Regenerating Historical, Landscape, and Environmental Heritage Through the Municipal Territorial Plan in Lombardy

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Abstract. Heritage-induced urban and landscape regenerations are imperative in highly urbanised territories. Integrated spatio-temporal historical knowledge needs to directly inform the legal documentation of municipal planning. Nevertheless, the methodological and application gap exists, separating academic heritage research from operational governmental practices. This paper demonstrates a GIS-based methodology used to develop a variant of the Territorial Plan (PGT) for Desio, a medium-sized municipality in Lombardy. The collaboration between university research teams and municipal planning offices resulted in the structured implementation of historical cadastral data and geospatial information, spanning from the 18th century until the present, to trigger a synchronic reading of landscape and urban evolution. The outcome was a design of the Municipal Ecological Network (REC), in the form of two multifunctional green belts. Their role is to reconnect the dispersed farmsteads and religious buildings, fragmented historical woodlands, and rural road networks through contextualised actions within the official planning documentation. The ecosystem enhancement targets 1,538,000 m^2 of currently undeveloped free areas, improving carbon storage, water regulation, and socio-cultural services. The urban regeneration relies on reconnecting these areas with available resources supported by the historical and cultural values of the local territory. The scalability and replicability of the approach are reflected in the applied case study, where historically informed GIS spatial databases can be intersected with regulatory planning frameworks on various governmental levels, aligning regeneration actions with EU policies and objectives.

Keywords: Historical Cartography · Urban Regeneration · Municipal Ecological Network · Municipal Territorial Plan (PGT) · Heritage-induced Planning · Geographic Information System (GIS)

1 Introduction

Historical data and spatio-temporal analysis of the territory are imperative for the all-encompassing and contextualised development of urban planning regulations and actions. Alongside the state of the built and natural heritage in the current setting, data-informed analyses recover the negative impacts of previous urbanisation decisions and

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uncontrolled city growth. Present urban planning practices demonstrate that most of the integrated historical research is static, resulting in uneven and under-documented data on heritage in official records, especially in smaller municipalities [1, 2]. Nowadays, digital technologies such as Geographic Information Systems (GIS) are widely used to build databases and manage government urban plans, making the incorporation of structured and systematised heritage information much easier. Therefore, the role of historical information and spatial-temporal data describing existing or lost territorial heritage not only informs the urban planning decisions but should actively influence them. With the creation of a multilayered database containing both contemporary and historical data, planning documents can also address other underlying issues, such as social context, cultural identity, sustainable mobility and landscape regeneration [3].

The paper presents collaboration between the municipal planning office and university researchers as a fundamental step in creating analytical frameworks. This includes structured repositories of historical and contemporary data, further used in the creation of the *Piano di Governo del Territorio* (PGT)[1], the most important Territorial Plan on the municipal level in Lombardy. The research covers studies carried out by several research teams to inform knowledge-based territorial investigations and formulate strategies and actions for the general variant of the PGT of the Municipality of Desio. This plan is implemented in accordance with Regional Law no. 31/2014, 'Provisions for the reduction of land consumption and for the redevelopment of degraded land'. Currently in force is a partial variant of the PGT, made in 2021[2]Currently in force is a partial variant of the, which will be replaced by the ongoing general variation to the PGT developed in 2025, together with Politecnico di Milano and external working groups. The additional value of this collaboration is that the university provided the municipal planning office with experts in the field, especially regarding the intricate, layered past of the urban and rural tissue, making the theory of urban studies and regeneration methodology feasible and well-documented.

Desio is a municipality in the north of Milan, located in the province of Monza and Brianza. Until the second half of the 1800s, the town held an important position, being at the intersection of major roads, created predominantly by agricultural and religious activities [4]. By the end of the century, and with the arrival of the 1900s, heavy industrialisation took hold, leading to the abandonment of the historical centre and fragmentation of the landscape. The result was an incoherent town organisation with fragile heritage characteristics that urgently needed reevaluation and regeneration.

For these declining areas, both in value and use, often located on the outskirts of big hub towns in northern Italy, the implementation of urban regeneration actions is crucial [5]. The planning regulations target not only the enhancement of the present state of natural and built environment through infrastructure, cultural assets, and overall sustainability, but also involve improvements in economic and social conditions. Moreover, urban and environmental regeneration is closely related to the 'Agenda 2030', developed by the United Nations General Assembly in 2015. Specifically, Sustainable

[1] PGT is a territorial planning instrument introduced through the regional law 12/2005, and it is specific to the regulatory framework for all Lombard municipalities.

[2] Consultable through the geoportal of the Lombardy region that provides access to territorial documentation coming from the public administration: https://www.multiplan.servizirl.it.

Development Goal (SDG) 11 relates to the concepts of urban development, planning, and improvement of sustainability in the cities [6]. The SDG goals require the creation of the Integrated Urban Development Model (IUDM). Amongst a collection of approaches toward urban planning, the model also bridges the gap between various governmental levels of territorial management and their resources. Applied urban models often require complex systems and data organisation, but with the development of GIS technologies, the proposed approaches can be managed across scales [7].

Subsequently, the European Union investigated multi-level governance frameworks to bring urban regeneration strategies as a part of local planning activities [8]. They often highlight the involvement of stakeholders, openness to the community, and integration of multiple data typologies into project preparation [9]. With the real case studies, the urban regeneration strategies have shown that they can significantly alter the urban tissue, both on micro and macro scales, shifting the change from only built to broader cultural impact [10]. Further in the European context, the strategic policies are being developed to focus on establishing good practises for revitalisation and reuse of undervalued space and communities [11]. The European Framework for Action on Cultural Heritage, established in 2018, uses concepts, approaches, and methodologies in common with the 'Agenda 2030', linking the goals for creating sustainable, inclusive and resilient European cities to the cultural heritage. This framework aims to apply regeneration through heritage, both in urban and rural contexts [12]. By following these policies and frameworks, the paper investigates the possibility of achieving 'urban renaissance' through the Municipal Territorial Plan in Desio.

2 Methodology for Data Implementation

Mentioned recommendations and reports conclude that cultural heritage behaves like a catalyst for urban environmental regeneration and development. It is one of the most important elements for redeveloping cities which were previously consumed by rapid industrial growth, as in the case of the Municipality of Desio. The application of these concepts directly in the official planning documentation can help recover the fragmented spatial qualities, lost cultural identity, and a sense of community [13]. While there are many academic discussions and research advancements on the topics of urban innovation in Italy, the public sector still shows financial weakness and the private one is often discouraged due to the long-term crisis. Therefore, the planners, governments, and third sector involved in urban regeneration would rather turn to urban reuse, readapting existing structures and areas within a newly established network [14].

Activating urban regeneration policies for territories takes into account the large number of stratified, identity-related, environmental, cultural, and social values embodied within. The centuries of different spatial uses greatly impacted the relationship between historical development, architectural components, and landscape features. To untangle the intricate and layered contexts in which these elements reside, a collection of various historical and contemporary data is needed. Historical cartography, together with archival documents and available indirect sources, enables a profound reinterpretation and critical analysis of the evolution of territories over time. This is fundamental for their enhancement and sustainable regeneration, as it allows the rediscovery of values

and strengths, reactivating relationships that have often been erased by the urban planning policies of the recent past, which were almost exclusively aimed at meeting housing and productive needs. Frequently, there is a methodological gap between historical analysis supporting the heritage and contemporary planning [3], but the research's methodology strives to establish standardised practices integrated into public documentation.

The research paper investigates established practices of GIS implementation in urban studies, using it for historical data systematisation, linkage to existing databases, and programming environmental actions. The applied procedure is built on the extensive heritage GIS literature, demonstrating that this geospatial technology is imperative for collecting, reading, and managing cultural heritage across the territory [15–17]. Nevertheless, the employed methodology further advances through its use in the real case study, shaping the dialogue with governmental administrations and their requirements. The georeferenced maps, vectorised historical cadasters, and multi-layered database connecting historical and contemporary data are not just the research outputs. They are embedded into a legally binding PGT as a tool available to the planning office. Unstructured and dispersed historical sources became an operational normative, digitised and linked with present standards of spatial representations and cataloguing. Moreover, the valorisation and quantification of landscape features, such as the rural road network, historical production and land usage, toponyms, and woodland boundaries, transform them into tangible targets in municipal planning.

This methodological approach formed the basis of the knowledge-building investigations carried out for the Municipality of Desio. It provided useful indications for outlining the new PGT, while at the same time, following the supra-municipal regulations. The activities of historical investigation and the construction of the innovative digital tool for consulting the collected data began with the georeferencing and digitisation of all available historical cartography for the Desian territory. The organisation of historic databases and the construction of information layers for their archiving and consultation today represent a fundamental tool [18]. This approach allows the reading of historical maps alongside current plans and cadasters, rendering the relationship between form and use, and between the past and present of a territory [19]. Historical documentation spans from the early decades of the eighteenth century to the present day, including cadastral maps, geographic maps, and orthophotos, across different scales. For example, the reading of the historical evolution of land use over the centuries revealed the most significant data for defining strategies for 'green regeneration' interventions. Processed historical data facilitated: identifying the system of farmsteads forming a belt around the built-up core of Desio, tracing rural paths connecting the various agricultural settlements, today still partly recognisable in the local road network, and marking the portions of green space historically devoted to deciduous woodlands [20].

The research investigated different environmental frameworks, prioritising PESTEL, to evaluate external factors influencing the specific study context. Its legal component has a direct influence on the application and performance of the methodology through policies and planning regulations, separating the environmental dimension into an independent methodological category. These micro-environmental factors, as one of the crucial drivers of the workflow and the standards used, were implemented throughout the project development phases in coordination with governmental entities and research

teams. When dealing with rigorous official municipal planning documentation, it is necessary to follow and validate all regulatory factors. Within the research, the PESTEL framework aided in managing and mitigating risks arising from political, economic or social spheres, while considering important technological effects on planning practices and administrative operations through the use of GIS and open geospatial data (Fig. 1).

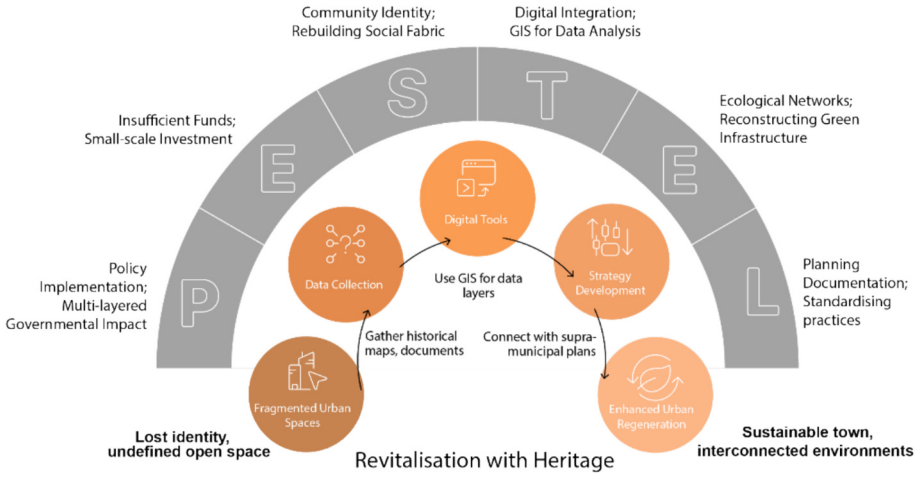

Fig. 1. Heritage-led urban regeneration methodological workflow analysed through the PESTEL strategic framework. External factors, such as planning documentation and governmental regulations, strongly influence the research methodology and its effective use.

Through the GIS digital environment, it is possible to construct dynamic two-dimensional representations that are fundamental for a clearer reading of the landscape in highly anthropised and urbanised territories, where historical features and the associated environmental values are often recognisable only in toponyms or in surviving fragments of landscape and built environment [21]. Comparison of historical continuities provided recognisable elements such as toponyms, agricultural and forest cultivation patterns, and the historical rural road network. These data formed an interoperable database, and together with contemporary information, codification, and vector shapefiles, can be visualised and analysed in parallel. Structured geographic metadata allowed implementation of strategies and actions within the Territorial Plan aimed at reconstructing the ecological and municipal green networks. On the one hand, strategies connect with supra-municipal plans and programs, and on the other, they locally enhance the historical, landscape, and environmental specificities of the territory of Desio. Subsequently, the research outcomes enabled the quantification and assessment of ecosystem benefits related to climate-environmental regulation, support and provisioning services, as well as socio-cultural benefits.

Systematising, georeferencing and vectorising historical cartography is the crucial part of preparatory and preliminary analyses for the formulation of urban planning actions. Vectorised historical maps were then linked with digitised land register data through attribute tables and cross-referenced with current information to create thematic

analysis. The synchronic reading of the historical-morphological evolution of the territory, together with analyses of agricultural green areas, aided the reconstruction of the peripheral landscape of Desio. Moreover, it can shape two multifunctional green belts of high ecosystem value for the whole territory [22]. These are interconnected through linear green infrastructures, reassembled along historical axes of the agricultural and forest landscape, redesigning the relationships between historical assets and rural landscapes.

Fragmentary elements of the 'green belt' extend from north to south on the west side of the Municipality of Desio. Many of these remaining areas are historical remains of the forests and orchards, and they were once part of a continuous green system characterising a larger territory. Today, a heterogeneous landscape is present with sparse farmsteads, often abandoned or demolished. In the recent past, regional and provincial interventions were developed for the revitalisation and reconnection of natural heritage with built points of interest, merging them into a unique infrastructure. In 2019, *Parco Branza Centrale* and *Parco Grugnotorto Villoresi* merged into GruBrìa. This local park, under Lombardy's Local Parks of Supra-Municipal Interest system, abbreviated PLIS, contributes to the Regional Ecological Network. It supports planning and ecological connectivity, while preserving natural, historical, and cultural heritage [23]. Within this merged park, Desio is the largest contributing municipality of a total of ten. It covers approximately 28.46% of the park (587 ha) [24]. Park GruBrìa benefits from a dense network of infrastructure: pedestrian paths, cycling routes, and rail connections, enhancing accessibility and connectivity with other regional parks (Fig. 2).

Additionally, the project focuses on redeveloping peripheral municipal areas with historical forests and cultural assets such as rural noble residences, churches, and farmsteads. According to the SIRBeC, an information system for cultural heritage in Lombardy, data obtained from the Geoportal of Lombardy (*Geoportale della Lombardia*) show that in the Municipality of Desio, there are forty-one buildings listed as cultural heritage[3]. Attention is given to the built heritage on the outskirts, from which nine belong to the 'religious and rural architecture' category and seven to the 'rural architecture' category. More specifically, SIRBeC reports seven completely or partially remaining farmsteads (i.e., typology: *cascina*) on the territory of Desio (Fig. 3).

3 Proposed Regeneration Actions and Results Implemented in the PGT

The territory of the Municipality of Desio was largely devoted to agricultural use until the eighteenth century, except for certain areas designated as deciduous woodlands, located mainly in the western sector toward the municipalities of Cesano Maderno, Binzago, and Bovisio. This situation remained largely unchanged until the end of the nineteenth century, when infrastructural and industrial development led to a progressive and continuous transformation of land use and the replacement of green areas with built-up spaces. This resulted in a gradual saturation of vacant and open spaces, occurring continuously from the 1950s through to the 2000s. These phenomena are clearly visible

[3] Source: https://www.lombardiabeniculturali.it/architetture/luoghi/560.763/ [last accessed 04/05/2026].

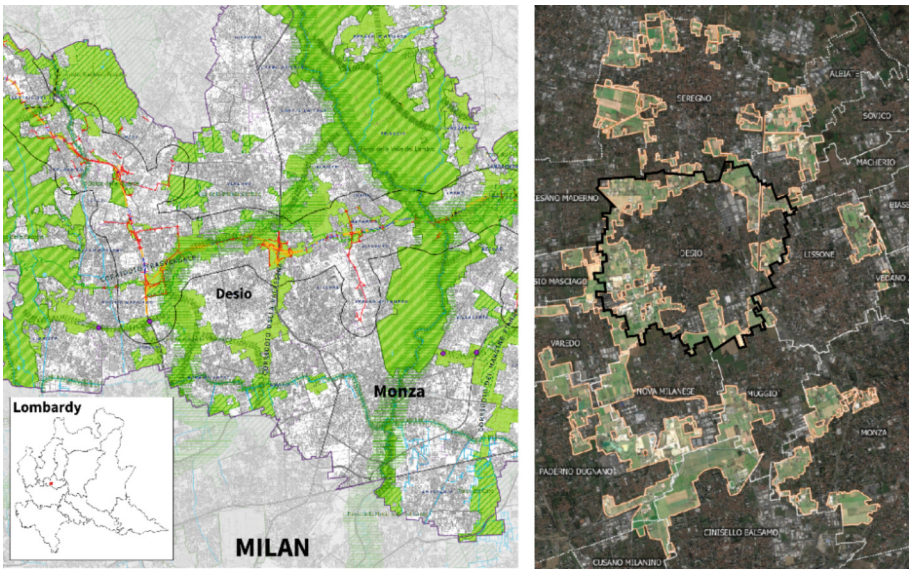

Fig. 2. On the left: Provincial Coordination Territorial Plan (PTCP). Table 6a: Landscape Protection and Enhancement Project (approved in 2013) (Source: https://www.provincia.mb.it/Temi/pianificazione-territoriale-e-parchi/pianificazione-territoriale/piano-territoriale-di-coordinamento/documentazione/ [last accessed 16/03/2026]. On the right: Map of PLIS GruBrìa Park showing Desio and adjacent municipalities (2021), Source: https://www.comune.desio.mb.it/it/page/grubria-fusione-dei-parchi-grugnotorto-villoresi-e- [last accessed 10/03/2026]).

through the overlay of georeferenced historical maps and development plans within the current system (Fig. 4). The results illustrate both directions and modes of land use consumption and landscape transformation, and they can identify the residual traces and enduring elements of buildings, green spaces, and historical infrastructures that have characterised this territory for centuries.

From the previously illustrated georeferenced analyses of Desio's historical territorial development, combined with the survey of the original vocations of the lands, it has been possible to reconstruct a cognitive framework of the historical agricultural and forestry functions of the Desio territory. Today, its readability is highly compromised by the intense urbanisation of recent decades, and it can impact the creation of a suitable framework for its investigation. Based on this multilayered territory reading, the Municipal Ecological Network (*Rete Ecologica Comunale* - REC) was constructed. Its structure originates in a landscape, recreational, and ecosystemic interpretation involving an informative reading of historical maps. Conducted analyses have highlighted that many of the agricultural areas recorded in the Lombardo-Veneto cadastre exhibited a forestry function linked to wood production, an element now perceptible only in restricted portions of the Desio territory and in its toponymy.

The strategies and actions underlying the implementation of the REC have primarily adopted the guidelines contained in the superordinate plans, the Regional Ecological Network (RER) and the Provincial Ecological Network (REP). On the other hand, when

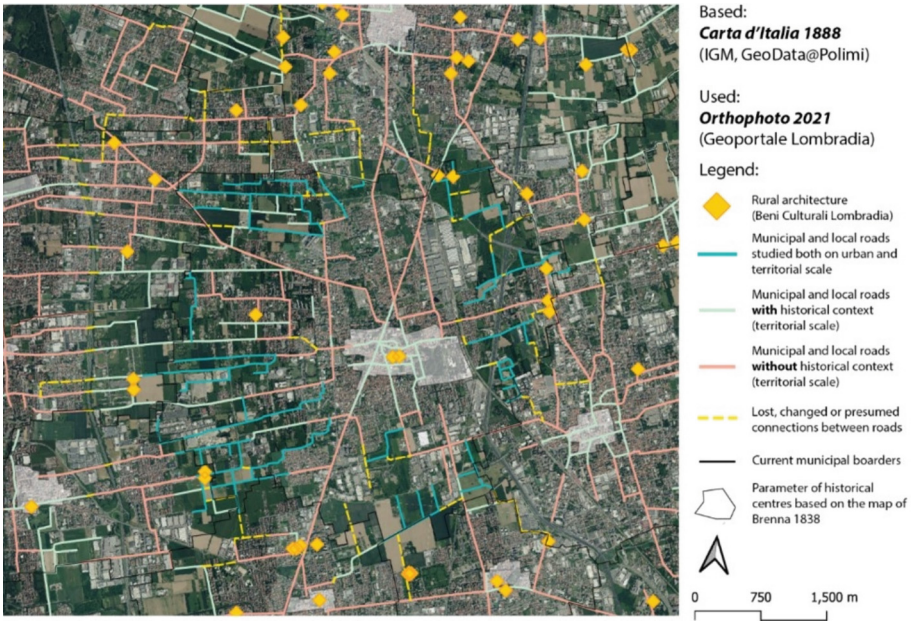

Fig. 3. Representation of the local rural roads and farmsteads (*cascine*) in the green belt around the Municipality of Desio. Road network was mapped using as a reference *Carta d'Italia, Istituto Geografico Militare* (1888), on the contemporary street network from *Geoportale della Lombardia* (2021).

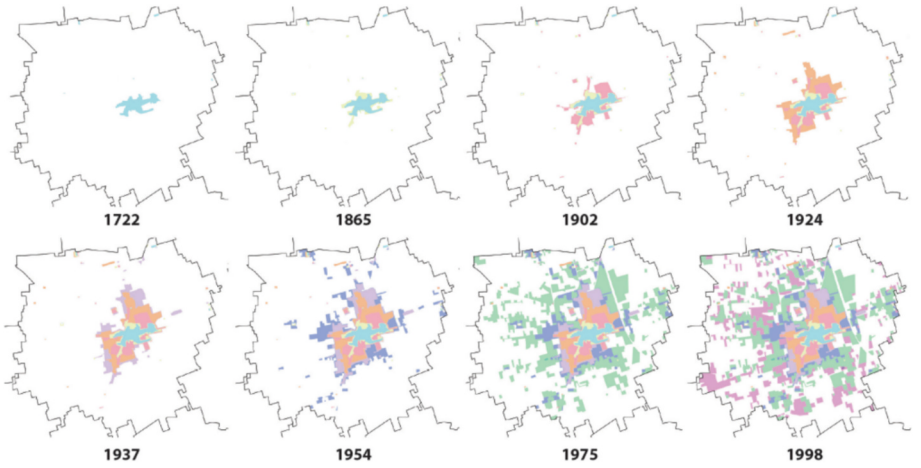

Fig. 4. Historical evolution of built areas from 1721 to 1998 of the Municipality of Desio. Elaborations are based on the historical cadaster (*Archivio di Stato di Milano*), topographic maps (*Istituto Geografico Militare*) and satellite imagery (*Geoportale della Lombardia*).

implementing them at a large scale, it is necessary to highlight existing discontinuities and thus identify possible local integration, implementation and final interventions. This involves a system composed of areal elements interconnected by linear elements, such as tree rows or cycle-pedestrian paths that have both ecological and environmental value. The green structure is articulated through two main systems. The outermost, so-called 'woods belt' consists of the existing and planned wooded areas, which develop mainly in the north-western portion of the municipal territory, in close connection with the Provincial Ecological Network. The implementation of this system pursues the dual objective of reconstructing the historical wooded landscape that characterised this part of the territory and enhancing the landscape, also in terms of providing ecosystem services.

On the contrary, the innermost ring is characterised by the so-called 'parks belt' that already partly surrounds and permeates the consolidated urban fabric. The implementation of this landscape-environmental system also occurs through environmental compensation arising from municipal territory transformation projects, particularly those affecting the Transformation Areas identified by the General Variant of the PGT and those related to new road infrastructures. Within this framework, the criticalities generated by the construction of the Lombard Pedemontana Highway in the north of the municipality of Desio have been treated as opportunities, and mitigation and environmental compensation projects have been identified as a strategic node of the Municipal Ecological Network (Fig. 5).

To better specify the composition of the two green systems, the former, nominated as the 'woods belt', is formed by areas already wooded or partially wooded, located predominantly along the western boundary of the municipal territory. This system is implemented and integrated through adjacent publicly owned areas that can be transformed into new woodland via the execution of compensation projects. To this are added compensation actions linked to the construction of the Pedemontana Highway and the identification of new strategic agricultural or green areas, privately owned, adjacent to the wooded belts. The latter system, referred to as 'parks belt', is formed by existing parks within the urban fabric, to which municipally and privately owned areas are added, capable of ensuring continuity to the city's landscape-environmental system (Fig. 6). Within the belt, buildings considered to be the morphological and typological features that characterise the historic built landscape have been mapped. Urban planning and building regulations aimed at their preservation are currently being drafted for each historical period to which they belong.

4 Expected Long-Term Impacts

The large green infrastructure generated by the implementation of the REC, designed by recovering the historical landscape features and by integrating the existing rural road network[4], and in all, represents a multifunctional belt capable of significantly increasing

[4] *Strade vicinali* (or *vie agrarie*) are private agricultural roads of local interest outside built-up areas. While they remain private property according to the Streets Code, strade vicinali grant public access through '*servitù di passaggio*' (source: Cereseto, G. B. (1894). *Le strade vicinali*. Unione Tipografico-Editrice).

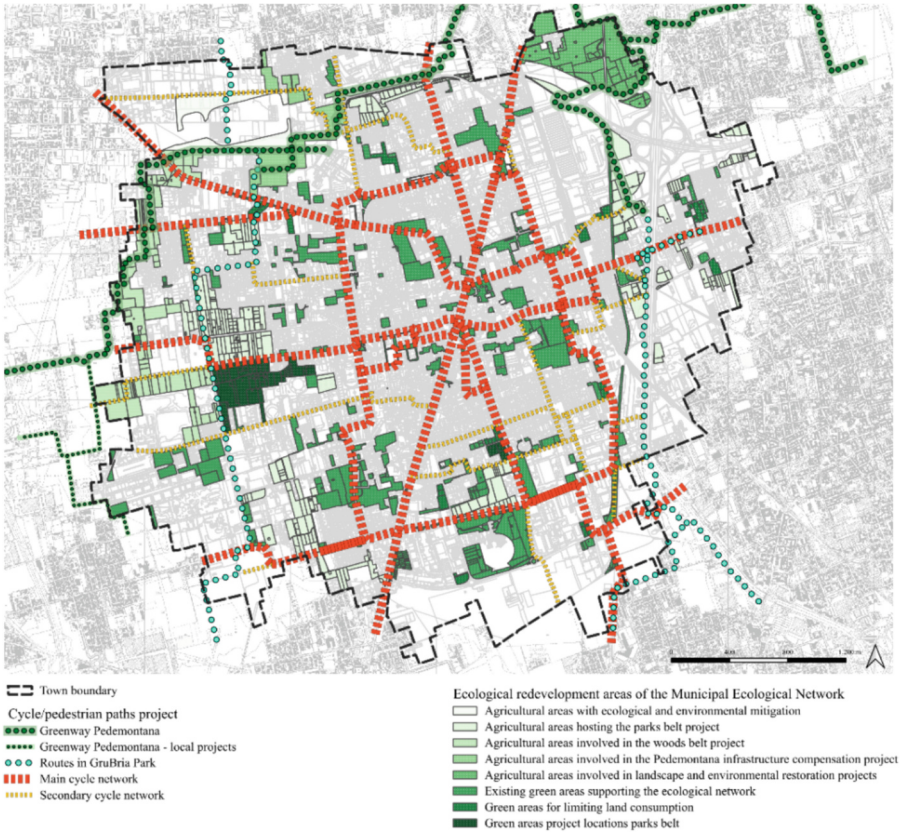

Fig. 5. Overlay of the Municipal Ecological Network (REC) with project cycle lanes identified by the General Variant of the PGT of Desio (edited by the authors).

the provision of ecosystem services[5] [25] of a regulating and socio-cultural nature for the territory and population of Desio. The application of the green systems of the new REC allows for a considerable increase in the ecological-environmental value of the underdeveloped free soils in the municipal territory, particularly by enhancing carbon storage capacity in the context of climate change mitigation. The new areas constituting the REC, located along the edges of the urban fabric, act as systems capable of absorbing, filtering, and managing water naturally and efficiently [26].

The transformation of free soils, which today are mostly areas deprived of vegetation, into forested systems or parks and gardens, with substantial tree and shrub cover, enables the delay of meteoric water infiltration. This is done through the interception by the foliage of tree canopies and an increase in the soil's absorption capacity, also

[5] According to the definition provided by the Millennium Ecosystem Assessment, ecosystem services provide multiple benefits, including regulating services (such as climate, water, and natural hazard regulation) and cultural services (such as recreational, aesthetic, and identity-related).

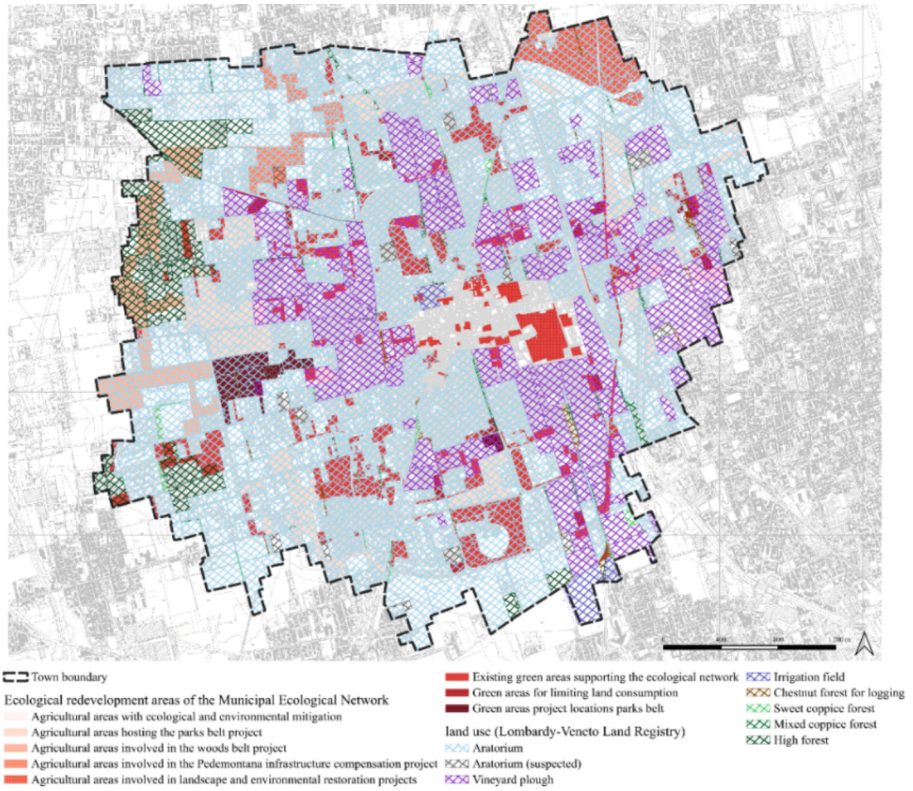

Fig. 6. Overlay of the Municipal Ecological Network (REC) with land use data extracted from the Lombardo-Veneto land cadastre (edited by the authors).

by constructing so-called natural systems for the infiltration and retention of meteoric waters (such as infiltration bio basins). These actions, measurable upon submission of the individual compensation projects, concern the litres of water intercepted by individual tree-shrub elements and the quantity of water infiltrated and retained by the bio basins. Furthermore, the creation of new forested surfaces, urban parks and gardens in the REC areas increases, both in number and extent, the surfaces capable of providing this ecosystem service of regulating soil temperature [27].

In total, the measures envisaged by the PGT variant provide for the enhancement, in ecosystem terms, of 1,538,000 m^2 of currently undeveloped free areas. This can be done by executing interventions of urban afforestation and reforestation, pursued through specific objectives and measurable targets directly correlated with the emerged vulnerabilities. These data are yet to be turned into actionable tactics for a long-term transformation of the industry-fragmented town of Desio. Building a resilient, eco-sustainable and green environment using the existing resources of the territory, not only targets the international and national recommendations and regulations but sets up the basis for future urban developments and positive impacts (Table 1).

Table 1. Summary of targets and performance for the implementation and enhancement of the Municipal Ecological Network[6] (edited by the authors).

Target	Performance indicators
Improvement of the ecological and environmental quality of the municipal area	- Potential green areas that contribute to improving ecological and environmental quality through urban afforestation and reforestation: 1,538,000 square metres, of which 409,200 square metres contribute to the 'forest belt', 912,996 square metres contribute to the 'park belt', 164,300 square metres of Pedemontana compensation areas and 96,816 square metres for interventions related to reducing land consumption - Existing green areas supporting the ecological network: 1,113,591 square meters - Increase: 142%
Preservation and reconstruction of the historical and naturalistic elements of the landscape	100% new wooded areas compared to areas historically designated as woodland (1,358,200 square metres of wooded areas of various types, cf. Extra-urban land use in georeferenced historical maps from the Lombardo-Veneto Land Registry)
Improving citizens' well-being in the use of green areas	- 3.5 km of existing municipal cycle and footpaths and 7.4 km of planned municipal cycle and footpaths crossing the compensation and support elements of the Municipal Ecological Network (REC) - Considering also the external cycle connections (existing and planned) to the REC, approximately 80% of the areas belonging to the parks and forest belt will be accessible
Improvement of the system for enjoying the landscape/environment/cultural heritage	100% of historical and cultural assets connected by the municipal cycle network (max. Distance 100 m)

The expected results of environmental performance remain contingent upon the implementation of the Plan, which is currently being drafted. After its approval, it will be possible to carry out the projects set out in the urban planning framework and begin a phase of thorough monitoring of the landscape and environmental actions. However, a further constraint of their implementation in the PGT is linked to the construction of grey public infrastructure, and urban and building transformation of territorial areas. They are currently open spaces on which land is being planned by private developers.

[6] The presented calculations were carried out using information from national and regional databases, with the shapefiles compiled in accordance with the rules of the Lombardy Region.

This approach to urban planning, which focuses on improving the environmental quality of free space, also, through its historical interpretation, remains linked to actions involving significant human pressure, such as new infrastructure (Pedemontana) and land consumption (areas of transformation).

5 Conclusions

The study has shown that integrating systematic studies of historical cartography and multitemporal territorial data within the PGT can effectively reconnect fragmented historical, environmental, and landscape values in a highly urbanised context, such as the Municipality of Desio. Collaboration between municipal planning offices and university research through GIS technology allowed the proposed methodology to transform heritage-informed analyses into concrete planning actions, following the regulations and frameworks on various governmental levels. One of these straightforward applications was the implementation and design of the Municipal Ecological Network and the definition of multifunctional green belts. The outcomes obtained from layering georeferenced historical cadastres, satellite imageries and contemporary data demonstrated that rural infrastructures and cultural assets can be reframed as active drivers of urban regeneration. They enhance ecosystem services and provide context-informed ecological continuities binding the whole territory.

Heritage-led regeneration can be operationalised within legal means from a planning perspective, like in the case of PGT. It allows various stakeholders to align local requirements with wider frameworks such as the REP, RER, the European frameworks for cultural heritage, and the SDG objectives. With tangible and intangible relationships between elements of the city, researchers were searching for true meanings and connections to create systems that rely on the gathered and processed historical knowledge. The linkage was obtained through toponyms, local present and past use, private and public property management, and reuse of assets already available within the territory to create a sustainable system for regeneration, development and movement. Remaining forested areas, *cascine*, *strade vicinali*, and tree rows are all part of the present heterogeneous systems, which were connected through this collaboration. These are all quantifiable benefits in the form of reduced land consumption, revived both inner and outer green belts, and improved conditions for socio-cultural services at multiple scales.

Nevertheless, the research indicates persistent challenges reflected in data gaps, the necessity of trained GIS municipality staff, constant data gathering, management and maintenance of the areas, both in person and through the geospatial databases. If these requirements are met, ecosystem regeneration can thrive in the long term, being beneficial for built and natural heritage, and the overall well-being of the citizens. The future advancements of this research will track and evaluate the applied methods in the field. There will be a need to refine the indicators for monitoring green services and infrastructure and prepare the database to receive updated information for processing.

The Desio case study confirms the efforts to use a GIS-supported historically informed planning tool as a scalable instrument to foster urban regeneration that can be environmentally, socially, economically and culturally inclusive. This specific, practically applied case study demonstrated the implementation of academic research into

governmental planning procedures. It also shows the replicability and feasibility of the methodology created using legal, socio-economic, and environmental regulations through a structured spatial-temporal GIS database. The approaches used in the research demonstrate the need to follow the documentational rigidity, while also integrating social, cultural, and environmental intangible values, which should be recognised and valorised before any planning actions.

Several challenges need to be addressed in the future. In most medium to small-sized Italian municipalities, there is a lack of standardised GIS practices and a permanent expert. The consequence is a partial database, lost or even unnecessarily repeated data. Additionally, the historical material is held in various public, private and religious holdings, mostly as part of larger collections. As such, they need to be collected, digitised, systematised, and handed to the municipal administrations for their use. There is an increasing risk that geospatial data will remain unmaintained and static for years to come, without constant information input. The solution would be a constant research urge of the public administration, investment in expert training, often collaborations with external study groups, and open, interoperable data formats. The real barrier emerges in replicating this methodology to other Italian regions, where municipal planning documents have a different form, or to other European cities with diverse planning models.

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