Chapter 11
The New Urban Plan of Rescaldina Municipality. An Experience for Improving Ecosystem Services Provision

Silvia Ronchi, Andrea Arcidiacono, and Laura Pogliani

Abstract This contribution presents the results of an urban planning process experience conducted in the Municipality of Rescaldina (located in the northern Milan metropolitan area, Lombardy region, north-west of Italy).

The new local Urban plan (including the Strategic Environmental Assessment – SEA) was developed based on ecosystem services (ES) addressing urban transformations and future development strategies towards the improvement of their performance as well as the promotion of human health and well-being. The integration of an ES-based approach in Planning involved the deployment of a local green infrastructure (GI) as the backbone for the design of urban and suburban public and private spaces, using nature-based solutions. The ES-based GI is a core strategy of both the SEA and the Urban plan, the assumption into both strategic and prescriptive frameworks of the Urban plan ensures its operability.

Keywords Urban planning · Urban ecosystem services · Regulating services · Open spaces design · Urban green infrastructures · Land-use regulation · Decision-making process · Performance-based planning · Human well-being

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S. Ronchi (✉) · A. Arcidiacono · L. Pogliani
Department of Architecture and Urban Studies, Politecnico di Milano, Milano, Italy
e-mail: silvia.ronchi@polimi.it

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11.1 A New Urban Planning Paradigm

In 2014, the newly elected local administration of Rescaldina – a municipality with more than 14,000 inhabitants located north of Milan – decided to start a radical revision of the local Urban plan although the previous one was recently approved (in 2012).[1]

This decision stems from the divergence between the new administration's electoral programme and the development policies set out in the 2012 Urban plan, which included a huge amount of new transformation areas, for commercial, industrial and residential settlements, with a significant alteration in the provision of ecosystem services (ES). This alteration strongly depends on soil sealing and land take dynamics, as the 2012 Urban plan forecasts the transformation of more than 210,000 square metres of agricultural and natural areas in artificial surfaces.

In addition to this prevision, another significant Urban transformation area was planned in the municipality of Cerro Maggiore, bordering Rescaldina to the south, involving 300,000 square metres of agricultural land for a new large-scale commercial area. This transformation would have had heavy implications in terms of habitat loss, ecological fragmentation, landscape and ecosystem degradation challenging to compensate.

Due to these critical issues, the new Rescaldina's administration initiated a general revision to 2012 Urban plan pursuing its winning electoral programme objectives, that is, defining a participatory, sustainable and resilient Urban plan, by ecologically and environmentally enhancing the natural and agricultural system; implementing a widespread quality of public spaces and urban greenery; strengthening of soil permeability by limiting soil sealing and land take process and achieving hydraulic invariance; improving the soft mobility with new local and supralocal paths, also developing a "green mobility" plan; redeveloping degraded areas and regenerating brownfields; and supporting local businesses, particularly threatened by a recent large-scale shopping mall located in the southern part of the municipality (Arcidiacono et al. 2018a).

Aiming to experiment different planning approach, based on land take limitation, combined with an Urban plan able to respond to the new environmental, ecological and social needs, the Municipal Administration requested a scientific and technical support to the Department of Architecture and Urban Studies (DAStU) of Politecnico di Milano finalised to prepare studies and research, fact-finding and interpretative surveys on the quality of open spaces and urbanisation dynamics (through an ES mapping) and support the municipality planning department to define strategies and structurally design the Plan (and related Strategic Environmental Assessment – SEA).

A further operational request made by the local government was to have a "unique, comprehensive strategy for land-use regulation which could address

[1] In the Lombardy Region, the Urban plan is called: *Piano di governo del territorio,* in English:Territorial development plan.

multiple issues, including public space design, natural landscape quality, regulation of land use in peri-urban areas, increased urban resilience as part of climate change adaptation" (Ronchi et al. 2020). This request has significantly guided and addressed the ecosystem services integration into the Urban plan.

The new Urban plan of Rescaldina was approved in March 2019, and it is still in force.

11.2 Understanding the Planning System to Integrate Ecosystem Services in Urban Plans

The proposed methodology is innovative for the adoption of an ES-based green infrastructure (GI), as a design tool which provides a multiplicity of ecosystem services based on their functions (Arcidiacono et al. 2018b), for planning purposes.

GI can be defined as a "network of natural and semi-natural areas with other environmental features that is supposed to deliver ecosystem services" (European Commission 2013) and as "a design vision that translates [a] planning strategy into physical reality while heeding the ecological and cultural characteristics of a particular locale – whether a region or an individual building" (Rouse and Bunster-Ossa 2013). As stated by Benedict and McMahon (2001), and by Hansen and Pauleit (2014), five principles guide the GI: "1) integration: considering the grey–green combination of GI; 2) multifunctionality: GI includes the ecological, social and economic/abiotic, biotic and cultural functions of green spaces; 3) connectivity between green spaces; 4) multiscale approach taking in all parcels, from the individual to the community, regional and state scale; 5) multi-object approach including diverse types of (urban) green and blue space."

GI partially takes up the ecological network concept and biodiversity targets but it emphasises the multifunctionality of the ecosystems and uses nature-based solutions (NBS), that is, "living solutions inspired and supported by the use of natural processes and structures [which] are designed to address various environmental challenges in an efficient and adaptable manner, while simultaneously providing economic, social, and environmental benefits" (European Commission 2015; Maes and Jacobs 2017).

GI represents the framework for the contemporary city urban design as a supporting structure (i.e. a backbone) useful to evaluate and verify the plan's urban transformation choices, addressing them to environmentally sustainable solutions for enhancing well-being. The adoption of an ecosystem approach to a local GI requires to overcome the traditional urban planning paradigm. As argued by Ronchi et al. (2020), traditional land-use planning was "based exclusively on land use (whether residential, manufacturing or commercial), these models do not take into account the suitability of the land to host a specific function or its consistency within a wider territorial context." Historically, the design of a city's green spaces was guaranteed by quantitative standards which set a mandatory minimum share of

public services. The Italian Inter-Ministerial Decree n. 1444/1968 sets the mandatory amount of 18 sqm per inhabitant in the sizing of the areas as "Planning standards." Such standards are to be considered the minimum provision of public facilities and public open spaces at the neighbourhood and local scale, subdivided into 4.50 sqm for education facilities, 2 sqm for facilities of common interest, 9 sqm for urban green spaces and 2.50 sqm for parking areas (Italian Government 1968).

The adoption of an ecosystem approach requires a different planning model based on the qualitative performance of multiple benefits in terms of regulation, support, provision and cultural services.

The innovation aspect of this research lies in the GI operability, which is guaranteed by the integration of the ecosystem assessments and GI design into the Urban plan with different forms of applications. This aspect is essential to transform the academic and scientific studies into a tool which is useful to the policymaker, enabling choices aimed at increasing the supply of ES to ensure a better quality of life for citizens, and support ordinary urban planning activities.

Understanding how to implement ES for planning purpose, it is important to know the planning system, the municipal urban planning tools and how they work and what effects they could produce on ES provision. Otherwise, the risk is that ES integration is a mere declaration of intent, often a recommendation (Haase et al. 2014) without a practical impact on the supply of ES or their management (Hansen and Pauleit 2014; Geneletti et al. 2017; Ronchi et al. 2020).

Considering this premise, the Lombardy urban planning system is explained in the following text, that aims to understand the process of integration of the research into the Plan and in all its components (strategic, operational and prescriptive).

The Lombardy Regional law on *Governo del territorio* (Territorial Government) n. 12 of 2005 sets the structure and process that local municipalities follow on preparing the Urban plan named Territorial Development Plan (TDP). The TDP is composed of three documents:

1. *Documento di Piano* (Planning document – DdP) contains a general framework of strategies, analysis, objectives and guidelines for the territorial, social and economic development of a municipality. It is valid for 5 years (this time is strictly related to the local Mayor's electoral period), can be modified at any time and contains indications that have no effects on the land-use rights. The DdP sets the new Urban Transformation (UT) "as areas, generally natural or agricultural, converted to host human activities (i.e. residential, commercial and tertiary)" (Ronchi et al. 2020).
2. *Piano delle Regole* (Regulative Plan – PdR) regulates the existent urbanised city. It has no temporal limit, can be modified at any time with direct effects on the land-use rights and property.
3. *Piano dei Servizi* (Services Plan – PdS) tackles with the issue of local services at municipal level considering not only the quantitative supply of areas and facilities but also the quality of services (in terms of performance, accessibility, efficiency and financial feasibility) in relation with the demand, the composition of the population and the different types of needs expressed, aiming to enhance the

quality and urban liveability. The PdS is drawn up to achieve the requirements of habitability and urban quality through the concept of public service. It has no temporal limit, can be modified at any time and deals specifically with the planning and the design of public services and facilities (such as social housing and green areas).

Considering this triple division (DdP, PdS and PdR) of the Urban plan in the Lombardy region, the local GI of Rescaldina was included in each one. The underlying goals are to improve the natural capital and human well-being through the conditioning and regulation of the existent public and private city and to address the transformation areas towards sustainable development. Specifically, the DdP fixes precise design strategies, also based on NBS, for the development of the forecasted UT following the ES-based GI strategy.

As stated by Ronchi et al. (2020), NBS are greening design actions that can contribute to developing GI in urban areas while GI is an application-oriented tool for integrating ES concept into land-use planning. For the TDP of Rescaldina, a specific catalogue of NBS was created according to GI landscape type and to the three management strategies (see Subchapter 11.3) including, for example, the creation of shrubs, woodlands, wetlands, green roofs, rain gardens, rural pathways and tree lines.

The UT criteria and guidelines include priority interventions for the public city and urban and environmental equipment (in accordance with the SEA and PdS) as dedication areas, as grant of private land for public use; riparian buffer zones; public spaces with permeable surfaces and facilities; private space for urban orchards; urban forestry; new pathways; green parking lots with permeable or semi-permeable paving.

The same approach was used for the projects concerning the so-called "public city," the one disciplined by PdS, identifying specific design criteria to improve the quality of public spaces based on ES performance including them in the overall strategy of the GI. Moreover, in the PdS, a sample of design schemes was provided to suggest how the NBS can be implemented in the public city.

Lastly, the PdR sets the rules for the built-up city giving precise prescriptions for each land-use classes (residential, industrial, mixed-use, tertiary, etc.) according to the ES-based GI. As an example, for the low-density residential areas, the PdR prescribes the urban forestry of native species in private green areas, the enhancement of the permeable open spaces, or the prohibition of cutting down of trees without a valid reason (Fig. 11.1).

The inclusion of GI strategy in the three documents of TDP ensures the complete transposition of the GI project into all the steps of the planning process, from the future vision of the territory to the land-use regulations, in the public and private domain.

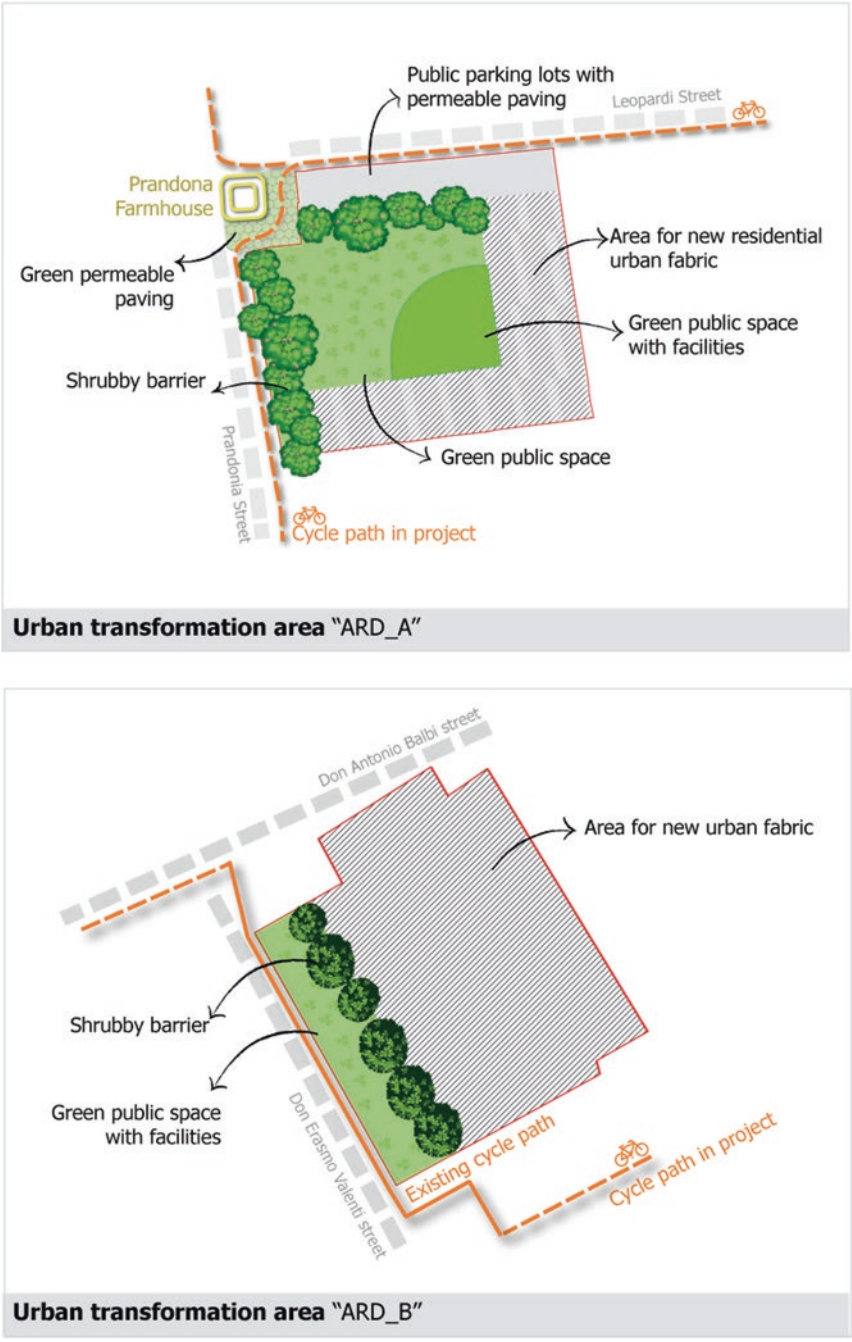

Fig. 11.1 Sample schemes of two UT area. Nature-based solutions are used for the design of green public spaces addressing urban built-up development (Based on Ronchi et al. 2020)

11.3 Guiding the Planning Process Through Ecosystem Services Mapping and Assessment

An important support for configuring the GI design and for the definition of urban regeneration strategies comes from the evaluation and mapping of ecosystem functions and related services (Naidoo et al. 2008; Burkhard et al. 2012, 2013) as "benefits that humans obtain from ecosystem functions" (de Groot et al. 2002; Millennium Ecosystem Assessment 2005) or "as direct and indirect contributions from Ecosystems to Human Well-being" (ten Brink et al. 2009). At the least, ES are the set of processes and conditions that make possible the survival of human life in Natural Ecosystems (Ronchi 2018).

The methodology identified for the construction of the Rescaldina GI was developed within the Strategic Environmental Assessment (SEA) process starting from the combined mapping and analysis of ecosystem functions as recognised by the Common International Classification of Ecosystem Services (CICES) (Haines-Young et al. 2018).

The first 5 layers – on regulating and supporting services – were elaborated using InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs), an open-source software, developed during the Natural Capital Project and jointly developed by Stanford University, the University of Minnesota, the Nature Conservancy and the World Wildlife Fund. The software is specifically dedicated for regional and urban planning considering both economic and ecological accounting (Tallis et al. 2011; Arcidiacono et al. 2016; Ronchi and Arcidiacono 2018). The InVEST outputs were subsequently processed using the ESRI ArcGIS platform to perform a weighted overlay analysis.

The ES modelled are the following:

1. Habitat quality, measured in terms of overall ecological quality based on proximity of the habitat to artificial land uses and the degree of disturbance caused by them (Tallis et al. 2011; Salata et al. 2017)
2. Carbon sequestration as the quantity of carbon stocked in 4 primary pools (above-ground biomass, below-ground biomass, soil, dead organic matter) (Tallis et al. 2011; Arcidiacono et al. 2015)
3. Water yield as annual water yield from a catchment area with the intended end use of reservoir hydropower production (Tallis et al. 2011; Redhead et al. 2016)
4. Sediment retention, that is, "the capacity of a land parcel to retain sediment by using information on geomorphology, climate, vegetative coverage and management practices" (Tallis et al. 2011);
5. Soil erosion, based on the Universal Soil Loss Equation (USLE), an empirical equation used to predict average annual erosion (Wischmeier and Smith 1978)

The cultural service was evaluated as the Cultural heritage distribution, selected according to Italian Legislative Decree no. 42 of 2004 concerning Cultural Heritage and Landscape, considered as an "important aspect of cultural and amenity services as a whole, implying the non-material benefits people obtain from ecosystems

through spiritual enrichment; cognitive, emotional and social development; reflection; recreation; and aesthetic experiences" (Millennium Ecosystem Assessment 2005). It has been estimated using a kernel density function in order to obtain a spatial concentration of heritage sites (Fig. 11.2).

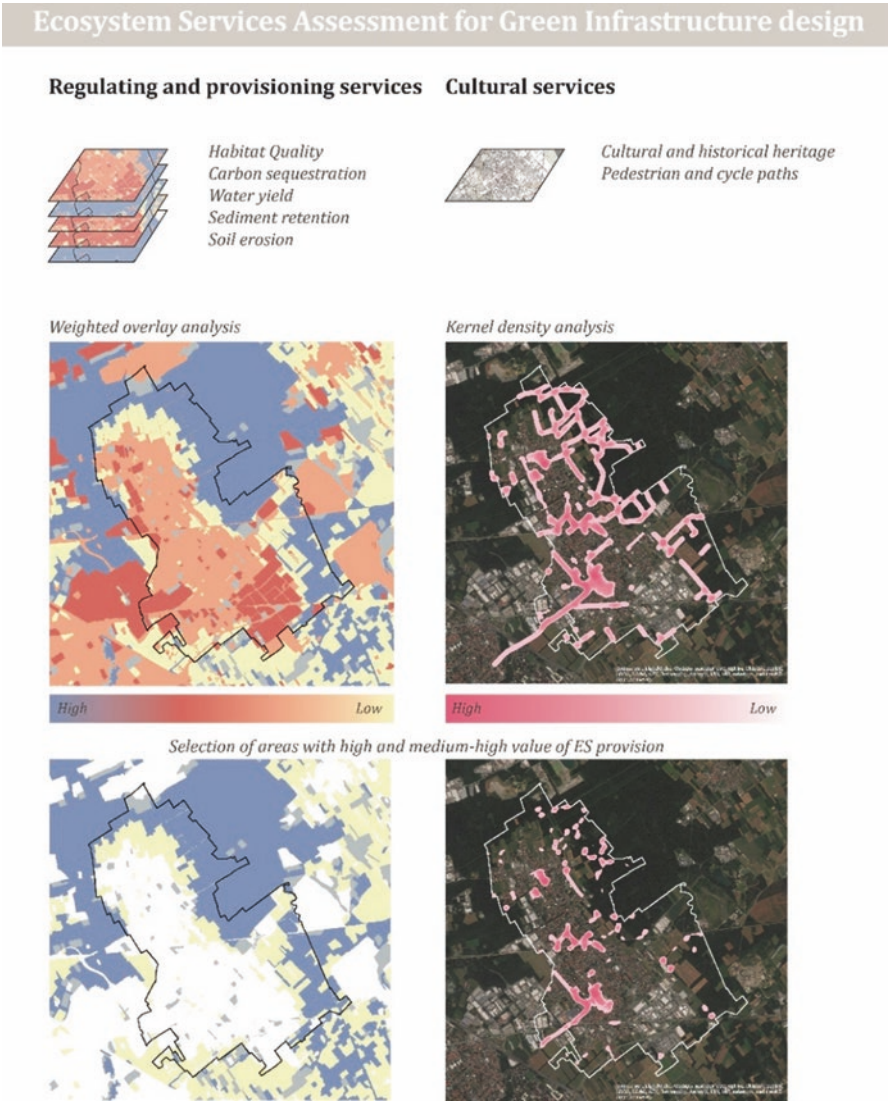

Fig. 11.2 Ecosystem services assessment for green infrastructure design (divided by ES type: regulating services, provisioning services and cultural services) (World imagery sources: Esri, DigitalGlobe, Earthstar Geographics, CNES/Airbus DS, GeoEye, USDA FSA, USGS, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community) (Based on Ronchi et al. 2020)

The combination of the analyses allows to define the most statistically significant areas and to select the ones to be included in the GI strategy. This selection involves areas with high ES supply values, which must be preserved and protected, and also degraded or abandoned areas that need to be regenerated and restored for improving their ecosystem performance in line with what is defined by target 2 of the European Biodiversity Strategy (European Commission 2011).

Assuming the methodology defined in the proposed Lombardy Regional Landscape Plan (mentioned in Chap. 5) (Arcidiacono et al. 2016; Salata et al. 2016) and as stated by Ronchi et al. (2020), the Rescaldina GI is divided into three types of landscape:

1. "Natural landscapes, including forests and semi-natural areas, deemed important for biodiversity and conservation reasons (in Rescaldina these areas mainly coincide with the wooded area named *Bosco del Rugareto*)
2. Anthropic landscapes, featuring historical and cultural heritage sites (mainly derived by the cultural ES assessment corresponding to the historical city centres)
3. Rural landscapes, featuring elements of traditional rural landscapes and consisting of "mosaics" of small-scale arable fields, traditional paddy fields and linear rural elements (Ciaian and Paloma 2011) (these mainly coincide with peri-urban areas characterised by a medium-to-high presence of regulating and provisioning services)"

For each landscape category (natural, anthropic or rural), three different levels of ES provision have been identified, based on the above analyses. They give rise to three different types of actions/strategies (maintenance, valorisation and regeneration). The maintenance strategies have been designed for areas with a high ecosystem value which need to be protected avoiding depletion and degradation that could compromise their quality. For the areas with a medium ES value, the actions are oriented towards the improvement of their performance, or in the worst case, the preservation of the current ecosystem quality. Regeneration and restoration strategies involve degraded areas such as quarries, brownfields, construction sites and landfills, for which it is necessary to reverse the current ES state and trends (Fig. 11.3).

The GI represents a strategy for Rescaldina municipality able to address a multiplicity of issues, including public space design, natural landscape quality, regulation of land use in peri-urban areas, increase urban resilience in climate change adaptation, suggesting actions and solutions based on territorial vocations and performances.

11.4 Conclusions

The adoption of an ecosystem approach for GI deployment guided the overall planning experience of Rescaldina municipality.

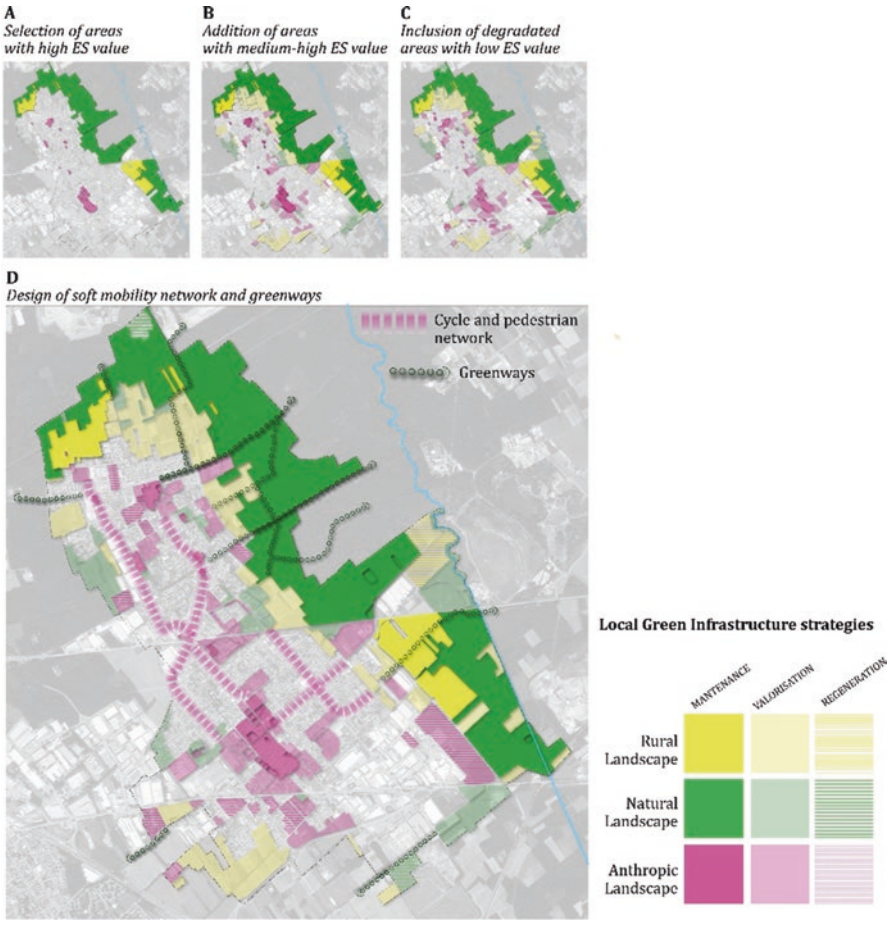

Fig. 11.3 A GI strategy for Rescaldina (World imagery sources: Esri, DigitalGlobe, Earthstar Geographics, CNES/Airbus DS, GeoEye, USDA FSA, USGS, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community) (Source: Rescaldina Municipality 2019; Ronchi et al. 2020)

The development strategies of the new Urban plan are oriented for improving ES provision aiming to enhance citizen's health and well-being. The GI allows to manage and govern numerous planning issues using one single strategy that is incorporated in the Urban plan and all its components and articulations. The operability of GI is guaranteed by its integration in the regulative tool with some mandatory actions for orienting new UT areas and the existing urbanised city promoting the adoption of NBS. GI advocates ES in Spatial planning using NBS to improve the performance of the urban design.

This research experience shows how ES could be integrated into the planning process overcoming the ordinary approach towards a performance-based one

highlighting solutions and opportunities and aiming to bridge the science–policy interface.

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