

An applied research experience  
in the city of Varese (Italy)

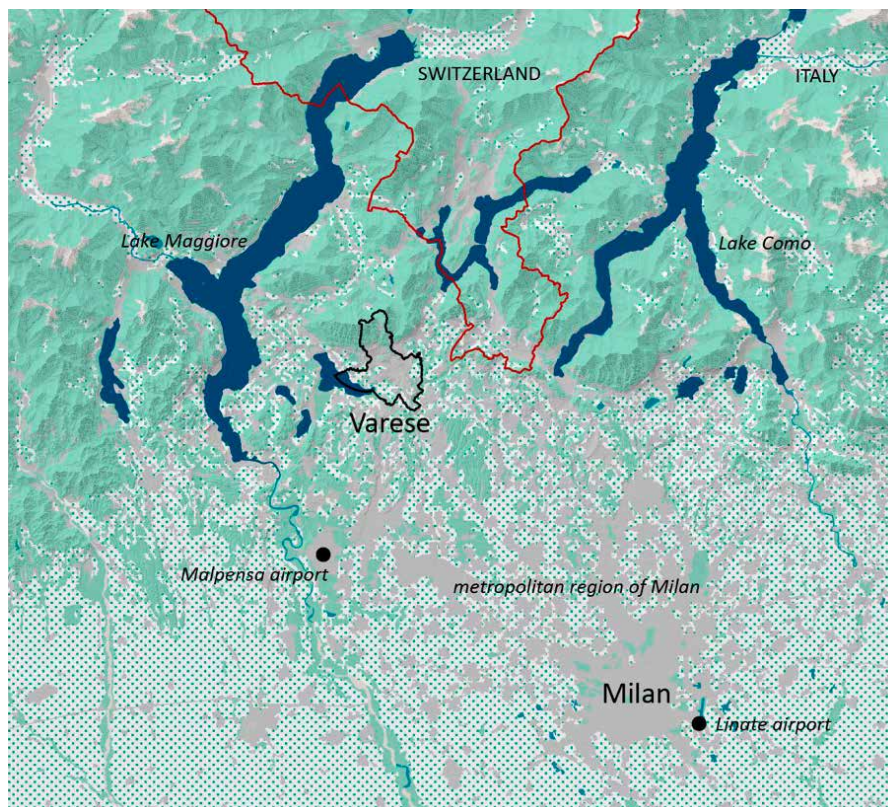


How can  
**ECOSYSTEM  
SERVICE  
MAPPING**  
**support downzoning  
and ecological  
enhancement?**

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**BEATRICE MOSSO** [PHD CANDIDATE], **FEDERICO GHIRARDELLI** [RESEARCH FELLOW],  
**ANDREA BENEDINI** [PHD CANDIDATE], **ANDREA ARCIDIACONO** [FULL PROFESSOR]  
[LAB PPTE / DEPARTMENT OF ARCHITECTURE AND URBAN STUDIES (DASTU) / POLITECNICO DI MILANO]

Reducing land take and restoring ecosystems are key strategies for achieving the EU's No Net Land Take (NNLT) target by 2050. This study presents the findings of research conducted by LabPPTE at Politecnico di Milano (DASTU) during the revision of the land use plan for the municipality of Varese, Italy. It shows how an Ecosystem Services (ES) approach could effectively support downzoning and Green and Blue Infrastructure (GBI) development.



The novelty of the presented approach lies in its ability to inform decision-making through a scientific quantitative foundation of environmental qualities

**FIGURE 1** Varese geographical context.

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## Land take risk in Varese

Varese is a medium-sized city with a population of around 78,000 inhabitants. It is located approximately 50 kilometers northwest of Milan, in the Lombardy region of Italy, near the Swiss border. The city is surrounded by a picturesque landscape of lakes and woodlands at the foothills of the Alps, offering a unique mix of natural and urban environments (Figure 1). In recent decades, urbanisation pressure, the escalating impact of climate change and inadequate planning have threatened the city's environmental quality, making it necessary to address past decisions and embrace adaptive strategies.

The current urban plan, adopted in 2014, permitted urban expansion into natural and rural areas, equivalent to approximately 60 hectares. Considering that approximately 26% of the forecasted urban transformation (16 ha) for the period 2014-2025 has been realised, the land take risk is still high and underscores the urgent need to implement effective land take reduction policies.

26 | The revision of the current urban plan by LabPPTe of Politecnico di Milano (DASTU) has provided an opportunity to address land take risk through downzoning. This study applied an Ecosystem Services (ES) approach to support land take risk reduction policies based on the assessment and analysis of ES performances. According to the Millennium Ecosystem Assessment (2005), ES are defined as the benefits people obtain from ecosystems; they play a crucial role in highlighting the value of natural capital and informing strategies aimed at preserving and restoring environmental quality.

This contribution presents the two pillars of Varese's downzoning. First, it outlines the legislative framework within which the urban plan operates. Then, it demonstrates how downzoning can be supported by an ES approach.

## The legislative framework for reducing land take in the Lombardy Region

Since a constitutional reform approved in 2001, regional governments in Italy have held autonomous authority to legislate in the field of urban planning. The Lombardy Region has adopted its regional law on urban and territorial governance in 2005 (Regional Law 12/2005). In 2014, this law was significantly amended to incorporate the provisions of the 'Regional Law for Land Take Reduction and Redevelopment of Degraded Land'. This amendment introduced a new regulatory approach, shifting the focus of urban planning towards the limitation of land take and the promotion of regeneration strategies on brownfields.

The Lombardy Region is a notable example in the European context regarding land take. Lombardy is one of the most economically and industrially dense territories within the EU and it records the highest percentage of sealed areas among Italian regions (SNPA, 2024). Considering these dynamics, the Regional Law (RL) no. 31 of 2014 introduced a pioneering legislative framework aimed at halting further urban expansion and promoting the sustainable use of land. Since it entered into force, Lombardy's Regional Law no. 31/2014 has imposed an immediate halt on new urban developments and downzoning procedures on those already planned in local urban plans (*Piano di Governo del Territorio*, PGT). The law mandates a thorough revision of planning instruments at all administrative levels, from regional to municipal, to redefine strategies for urban development based on future demand projections and the current availability of land. The overarching goal of the Region's initiative is explicit: to limit land take, placing particular emphasis on the protection of agricultural areas, by downzoning.

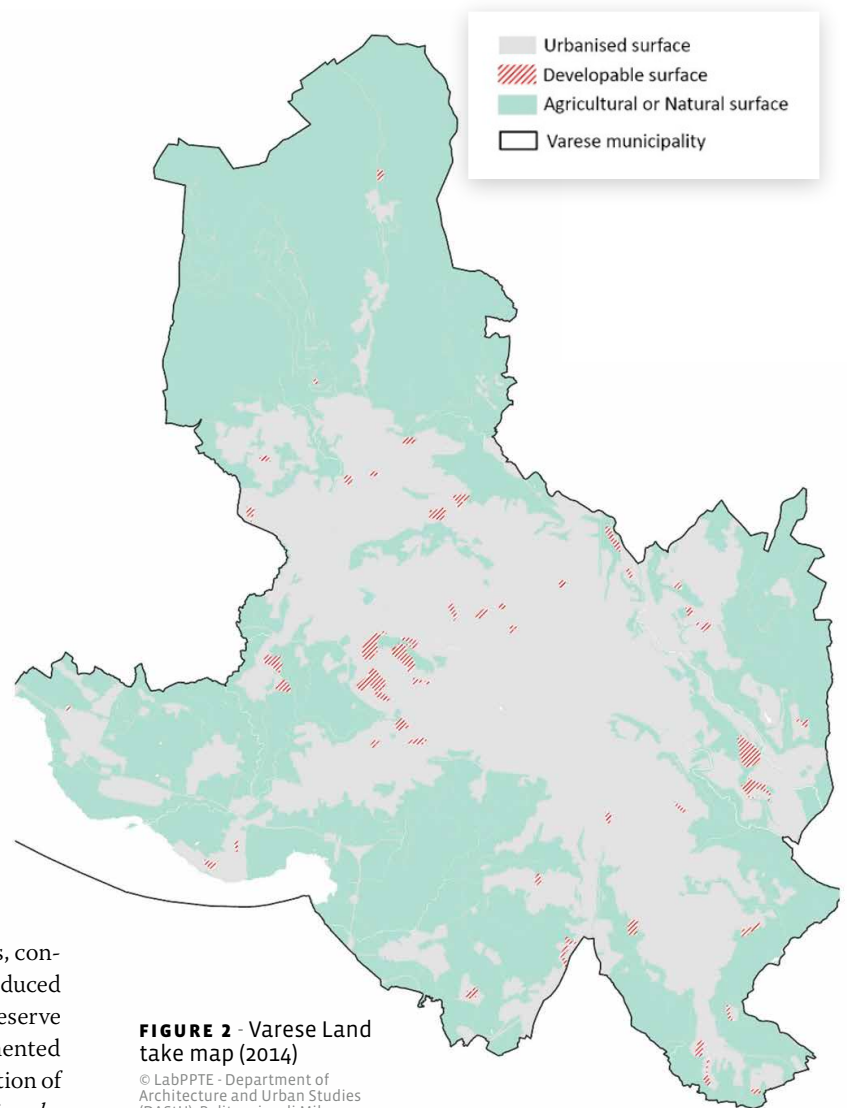
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## Downzoning

Downzoning is defined as the reclassification of land uses, converting areas with development potential into zones with reduced or no building capacity, to prevent future land take and preserve the ecological functions of the soil. This goal is implemented through multi-level governance that begins with the adoption of a revised 'Regional Territorial Plan' (*Piano Territoriale Regionale*, PTR). The PTR is the result of a collaboration between the Region, provinces and municipalities and sets out the methodological framework and the technical criteria for measuring land take and establishing land take reduction targets. Indeed, a pivotal component introduced by the RL no. 31/2014 is the land take reduction threshold. The threshold is calculated as a percentage reduction of developable land designated for transformation in the PGT as of the law's effective date (2014). These thresholds are applied as ranging targets: 20–30% for predominantly residential land use plan zones and 20% for non-residential ones.

At the municipal level, local authorities are required to update their PGTs at the earliest opportunity of fixed review. These updates must incorporate the land take reduction thresholds through a new planning instrument: the 'Land Take Map' (LTM). The LTM comprises one or more cartographic layers accompanied by an analytical report, and classifies the entire territory into three macro-categories (Figure 2):

- **Urbanised areas** include developed areas, such as built-up zones and transport infrastructure, as well as undeveloped areas with approved detailed plans with acquired development rights.
- **Developable areas, considered as land take risk areas**, comprise natural or rural areas designated for new residential, industrial and commercial settlements, infrastructures and public facilities.



**FIGURE 2** - Varese Land take map (2014)

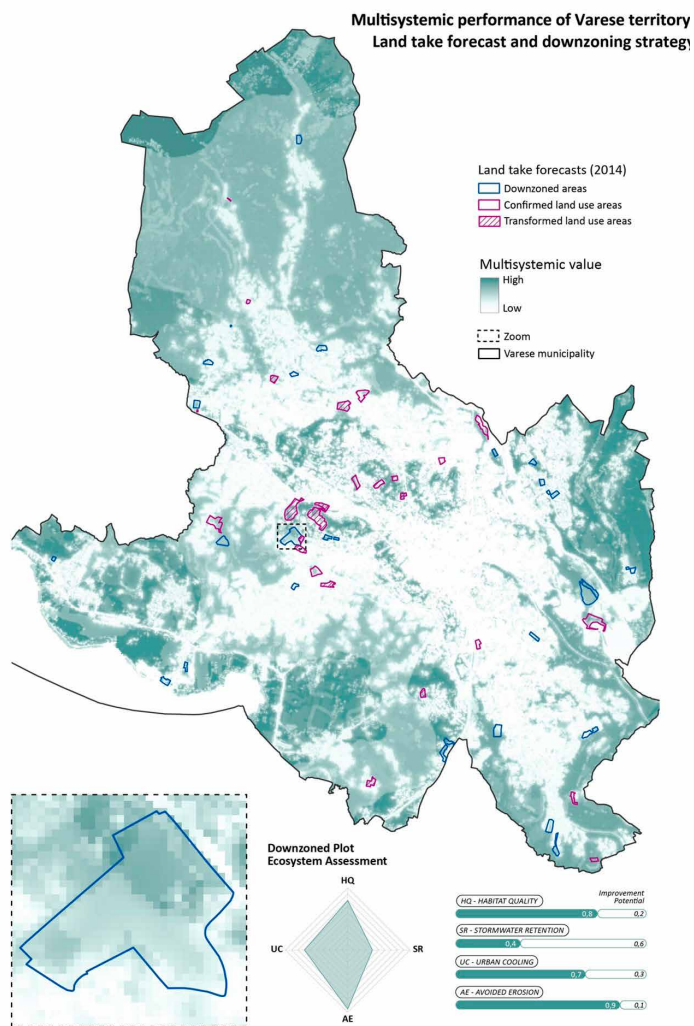
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- **Natural or rural areas** encompass all remaining areas, including rural land, forests, wetlands and large parks.

The LTM also reflects the outcomes of downzoning decisions. Specifically, it identifies, among the areas classified as *Developable*, those in which development rights are revoked, intending to reclassify such zones as agricultural or natural land, not only in factual land use but also in legal and planning terms. These reclassifications contribute directly to achieving the land take reduction thresholds established by higher-level planning frameworks (regional or provincial).

The revision of the Varese urban plan has started from this legislative framework (Figure 2). However, the research recognises the limit of a quantitative target: it does not address the environmental quality of downzoned areas. Indeed, the RL 31/2014 prioritises quantitative equivalence over qualitative ecological value. This mechanism raises significant concerns about the actual environmental effectiveness of such compensatory measures, especially in cases where high-value agricultural or natural soils are lost without a robust, evidence-based ecological justification.

For this reason, the applied research introduces an ES-based approach aimed at developing an LTM that effectively integrates the qualitative assessment of non-urbanised land.



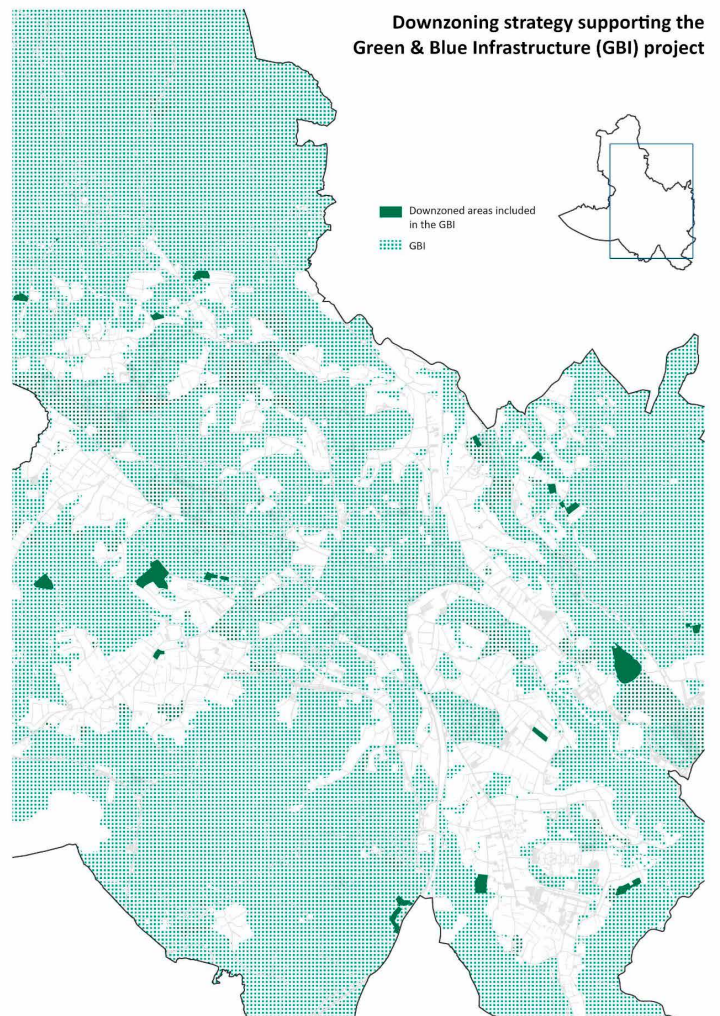
**FIGURE 3** - Multisystemic performance of Varese territory. Land take forecast and downzoning strategy.

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## Ecosystem-based analysis supporting downzoning strategy for the new Land Use Plan

This study has applied the ES framework by implementing a spatial assessment of the biophysical capacities of soil and vegetation as the main knowledge base to guide downzoning. The assessment has involved four ES — habitat quality, stormwater retention, sediment retention, and urban cooling — selected according to site-specific urban and natural features. The study has used the 'Integrated Valuation of Ecosystem Services and Trade-offs' (InVEST) software to model and map the four ES. Consequently, the ES analyses have been overlaid to generate a composite representation and to define a multisystemic value (given by the sum of the four normalised ES). This provides a scientific basis for evaluating the spatial distribution of ecological qualities across Varese.

The composite analysis has highlighted the high environmental value of major municipal green spaces as well as built-up areas and vacant lots, which contribute significantly to ES delivery. The analysis shows a diffuse high provision of ES across the



**FIGURE 4** - Downzoning strategy supporting the Green & Blue Infrastructure (GBI) project

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city that can be explained by the widespread presence of green areas, historically embedded within the dense urban fabric. For example, the historical typology of villas and parks, which constitute part of the cultural and natural heritage of the city, has allowed the preservation of certain biophysical values rarely found in Italian historical centres.

Cross-analyses of the ES assessments and the land take risk areas have enabled the evaluation of the developable areas' multisystemic performance (Figure 3). Consequently, areas identified as ecologically valuable were proposed to be downzoned to the local authorities given their environmental significance. In light of the considerable environmental value of the Varese landscape, many vacant plots, including those within densely populated urban areas, demonstrated notable ecosystem service (ES) performance.

This assessment supports a robust downzoning action that goes beyond the downzoning legislative requirements (RL 31/2014) by acknowledging the multisystemic value of these plots. The detection of their multisystemic value guided the withdrawal of more than 15 hectares of developable areas designated for residential use and 8 hectares designated for other uses.

The historical typology of villas and parks, which constitute part of the cultural and natural heritage of the city, has allowed the preservation of certain biophysical values rarely found in Italian historical centres

## Green-Blue Infrastructure

Following this decision, it also became necessary to redefine the role of these areas within the broader urban system. Although no longer designated for development, these areas could not be left unmanaged or subject to degradation. Therefore, downzoning has not been limited to the formal change in land use zoning, also a new role for these areas has been proposed. As a result, these areas have been incorporated into one of the key strategic components of the upcoming land use plan: the Green Blue Infrastructure (GBI).

The GBI aims to protect, manage and enhance rural, natural and urban open spaces while supporting the ecological resilience of areas vulnerable to climate-related risks, such as heavy rainfall, urban heat islands and biodiversity loss. The downzoning strategy supports the spatial design of GBI by integrating reclassified areas into the natural/rural system as structural components of the GBI (Figure 4). This integration enables their inclusion in a comprehensive green strategy, contributing to a coherent and strategic vision for a multifunctional and adaptive GBI at municipal scale.

In summary, this study proposes a methodology to enable an ES-based downzoning. The novelty of the presented approach lies in its ability to inform decision-making through a scientific quantitative foundation of environmental qualities. Empirical ES modelling was used to define urban criteria steering urban transformation, thereby improving the soundness of the plans' provisions (Ronchi et al., 2020). A particularly valuable aspect for the international community is the method's replicability. By gaining a deep understanding of the specific context and carefully selecting the most relevant ES to highlight the biophysical strengths or vulnerabilities of the territory, it becomes possible to establish a robust basis for achieving No Net Land Take (NNLT) goals and facilitating the crucial climate-adaptive transition of urban territories.

### MORE INFORMATION

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