Metropolitan city of Cagliari. (A) Natura 2000 sites. (B) Areas characterized by different degree of landslide and flood hazard. (C) Degree of landscape fragmentation measured by using CILF. The darker the color, the more fragmented the landscape.

Table 2. The landscape units included in the MC of Cagliari.

Landscape Unit (Code)	Landscape Unit (Name)
31	Serpeddi–Monte Genis
28	Sulcis
29	Valle del Cixerri
2	Nora
33	Parteolla Trexenta
27	Golfo Orientale di Cagliari
30	Basso Campidano
1	Golfo di Cagliari

Nora, Sulcis, Valle del Cixerri, Serpeddi–Monte Genis, and part of Golfo Orientale di Cagliari are characterized by forest and seminatural areas (e.g., broad-leaved forest and Mediterranean maquis), while Basso Campidano and part of Golfo di Cagliari mainly show agricultural areas (e.g., olive groves and horticultural crops). Golfo di Cagliari and Golfo Orientale di Cagliari, respectively, include the most populous cities in the south of Sardinia: Cagliari (about 150,000 inhabitants) and Quartu Sant’Elena (about 70,000 inhabitants) [36].

Finally, Golfo di Cagliari and Golfo Orientale di Cagliari host water bodies (ponds) relevant to birdlife, such as the pink flamingo or greater flamingo (*Phoenicopterus roseus*) [37].

The hydrogeological regional plan classifies the region into seven basins. Basins ‘Sulcis’ and ‘Campidano’ include the MC of Cagliari and are significantly affected by hydrogeological risk. In these areas, a poor adaptation to hydrogeological risk has emerged. Basin ‘Sulcis’ is the area most affected by the risk of landslides. In areas affected by hydraulic and landslide risk, GIs are able to mitigate the risk. In this regard, the hydrogeological regional plan suggests the use of non-structural and naturalistic structural engineering measures based on GIs components [38]. In Figure 3, the landslide hazard (Hg) ranges from Hg0 (lowest hazard) to Hg4 (highest hazard), while the flood hazard (Hi) ranges from Hi1 (lowest hazard) to Hi4 (highest hazard). According to the strategic plan [34], the inclusion of nature-based solutions -such as GIs- in planning tools, and their practical implementation, are useful solutions against climate change and hydrogeological vulnerability, which are reported as the main threats to be tackled.

Finally, we consider the landscape fragmentation issue, as it can affect biodiversity and ecosystem continuity [39,40]. We consider the degree of landscape fragmentation due to urbanized areas and transport and mobility infrastructures, which was calculated by applying a composite indicator [41,42]. The composite indicator of landscape fragmentation (CILF) consists of three indicators, which consider the effect of roads and railways, human settlements, and patch density on landscape fragmentation. Specifically, CILF combines the Infrastructural Fragmentation Index (IFI), the Urban Fragmentation Index (UFI), and effective mesh density (S_{eff}) [39,41–44]. De Montis et al. point out that “the use of the CILF is intended for analytical and decision-making purposes, as it allows a simplification in the interpretation of a unique metric” [41]. In addition, the use of a composite indicator can provide “a system able to support policymakers, who are able to visualize results and maps via an intuitive graphic representation [and] a wise reading of the CILF may support planners and policymakers in addressing the most efficacious measures for managing LF [. . .]” [41]. In Figure 3C, according to the values of CILF, the darker the color, the more fragmented the landscape. The CILF has been calculated for each landscape unit defined by the RLP of Sardinia [45].

Table 3 reports on CILF values measured for the landscape units included, also partially, in the MC. The composite indicator varies in the range 0–1: the higher the value, the higher the degree of landscape fragmentation. Landscape Unit ‘Golfo di Cagliari’ is the most fragmented (CILF = 0.5). Landscape Unit ‘Basso Campidano’ also shows moderate fragmentation (0.37). In this context, the adoption of GIs as an ensemble of ecological corridors linking otherwise isolated habitat patches can contribute to the reduction of landscape fragmentation.

Table 3. Composite indicator of landscape fragmentation (CILF) by RLP landscape unit included in the MC of Cagliari.

Landscape Unit (Code)	CILF
31	0.04
28	0.05
29	0.06
2	0.10
33	0.14
27	0.15
30	0.37
1	0.50

This spatial analysis might be relevant to regional (and sub-regional) planning, as it focuses on key issues, such as: the conservation of biodiversity in Natura 2000 sites; an overview on the areas affected by geological and hydrogeological risk, where countermeasures have to be defined; and landscape fragmentation, which hinders the movement of

specific target species between habitat patches, where defragmentation measures could be planned. However, such a spatial analysis needs to be supplemented with information, data, and suggestions provided by the stakeholders involved in the planning process.

4.2. Consistency Check

In this section, we focus on the consistency check. We identified regional objectives that are consistent with those of the 2030 Agenda, the EU Biodiversity Strategy for 2030, and the National Strategy for Sustainable Development. The identified regional objectives can be the basis for defining the general objectives of the preliminary GI guidelines.

Table A1 in Appendix A reports on the sustainability objectives to which the planning of a GI for the MC of Cagliari should refer to. Table A1 has been set according to a top-down approach, i.e., from objectives of higher (international) to lower (regional) governance level. According to the consistency check, Table 4 shows the regional objectives (ROs) that are consistent with the 2030 Agenda, the EU Biodiversity Strategy for 2030, and the National Strategy for Sustainable Development.

Table 4. Code and regional objectives (ROs) consistent with the 2030 Agenda, the EU Biodiversity Strategy for 2030, and the National Strategy for Sustainable Development.

Code (RO _x)	Regional Objectives (Ros)
RO ₁	Improving the ability to design, implement, and manage strategic tangible and intangible infrastructure.
RO ₂	Conservation, protection, and enhancement of soil habitat in terms of addressing erosion and preventing hydrogeological risk.
RO ₃	Development of territorial strategies for ecologically sensitive areas.
RO ₄	Restoration of degraded landscapes.
RO ₅	Enhancement and promotion of the links between the tourism sector and natural resources.
RO ₆	Conservation and management of landscapes of ecological interest.
RO ₇	Environmental protection, enhancement, and increase of the quality of the ecological systems of the forest for biodiversity protection.
RO ₈	Protection, restoration, and enhancement of ecosystems that depend on agriculture and forests.
RO ₉	Improving the functional efficiency of Mediterranean forest systems.
RO ₁₀	Protection, restoration, and improvement of biodiversity in Natura 2000 sites and implementation of ecological corridors.
RO ₁₁	Conservation of biodiversity, ecosystems, natural heritage, natural and environmental components.

4.3. Draft of GI Guidelines

We focus on the structure of the GI guidelines for the MC of Cagliari by indicating the contents of Table 5.

Table 5. The structure of the GI guidelines for the Metropolitan City of Cagliari.

Item n.	Key Elements
1	Main objectives of a GI and measures to be implemented
2	Where the GI can primarily be implemented
3	Approach to GI planning
4	Time-schedule
5	Stakeholder involvement

Below we describe the key elements of the GI guidelines.

As for the main objectives of a GI (Table 5, Item 1), we set four General Objectives (GOs), which have been inspired by the guidelines analyzed. GOs rest on regional objectives (ROs) and consider the findings of the SWOT analysis specifically tailored to the MC of Cagliari (Table 6). ROs refer to the objectives of regional plans and programs set out in Table 4 (Section 4.2).

GOs can be subdivided into General Lines of Action (GLAs) (Table 7). Each GO breaks down into three GLAs, which should be developed for meeting sustainability objectives. As for the measures/actions, Table 7 also summarizes a package of actions that refer to GOs and GLAs (details in Table A2, Appendix A). The structure of Table 7 is inspired by the Green City Network [31], which focuses on four general objectives and twelve general lines of actions (tree actions per objective). The narrative summarizes measures/actions retrieved from the scrutiny of the scientific literature, guidelines, and institutional documents described in Table A2, Appendix A.

As for the location of GIs (Table 4, item 2), GIs have potential for promoting the protection of areas affected by hydrogeological risk. In this regard, the Regional Hydrological Plan provides structural and non-structural naturalistic engineering measures (i.e., GI components) that can counteract landslides and floods. Furthermore, GIs can be planned and implemented in priority areas, such as those that need ecological reconnection and improved accessibility, valorization and restoration, such as the Natura 2000 sites, i.e., Sites of Community Interest (SCIs), Special Areas of Conservation (SACs) and Special Protection Areas (SPA).

As a practical example of support offered by the guidelines, we can identify the potential location of GIs in priority areas, which is consistent with (i) the regional objectives RO₃, RO₄, RO₆, RO₁₀, and RO₁₁ (see Table 3, Section 4.2), and (ii) the General Objective GO₂ (see Tables 5 and 6); we can plan to defragment the landscape and further improve habitat connectivity of areas occupied by the Corsican red deer (target species), an endangered species living in Natura 2000 sites of the MC of Cagliari. The Corsican red deer (*Cervus elaphus corsicanus*)—a sub-species of the European red deer—is endemic to Corse (France) and Sardinia [46]. According to Annex II of the Habitats Directive, the Corsican red deer “is considered a priority for conservation species [and] is also included on the IUCN [International Union for Conservation of Nature] Red List as an endangered species” [46]. The Corsican red deer is also included in the management plans of both Natura 2000 sites [47,48]. The implementation of a GI network—as defragmentation measures able to reconnect habitat patches and/or increase the surface area of habitats—would be desirable. Natura 2000 sites are key for habitat and biodiversity conservation and valorization.

Table 6. General Objectives (GOs) and GI guidelines by regional objectives and SWOT analysis. The regional objectives (ROs) are consistent with the 2030 Agenda, the European Biodiversity Strategy for 2030, and the National Strategy for Sustainable Development.

General Objectives (GOs)	GI Guidelines	Regional Objectives	SWOT Analysis, Theme 'Environment': Strengths (S) and Weakness (W)
GO1. Ensuring high environmental quality	ISPRA [30] Provincial Council of Turin [29] Green City Network [31]	RO ₂ , RO ₃ , RO ₄ , RO ₆ , RO ₇ , RO ₈ , RO ₉ , RO ₁₀ , RO ₁₁	High ecological value due to different protected areas (S). Poor management and valorization of humid zones (W).
GO2. Defragmenting landscape and protecting biodiversity	ISPRA [30] Provincial Council of Turin [29] Provincial Council of Novara [28]	RO ₁ , RO ₃ , RO ₄ , RO ₆ , RO ₇ , RO ₈ , RO ₉ , RO ₁₀ , RO ₁₁	High ecological value due to different protected areas (S).
GO3. Implementing measures to address climate change	Provincial Council of Turin [29] Green City Network [31]	RO ₁ , RO ₂ , RO ₄ , RO ₆ , RO ₉	Governance of adaptation to climate change (W). Improving coordination among stakeholders involved in the adaptation planning (W).
GO4. Improving governance	Green City Network [31]	RO ₁ , RO ₅	Improving the coordination among stakeholders involved in the adaptation planning (W).

Table 7. Main objectives of green infrastructure planning. General objectives (GOs), general lines of action (GLAs), and the narrative concerning the GI design for the Metropolitan City of Cagliari.

General Objectives (GOs)	General Lines of Action (GLAs)	Actions/Measures/Narrative
GO1. Ensuring high environmental quality	GLA1. Defining provisions on urban, peri-urban and rural GIs	Choice of species based on specific criteria; preparatory work for the conversion of specific areas to GIs; drafting of the maintenance plan.
	GLA2. Ensuring good air quality	Planting of forestry in urban and peri-urban contexts, which depends on the careful choice of species, preparation works and the maintenance plan. In peri-urban areas, wooded bands could mitigate the air pollution that comes from the urban areas.
	GLA3. Ensuring more sustainable mobility	Cycle and pedestrian networks as ecological corridors. Pedestrian and cycle paths are sometimes bordered by hedges and/or trees, which can be ecological corridors for target species. These corridors represent sources of food and allow target species to move from one habitat patch to another.

Table 7. Cont.

General Objectives (GOs)	General Lines of Action (GLAs)	Actions/Measures/Narrative
GO2. Defragmenting landscape and protecting biodiversity	GLA4. Preservation and improvement of ecological connectivity	Green roads; green roofs; cycle paths; riparian vegetation; buffer strips; forest belts; hedges; green bridges as corridors for wildlife; conservative farming practices; conservation of autochthonous vegetation. Note that the effectiveness of green roofs as stepping stones depends on context and target species.
	GLA5. Improving the quality of the urban, peri-urban, and rural landscape	Enhancement of historic green zones; urban green areas for recreational services; design of new green areas; gardens; green roofs, re-naturalized areas.
	GLA6. Preservation of agricultural systems	Conversion of arable land to permanent lawns; implementation of conservative agricultural practices; hedges; rows of trees; fair management of forest systems; promotion of remediation actions in forestry areas; conservation of natural elements; buffer strips; grassy slopes.
GO3. Implementing measures to address climate change	GLA7. Reduction of greenhouse gas emissions	Implementation of multifunctional wooded areas; planting of forest belts; fast-growing forestry areas; promotion of fire prevention policies and management.
	GLA8. Increase of carbon sequestration	Forestry maintenance; choice of vegetable species (according to longevity, management, fast-growing nature, and other issues); protection of soil.
	GLA9. Implementation of adaptation measures against hydrogeological risk	Green roofs, green roads, and grassy strips (to ease the drainage of rainwater); slopes protected with vegetation; conservation of riparian species in waterways; implementation of infiltration basins; enhancement of wetlands; reforestation.
GO4. Improving the governance	GLA10. Strengthening of governance processes concerning environmental components	Involvement of municipal administrations, according to a participative planning approach. The GIs planning processes must be trans-and-multi disciplinary, and include several types of actors (professionals, citizens, local authorities, and other stakeholders).
	GLA11. Improving the sharing and dissemination of information	The stakeholders should be involved through meetings, online surveys, thematic meeting, etc.
	GLA12. Ensuring the consideration of GIs in planning processes	SEA procedure can ease the inclusion of GIs in plans and programs. Such an approach has potential to promote the consideration of environmental issues and definition of adaptation to climate change measures. The GIs should be explicitly addressed in the plan or program. The planning of green urban areas should include approaches based on ecological networks or networks of GIs.

With respect to the approach to GI planning (Table 5, Item 3), a fair course of action requires the adoption of strategic tools for improving their inclusion in the decision processes

and successful implementation. In the design process of a GI network, consideration of various planning tools is needed. The practical tools include such provisions as interventions of habitat creation, protection, valorization, and re-naturalization. A proper planning and design of a GI network needs to refer to policies, strategies and plans defined at European, national, and regional scales. As a reference framework able to support and steer the decisional process, planners and decision-makers should consider: Directive 92/43/EEC 'Habitats Directive', Directive 2009/147/CE, national laws, regional norms, and provisions of plans and programs adopted at different hierarchical levels (from national to local scales). Thus, the draft of guidelines for a GI in the MC of Cagliari depends on a corpus of tools including EU directives, the national law 394 of 1991 (also known as the "law on parks"), guidelines concerning the management plans of Natura 2000 sites released by the regional administration (guidelines for the drafting of SCI and SPA management plans), the Regional Hydrogeological Plan (RHP) [38], the Rural Development Program 2014/2020 [49], and the Regional Landscape Plan [45]. As for the economic tools, financial support is assured to private citizens and public bodies for the design and implementation of GIs. The economic tools included in the draft guidelines include provision of financial funds through direct support and financial incentives to facilitate the realization of a GI design.

With reference to the time-schedule (Table 5, Item 4), a GI should be planned to be effective in the short–medium and the long run. In the short–medium term, a GI is a way to deal with a changing climate, according to an adaptation approach, while in the long term it plays a role in terms of mitigation measure as it contributes to reducing carbon dioxide concentrations. However, planning, designing, implementing, and managing a GI network requires activities that often develop over long periods of time. Thus, a feasible and operational time-schedule needs to be defined with the purpose of informing and involving politicians, stakeholders, and local communities in key phases of the planning and decision process. The short-term implementation of the GI network could be hindered by administrative issues connected to the release of building permits. These processes include expropriation of private land, environmental assessments, the public display of relevant documents, etc.

With reference to stakeholders' involvement (Table 5, Item 5), many authors believe that GI implementation relies on the explicit inclusion in the decision process of as many actors as possible, according to a trans- and multi-disciplinary approach [15,50–53]. Thus, the proposed draft guidelines for the MC of Cagliari must include relevant stakeholders, such as institutional and local actors, i.e., local administrators, associations, NGOs, professionals, academics, students, and citizens (Table 8).

The stakeholders can have divergent opinions and point out quite different views on the same subject. In this regard, Living Labs (LLs) could be useful to promote the participation of scholars, practitioners, private citizens, and public bodies, and other interested parties, who can work together in the planning process "towards a shared solution" [54], although the LLs "processes itself are unable to overcome or eliminate many hindering factors, such as very diverging interests, distrust, or solve conflicts" [55]. Lupp et al., in a study concerning the co-design of Nature-Based Solutions, stressed the key role of "openness, knowledge development, learning processes for all participants, and meeting on equal ground [. . .]" [55].

Table 8. Stakeholders to be involved in the drafting of the GI guidelines for the Metropolitan City of Cagliari by role and scale.

Stakeholders	Role	Scale
Metropolitan Mayor Metropolitan Council members Metropolitan Conference Municipal Mayors Municipal Council members Protected Areas Managers	Institutional	Provincial
Professionals Non-governmental organizations Strategic public bodies Environmental associations and local universities Research centers Irrigation Consortium Farmers Schools Citizens	Non-institutional	Local

5. Discussion

In this section, we discuss the application of the method and the findings, with respect to the aims we delineated at the end of Section 1. Thus, we focus on the outcomes of the application, with reference to context analysis, the consistency check, and the preliminary draft of GI guidelines.

As scholars have scarcely addressed methods for drafting guidelines aimed at designing and implementing GIs at sub-regional scales, in this work we developed a method for leading processes of designing GI guidelines and proposed a possible implementation in the context of the MC of Cagliari, Italy. The method develops in three phases: context analysis, the consistency check, and the draft of GI guidelines.

According to Ibáñez Gutiérrez and Ramos-Mejía [19] and Langemeyer et al. [21], we performed a context analysis with the purpose of providing a framework on the vulnerable areas of the MC of Cagliari. Such areas need to be preserved and protected against hydrological and geological risk. According to the strengths, the Metropolitan City assures significative relevance to the protection of vulnerable habitats and species, where a GI has the potential to maintain a fair conservation status [56], while the main weaknesses concern governance of adaptation to climate change and poor management and valorization of humid zones. As for the management and valorization of humid zones, GIs are key in terms of improved accessibility and connectivity [56,57].

As for the consistency check, we tailored the preliminary draft of GI guidelines to the contents and sustainability goals established by the 2030 Agenda, the European Biodiversity Strategy for 2030, the National Strategy for Sustainable Development, and regional sustainability objectives. The consistency check allowed us to draft GI guidelines according to sustainability principles.

Finally, we proposed the draft of GI guidelines that is structured according to: (i) the main objectives of a GI and the measures to be implemented, (ii) where the GI can primarily be implemented, (iii) the approach to GI planning, (iv) time-schedule, (v) stakeholder involvement. The main objectives rely on considerations emerging from context analysis (Section 4.1) and the consistency check (Section 4.2), and are consistent with international, European, national, and regional purposes. Such an approach allowed us to set the GI guidelines according to a top-down approach and define its main objectives within a sustainability framework [13,32,33]. We suggested a differentiation of the measures for urban, peri-urban, and rural areas. The measures are aimed at enhancing abandoned sites and meeting objectives concerning air quality, sustainable mobility, ecological and landscape defragmentation, adaptation and mitigation to climate change, and improved governance, via the GI. Each general line of action allows public administrators to set certain measures depending on the context that will be affected by the GI.

The location of the GI has been identified by considering three issues: Natura 2000 sites, areas affected by hydrogeological risk, and landscape fragmentation. We considered such issues to identify priority areas where GIs or GIs networks would be desirable, with the purpose of reconnecting and increasing the surface areas of habitat patches [56,58], promoting the conservation of endangered species (e.g., the Corsican red deer), and increasing the resilience of the priority areas, as GIs can reduce flood and landslide hazard [59–61].

The approach to GI planning refers to the corpus of policies, strategies, and plans defined at European, national, and regional scales. The planning and design of GI networks should consider such institutional tools as frameworks able to support and steer the decisional process. Thus, the GI guidelines rest on EU directives, national law, and regional planning and programming tools (e.g., [45,49,62] etc.). Such an approach aims at improving the inclusion of a fair course of actions defined by several institutions and promoting their successful implementation in practice.

A well-planned time-schedule should allow politicians and stakeholders to be involved in the planning and decisional process at the appropriate times. A time-schedule of actions is advisable so that the implementation of the GI takes place as soon as possible. However, the time-schedule needs to consider the time requested to assure the participation of non-institutional (or non-governmental, i.e., citizens, etc.) actors, according to a widely shared decision-making process. Therefore, since the establishment of reliable implementation times is quite difficult, our guidelines identify the more time-consuming commitments (administrative issues, involvement of politicians, stakeholders, and local communities) to plan a calendar of actions able to streamline/speed up the planning process.

Participation in the planning and decision process can be useful as it is strategic to support the stakeholders in order to meet the planning agenda [53]. The involvement of all interested parties (researchers, planners, professionals, local authorities, NGOs, associations, citizens, etc.) allows the identification of cause–effect relationships between society and environment [51]. In this regard, the proposed draft GI guidelines must include all the relevant institutional and non-institutional stakeholders, including the Metropolitan Mayor, Metropolitan Council members, the Metropolitan Conference, universities, research centers, etc. The institutional actors provide regulatory requirements and local policy support, coordinating the assessment practices concerning the impacts and effectiveness of GIs, while the non-institutional actors play a supporting role in information sharing, collaborations, and local partnerships [52].

Other authors studied the planning of GIs through guidelines. Klemm et al. [20] have studied the drafting process of GI guidelines for urban climate change adaptation. After Klemm et al. [20], we investigated the drafting of guidelines useful in practice, by also considering context analysis, the consistency check and approval of the guidance document. As for the research of Langemeyer et al. [21], who focused on the promotion of green roofs, we considered all types of GIs, their location, etc. Finally, with respect to Ibáñez Gutiérrez and Ramos-Mejía [19], our research considered the consistency check as an additional phase. Furthermore, while Ibáñez Gutiérrez and Ramos-Mejía [19] focused on a single component of the GI network, we considered all the components.

6. Conclusions

Currently, Italy lacks studies that address the drafting of guidelines for the practical implementation of GIs in metropolitan cities. In this study, we have applied a methodological approach proposed by De Montis et al. [18] for drafting guidelines aimed at supporting planners and decision-makers in the GI planning process. The method has not been applied in previous research, so its validation has been the main aim of this study. The proposed method was found to be applicable to the MC of Cagliari (Italy).

We are now able to provide an answer to the research question: is the method proposed by De Montis et al. [18] applicable in practice? We have proved that four out of six phases proposed by De Montis et al. [18] are applicable to the MC of Cagliari. Thus, after scrutinizing the scientific and grey literature (phase one), we have focused on context

analysis, the consistency check, and the draft of GI guidelines (phases two to four). We set general objectives, general lines of actions, and measures concerning the GI or GI network that could bring benefits in terms of landscape defragmentation, increase habitat connectivity, and adaptation to climate change in priority areas (i.e., Natura 2000 sites with high landscape fragmentation and/or affected by landslide and flood hazard). As for the actions that each stakeholder group should undertake in the planning process, the actors involved in the LL should provide suggestions, advice, considerations, data, and information related to the interests they represent.

In general, the findings can support the public administrators of the Metropolitan city to plan an effective GI network and promote the inclusion of GIs in spatial planning. The preliminary guidelines for GI design for the MC of Cagliari can be shared with stakeholders and, finally, definitively approved and deliberated.

We feel that this study has a reliable and solid scientific basis and could be further developed in future research. The methodological approach lies on international and European considerations and could be applicable not only in other Sardinian contexts but also in other Italian and European metropolitan cities.

The main limitation of this study regards the incomplete application of the method. Since we have applied four out of six phases of the method proposed by De Montis et al. [18], future studies could address the remaining two steps of the method concerning the ‘sharing of the draft with the stakeholders’ (phase five), and the integration of the preliminary document to achieve the ‘approval of the final guidelines’ (phase six). Finally, the level of detail of the preliminary guidelines is obviously bound by editorial matters, as all the scrutinized guidelines consist of more than 50 pages each. Thus, the proposed guidelines are intended as a sort of table of contents that the actual guidance document should refer to.

In summary:

1. We have proved that four out of six phases proposed by De Montis et al. [18] are applicable to the MC of Cagliari;
2. The method allowed us to set objectives, general lines of actions, and measures concerning the GI or GI network that could bring benefits in terms of landscape defragmentation, increase of habitat connectivity, and adaptation to climate change in priority areas;
3. The LL approach can be used to involve stakeholders in the planning process, although limitations to this approach have to be carefully considered;
4. The main limitation of this study regards the incomplete application of the method, as we have applied four out of six phases proposed by De Montis et al. [18].

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Appendix A

Table A1. Consistency check. The scrutiny of the 2030 Agenda [32] allowed the identification of sustainability objectives at a global level (Sustainable Development Goals, SDG) that can be achieved by implementing a GI (first column, SDG n. 11, 13, and 15). The second column shows the targets of the 2030 Agenda, which are linked to each SDG and the functions and purposes of the GI (such as the provision of ecosystem services). The third column includes the objectives of the European Biodiversity Strategy 2030 [13]. The fourth column refers to the actions envisaged by the European Biodiversity Strategy 2030 concerning the adoption of Nature Based Solutions, which imply the planning, design, and implementation of GIs, or their components, to meet the objectives of the Strategy. The fifth column shows the strategic choices of the National Strategy for Sustainable Development [33]. The last column includes objectives defined by the regional plans.

2030 Agenda for Sustainable Development (United Nations [32])		EU Biodiversity Strategy for 2030 (European Commission [13])		National Strategy for Sustainable Development (Italian Ministry of the Environment and Land and Sea Protection [33])	Sardinian Regional Plans
Sustainable Development Goals (SDG)	Target of Sustainable Development	General Objectives	Actions	Strategic Choices	Regional Objectives
SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable	11.4 Strengthen efforts to protect and safeguard the world’s cultural and natural heritage. 11.a Support positive economic, social, and environmental links between urban, peri-urban, and rural areas by strengthening national and regional development planning. 11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels.	Restoration and maintenance of ecosystems and related services.	Set priorities aimed at restoring eco-systems and promoting the use of green infrastructure. Promotion of green infrastructures in urban and rural areas through specific investments. Drive towards better rural development for biodiversity conservation. Reduction of indirect causes of biodiversity loss.	Halt soil consumption and combat desertification. Ensure the development of potential and the sustainable management of territories, landscapes and cultural heritage. Promote the demand and increase the supply of sustainable tourism.	Improve the ability to design, build, and manage (maintenance and renovation) strategic tangible infrastructures [63]. Soil conservation, protection and enhancement (avoiding erosion, preventing hydrogeological risk) [38,45,64] Develop territorial strategies for ecologically sensitive areas [45]. Restoration of degraded landscapes [45]. Enhancement and promotion of environmental sustainable relations between tourism and natural resources [65]. Conservation and management of landscapes of ecological interest [45].

Table A1. Cont.

2030 Agenda for Sustainable Development (United Nations [32])		EU Biodiversity Strategy for 2030 (European Commission [13])		National Strategy for Sustainable Development (Italian Ministry of the Environment and Land and Sea Protection [33])	Sardinian Regional Plans
Sustainable Development Goals (SDG)	Target of Sustainable Development	General Objectives	Actions	Strategic Choices	Regional Objectives
SDG 13: Take urgent action to combat climate change and its impacts	13.1 Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries. 13.2 Integrate climate change measures into national policies, strategies and planning.	Increase the contribution of agriculture and forestry to maintain and strengthen biodiversity.	Avoid the loss of biodiversity and ecosystem services. Drive toward better rural development for biodiversity conservation. Support foresters to protect and increase forest biodiversity. Integration of reforestation measures into forest management plans according to sustainable forest management. Reduction of indirect causes of biodiversity loss.	Contribute to increase resilience and manage new environmental risks in most vulnerable regions.	Conservation, enhancement and improvement of the quality of forest heritage ecosystems [64]. Preservation, restoration and enhancement of ecosystems which depend on agriculture and forests [49]. Improvement of the functional efficiency of the Mediterranean forests to preserve soil stability [64].
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains, and drylands, in line with obligations under international agreements. 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation neutral world. 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.	Full implementation of the Habitats and Birds Directives. Contribution to avoid the loss of biodiversity.	Complete the establishment of the Natura 2000 Network and ensure its good management. Support foresters to protect and enhance forest biodiversity. Integration of measures for biodiversity protection into forest management plans set for Natura 2000 sites. Reduction of indirect causes of biodiversity loss.	Safeguard and improve the conservation status of species and habitats in terrestrial and aquatic ecosystems. Ensure ecosystem restoration and defragmentation, strengthen ecological urban-rural connections.	Protection, restoration and improvement of biodiversity in Natura 2000 sites and design of related ecological corridors [45,49]. Conservation of biodiversity, ecosystems, natural heritage, and natural and environmental components [45,49,64].

Table A2. General objectives, general lines of action (GLAs), and the narrative concerning the GI design for the Metropolitan City of Cagliari.

GOs	GLAs	Actions/Measures/Narrative
GO1. Ensuring high environmental quality	GLA1. Proper implementation of GIs in urban, peri-urban and rural areas	The urban green can be valorised and increased through implementation of GIs and valorisation of current GIs. The planning of GIs refers to: choice of species based on specific criteria [30], preparatory work for the conversion of specific areas to GIs, drafting of the maintenance plan. In peri-urban areas, brownfield sites could be restored through GIs, by using natural elements in the buffer zone around the cities [28]. In rural areas, the planning of GIs aims at (i) supporting landscape and biodiversity conservation, (ii) converting intensive agricultural areas to conservative agricultural practices [49], (iii) valorising humid zones, (iv) retraining the riparian vegetation, and (v) designing sustainable paths [27].
	GLA2. Aiming at achieving high air quality	Planting of forestry areas in urban and peri-urban contexts [66] depends on the careful choice of species, preparation works and a maintenance plan [30]. Sustainable mobility in urban centres implies a reduction of polluting gasses emissions [31]. In peri-urban areas, wooded bands could mitigate the air pollution that came from the urban areas [30]. In rural areas, stakeholders should be informed about air pollution due to agriculture and actions aimed at reducing ammonia emissions.
	GLA3. More sustainable mobility	GIs can enhance the main connectivity between urban centers and peri-urban and rural areas [67]. Cycle and pedestrian networks have also a role as ecological corridor at provincial scale [67]. As for the Metropolitan City of Cagliari, the current sustainable mobility systems could be consolidated by promoting car sharing, bike sharing, electric mobility, cycle paths [34]. According to the scrutinized guidelines, the components of GIs, such as cycle and pedestrian networks, can enlarge the sustainable transport and mobility infrastructure systems. The provision of new energy supply points and financial incentives can encourage the use of electric cars [31].
GO2. Defragmenting landscape and protecting biodiversity	GLA4. Preservation and improvement of ecological connectivity	The main green areas of the urban setting can be connected by GIs as green roads, green roofs, cycle paths, riparian vegetation [21,68–71]. GIs are strategic elements to allow and/or enhance the ecological and spatial connectivity between the urban and rural areas. In peri-urban areas, the buffer strips, forest belts, hedges, green bridges, as corridors for wildlife, have potential to protect biodiversity. In rural areas, biodiversity can benefit from the adoption of conservative farming practices and the conservation of autochthonous vegetation [72].
	GLA5. Improvement of urban, peri-urban and rural landscape quality	Enhancement of historic green zones, urban green areas for recreational services, or design of new green areas to improve landscape quality and ecosystem services provision in urban areas. In peri-urban and rural areas, GIs (gardens, green roofs, re-naturalised areas) could be implemented to better integrate the built-up landscape into the surrounding landscape [73]. The implementation and enhancement of sustainable transport and mobility infrastructures can contribute to the defragmentation of the rural landscape and to the development of sustainable tourism [28].
	GLA6. Preservation of agricultural systems	The administrations have to preserve the agricultural ecosystems as components of GIs. The suggested measures include: conversion of arable land to permanent lawns and the implementation of conservative agricultural practices and GIs (hedges, rows of trees, etc.) in cultivated areas with the purpose of ensuring landscape continuity [49]. The fair management of forest systems, the promotion of remediation actions in forestry areas, conservation of natural elements, practices of organic matter integration and conservation, etc., are important actions aimed at hindering soil erosion phenomena and desertification [64]. Furthermore, GIs, such as vegetable buffer strips, grassy slopes, hydraulic and watershed protection, protect the agricultural-forestry system against hydrogeological risk [38].

Table A2. Cont.

GOs	GLAs	Actions/Measures/Narrative
GO3. Implementing measures to address climate change	GLA7. Decrease of greenhouse gas emissions	A greenhouse gas emissions monitoring system is needed [31]. The implementation of multifunctional wooded areas is suggested in urban areas, while in peri-urban areas the planting of forest belts is desirable [66]. Fast-growing forestry areas could be implemented in rural areas. The promotion of fire prevention policies and management is desirable [30].
	GLA8. Increase of atmospheric carbon sequestration	The first action concerns forestry maintenance and it is aimed at sequestering atmospheric carbon. The next steps concern location of the more suitable sites, the type and availability of soil, choice of vegetable species (according to longevity, management, fast-growing, and other factors). Finally, the protection of the soil area surrounding the trees should be assured against human activities [30].
	GLA9. Adaptation to hydrological and geological risk	In urban areas, natural solutions, such as green roofs, green roads, and grassy strips (to ease the drainage of rainwater), are suggested [38]. In peri-urban areas, the slopes should be protected with vegetation. The conservation of riparian species in waterways is needed [38]. In rural areas, the implementation of green and blue infrastructures, such as infiltration basins, enhancement of wetlands, and reforestation, are suggested [38,49,64].
GO4. Improving the governance	GLA10. Define a governance system for environmental components	The improvement of GIs governance requires the involvement of municipal administrations that are part of the Metropolitan City, according to a participative planning approach. The GI planning processes must be trans- and multi-disciplinary, and include several types of actors (professionals, citizens, local authorities, and other stakeholders).
	GLA11. Improvement of dissemination and sharing of information	Stakeholder expectations play a relevant role in the participative processes. Thus, the stakeholders should be involved through: (i) a first meeting that aims at involving the highest number of citizens; (ii) online surveys, i.e., questionnaires to collect data about knowledge, expectations, opinions on GIs and ESs; (iii) thematic meetings, which involve actors who have prepared the first draft of the project; (iv) involvement of the entire set of stakeholders and communication of the findings.
	GLA12. GIs must be considered in the planning processes	SEA procedure can ease the inclusion of GIs in plans and programs issued by the Metropolitan City. Such an approach has the potential to promote the consideration of environmental issues and the definition of adaptation to climate change measures. The GIs should be explicitly addressed in the plan or program. The planning of green urban areas should include approaches based on ecological networks or networks of GIs.

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