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Ecopolitana: A Plan of Cities, Territory, Landscape, and Ecology

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Abstract: A national green planning strategy has recently been introduced in the Italian urban planning sector, aimed at making all local initiatives undertaken nationwide consistent with each other. At a regional level, Friuli Venezia-Giulia has recently implemented a Landscaping Plan, which is of an urban planning and ecological nature at an intermediate level between national and local. This article describes the local green plan of Latisana, which has been titled Ecopolitana, given that it represents the experimental phase, at a regional level, of the possibilities offered by landscape planning and design. Specifically, it outlines the multi-disciplinary approach used, demonstrating how landscape planning can be compared to the sustainable development of cities, with specific regard to the agricultural sector. In this regard, a low-intensity cropping model is also suggested, based on the principles of agroecology and landscape ecology, which has already been implemented in the historical rural landscape of Plasencis (UD) and investigated through GIS analysis and remote sensing processes. Its aim is to be the starting point for the achievement of the goals set in the 2030 Agenda, especially Goals 13 (climate action) and 15 (life on land), given the current scarcity of agroecological infrastructures in the area of Latisana (UD) and the high percentage of soil used for intensive cropping.

Keywords: Ecopolitana; greenscape; forestry plan; ecological network; green infrastructures; biodiversity; agroecology; conservation agricolture; Sentinel 2; LiDAR

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1. Introduction

The article describes the recently approved local green plan (LGP) of the Municipality of Latisana, in Friuli Venezia-Giulia (Italy), and outlines its innovative role in territorial and landscape planning. The preparation of the LGP involved an exploratory project procedure, introducing into territorial and landscape planning in Italy a series of proposals and experimental tools aimed at achieving synergy between the ecological aspects and those of a social, spatial, perceptive, and economic nature that are typically involved in urban planning. It was based on an approach that could be defined as "planning with nature".

In Italy, there is no legislation for defining and implementing green plans. They respond to the guidelines of the Ministry of the Environment and Land and Maritime Protection (MATTM), which define a series of methods of constructing the plans from a strategic viewpoint, at an overall national level, but the local territorial authorities are responsible for translating them into urban plans [1]. Friuli Venezia-Giulia is a region with a special statute, and is therefore independent in terms of urban planning legislation.

A green plan should be composed of three parts: a cognitive overview, an orientation plan, and the technical legislation for implementation. The work on the Latisana (UD) PCV was started in January 2019, and, at that time, no municipality in Friuli Venezia-Giulia had a complete three-part green plan in place. The lack of a specific implementing legislation and the absence of a series of comparable experiences at a regional level therefore made

this tool a new one, with an exploratory role, the structure of which is described in the following section.

An Urban Green Plan is defined by the MATTM as an extraordinary planning tool, which, in addition to providing a strategic vision of the natural and anthropic systems of the landscape, defines the principles and establishes the orientation criteria for the realization of public green areas in the framework of future general urban planning, with the aim of mitigating the environmental impact of anthropic activity in the area, guaranteeing a more rational use of the environmental resources, valorising the farming land, optimising the social, aesthetic, and environmental role of open spaces in and around cities, and encouraging the economic and social development of the area [1]. This study broadens the definition in such a manner as to comprehend all of the questions contemplated in the general conception of a LGP and to contribute towards planning.

This type of plan is a recent addition to the planning sector; aimed at achieving environmental and social sustainability, with specific reference to the 17 Global Goals For Sustainable Development [2] adopted by the UN in 2015 and aimed at solving a series of criticalities by 2030. In particular, landscape and territorial planning, as in the definition being used in this instance, is directly comparable to Goals 11 (sustainable cities and communities), 15 (life on land) and, indirectly, Goal 13 (climate action).

In addition to the analysis of the elaboration methods of the strategic and planning forecasts, we present here a specific study on one of the most relevant aspects of the green plan, that of the landscape matrices. The Local Green Plan of Latisana, the "Ecopolitana", prefigures a reorganisation, which will hopefully guide the overall territorial development of the area, on four axes: two landscape-environmental, one infrastructural and one urban. Specifically, the two landscape-environmental axes concern the agrarian landscape, especially that of environmental reclamation, and the water landscape (rivers, canals, and lagoon); the infrastructural axis concerns slow mobility, i.e., bike paths as greenways; while the urban green implies a structural connection of public space in urban centres and rural hamlets.

Of all these, the agricultural matrix is the most important, as it plays a vital role in the environmental functioning of the landscape. This role, which is especially indispensable in terms of ecological continuity, goes well beyond the reductive concept of "biological corridor" and leads to a reconsideration of the very concept of "ecological network" [3].

The adoption of agronomic practices aimed at the greatest possible exploitation of local resources has led over time to a vulgarisation of crops, the progressive elimination of traditional agricultural and ecological infrastructure, and the reduction of habitats suitable for the settlement and reproduction of many species of local fauna. This has led, not only to a significant loss of biodiversity [4], but also to an impoverishment of landscape quality and all associated ecosystem services [5,6]. The scientific literature is full of examples of how a connected spatial matrix is absolutely vital in terms of maintaining a healthy ecosystem [7–9] and in a context of global change such as the current one, its implementation is absolutely necessary.

In line with that stated in Goal 11, the management of urban and extra-urban green areas must be conjoint, since currently, rural areas are asked not only to deal with primary production, but also numerous other ecosystem services combining the supply of food with the production of landscape and nature [10].

On the basis of these presuppositions, it has been decided to analyse, through GIS and remote sensing systems, a portion of the farming mosaic on the municipality of Latisana and to compare it with the "Plasencis countryside", suggesting a low-intensity cultural model based on the principles of agroecology [11] and landscape ecology [12]. Plasencis, in Friuli Venezia Giulia (Italy), is an area rich in agricultural and ecological infrastructures and closed fields where sustainable agricultural practices are implemented, making it an ideal model of sustainability to compare with a highly exploited area such as Latisana.

This detailed study aims to investigate the recovery of conservation agriculture and the potential in general of the agricultural environment in the planning of a territory that,

historically, is based on a peasant culture, of which the settlement principles of the few inhabited centres are a natural evolution in structural terms.

Conservation agriculture is a recent soil management technique based on the reduction of processing (minimum or no tillage), maintaining a continuous covering of the land with residual crops and/or cover crops, and crop rotation [13]. This technique helps not only to mitigate the problem of soil erosion, but also promotes the efficient use of water and nutrients, the quality of the soil, the sustainability of farming and its products and, especially, encourages biodiversity [14]. As regards, instead, landscape ecology, we believe that the presence of adequate farming and ecological infrastructures is extremely important, given the characteristics of the area being surveyed. A farming fabric characterised by natural and semi-natural elements, such as single trees, rows of trees, hedges, wooded areas, sheltering woods, ditches and slopes, small ponds, traditional low stone walls, and hedged pastures, thus highlights very interesting potential for diversifying the landscape, increasing functional biodiversity, and providing ecosystem services [15].

2. Materials and Methods

2.1. A Territory of Soil and Water

Latisana's green plan consists of a cognitive overview, a strategic part, and an operational part. The cognitive overview is the result of the analyses, readings, interpretations, surveys, and feedback of the inter-disciplinary work group in the area. It is aimed at understanding and interpreting the landscaping and environmental aspects of the area, the landscape being intended as an exterior manifestation "of the overall organisation of an area" [16]. The outcome is a planning basis aimed at the identification of a complex spatial structure on which to base the strategies and actions of the plan. From a methodological viewpoint, the cognitive overview is the result of different interpretative approaches. Knowledge of the area from various disciplinary aspects is achieved through in-the-field surveys, mapping research, and remote sensing.

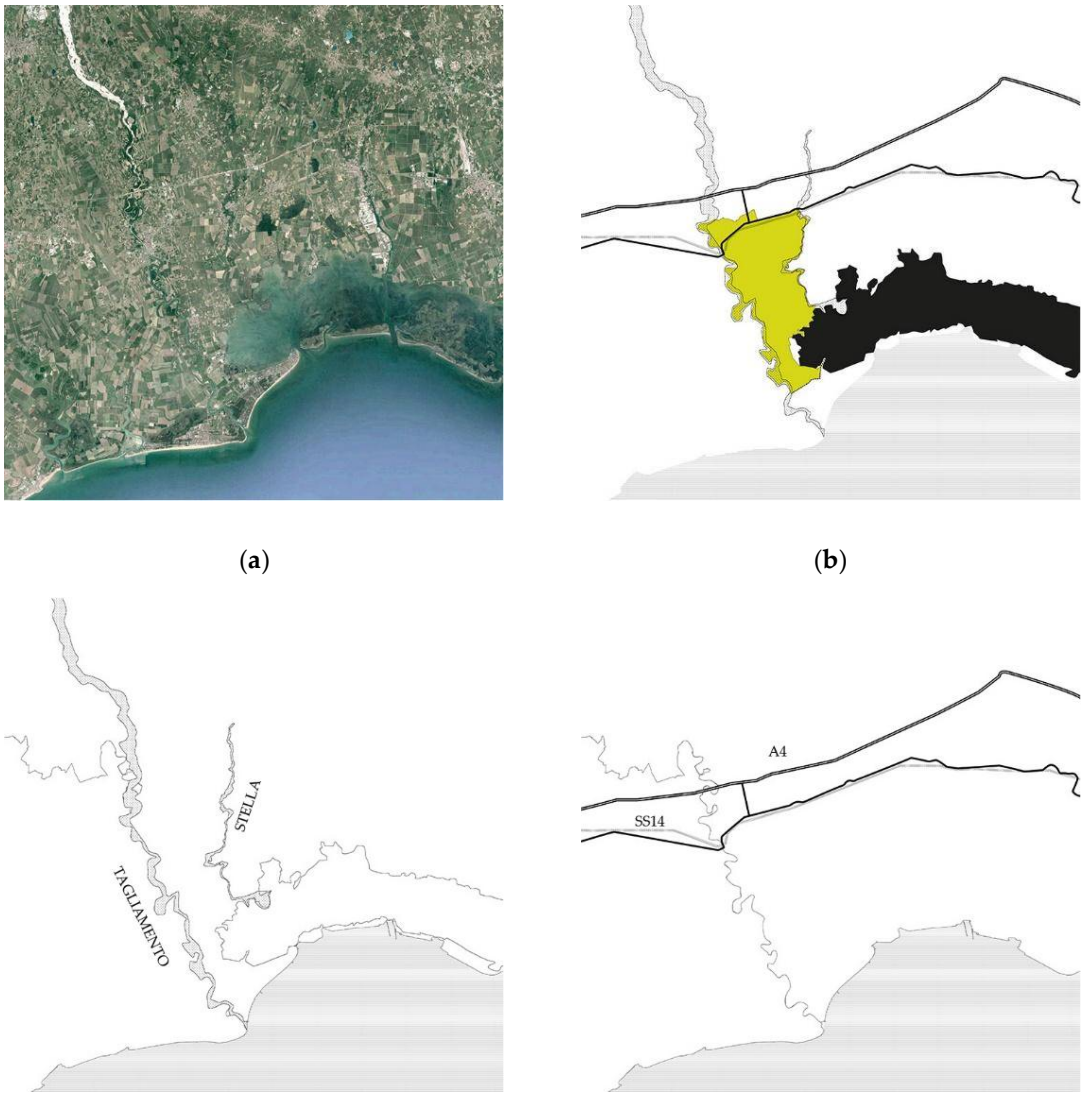
The strategic part lays down the ideas for the future of the landscape through a series of choices, orientations, and principles, constructing an overall vision for the area. This emerges directly from the cognitive overview and has the role of integrating the Green Plan with regional plans, in particular the Regional Landscaping Plan, and local tools, such as the general Local Regulatory Plan, the General Urban Traffic Plan, the Rural Police Regulation, and the Construction Regulation.

The operative part is the translation of the vision suggested in the strategic part into rules and zoning and is constituted by the contexts of the plan and a green regulation, which dictates the rules for the management, transformation, planning, and protection of the local green areas.

As already mentioned, the essence of the plan is closely based on the cognitive framework. The first in-the-field definition of construction of this framework is the identification of the Landscape Unit (LU), this being intended as the landscape subsystem characterised spatially by the ecosystems that comprise it, the delimitation of which coincides with the presence of historical and geographical elements, historical and morphological aspects, and the distribution of vegetation, consistently with Vittorio Ingegnoli's definition of landscape [17]. The municipality of Latisana is part of a wider ranging context, a sub-region, which has overall characters linked to the geography and morphology of the area and the landscape, and which mainly includes the Friuli lower plain and the coastline and lagoon. The reference Landscape Unit for the construction of the cognitive overview goes beyond the administrative confines of the Municipality of Latisana and is identified as follows (Figure 1):

- The rivers (to the East and West): the reference area is accurately delimited by two major rivers, the Tagliamento and Stella, with an ecological connectivity function; the distance separating them varying from about 5 to 7 kilometres.
- The infrastructural area (to the North): the main roads and railways which run from West to East in the area in question, acting as a barrier as well a major anthropic element.

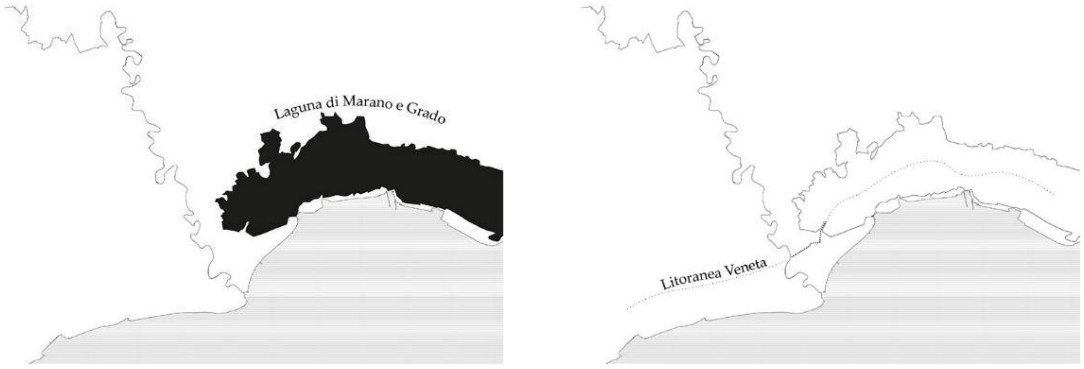
- The lagoon (to the South-East): the Lagoon of Marano and Grado is not only a bordering element: the origin of the area itself, which in ancient times was swampland, has determined over time the current state of the soils as a result of an anthropic action closely linked to the presence of the lagoon and the swampy nature of the surrounds; the LU is mainly a land reclamation area.
- The Veneto coastline (to the South).



(**a**) (**b**)

(**c**) (**d**)

Figure 1. *Cont*.



(**e**) (**f**)

Figure 1. The Landscape Unit: (**a**) orthophoto overview; (**b**) the components of the LU; (**c**) Tagliamento and Stella rivers; (**d**) the infrastructural area; (**e**) the Lagoon of Marano and Grado; (**f**) the Veneto coastal channel.

The Landscape Unit involved in the overall landscape analysis—and also the planning strategies of the green plan itself—is, therefore, an area that also includes part of the two Municipalities bordering it to the East and North. The total surface area of the LU is approximately 64.88 km^2.

The results of the analysis are the basis used to identify the system of landscapes and the configuration of the Local Ecological Network. Specifically, two landscape matrices have been identified, originating from the peculiar combination of morphological structure, vegetation present (indigenous and non-indigenous species present), and history and evolution of the area: the farming matrix and the hydrographic matrix.

Farming matrix (Figure 2):

Figure 2. Location of farming areas in the LU.

2.2. Detailed Analysis: Ecopolitana and the Agricultural Fabric

The assessment of the farming matrix of the Landscape Unit was conducted by comparing two sample areas covering 7 km^2, one of them located in the "Plasencis countryside" between the municipalities of Mereto di Tomba, San Vito di Fagagna, and Coseano (Figure 3), and the other in the municipalities of Latisana and Precenicco, within the LU described above (Figure 4).

Figure 3. Graphic contextualisation of the sample area in the Plasencis countryside. The numbered photos, the position of which is given in the superimposed polygon, showing a selection of the variety of linear and punctual elements of the landscape such as (1,3,5,8) rows of trees, (2) ditches, (4,7,9,10) protective belts, (11,12) groves, and (6) permanent grassland.

The latter is part of the National Rural Network, given that it is considered to be historical rural landscape. The significance of the area is linked to the persistence of a landscape mosaic of closed fields (shelter belts), delimited by hedges and rows of trees (Figure 3-4,7,9,10). This peculiarity represents one of the main characteristics of the historical farming landscape of the Friuli plains. Contrarily to what has occurred in the remainder of the areas, the area selected has not yet undergone land reordering interventions, which have modified the farming areas with a view to improving production yields. The fields in the area are still divided by common oak, ash, maple, false acacia, and elderberry trees, also used to delimit their confines, and rows of mulberry bushes (Figure 3-3) introduced in the late eighteenth century with the widespread introduction of sericulture [18]. The spaces thus delimited, closed or semi-closed, include arable land and pastures. Some of the fields are cultivated through conventional farming, but there is also widespread use of conservation agriculture.

Figure 4. Graphic contextualisation of the sample area in the Latisana countryside. The numbered photos, the position of which is given in the superimposed polygon, showing a selection of the variety of linear, spatial, and punctual elements of the landscape, such as (1,2,7) ditches, (3,4,6,11) individual trees, (5) *Typha latifolia*, (8) Fossalon canal, (9) grassy vegetation in the Fossalon canal, (10) artificial canal, and (12) vines interspersed with threshed wheat.

On the other hand, the countryside around Latisana only has land that is farmed conventionally and intensively. As can be seen in Figure 4, and specifically in images 4-1 and 4-6, the conformation of closed fields typical of Plasencis gives way here to open hectares of land with almost no linear or punctual structure which, if present, are natural remains from past ages.

The two sample areas were compared using GIS and remote sensing techniques taking two environmental parameters into account: the presence of linear vegetation elements (hedgerows, field margins, buffer strip, shelterbelts) and punctual ones (stepping stones) (small structures, such as groves, ponds, etc.) [19], and the extent of the practice of conservative agriculture.

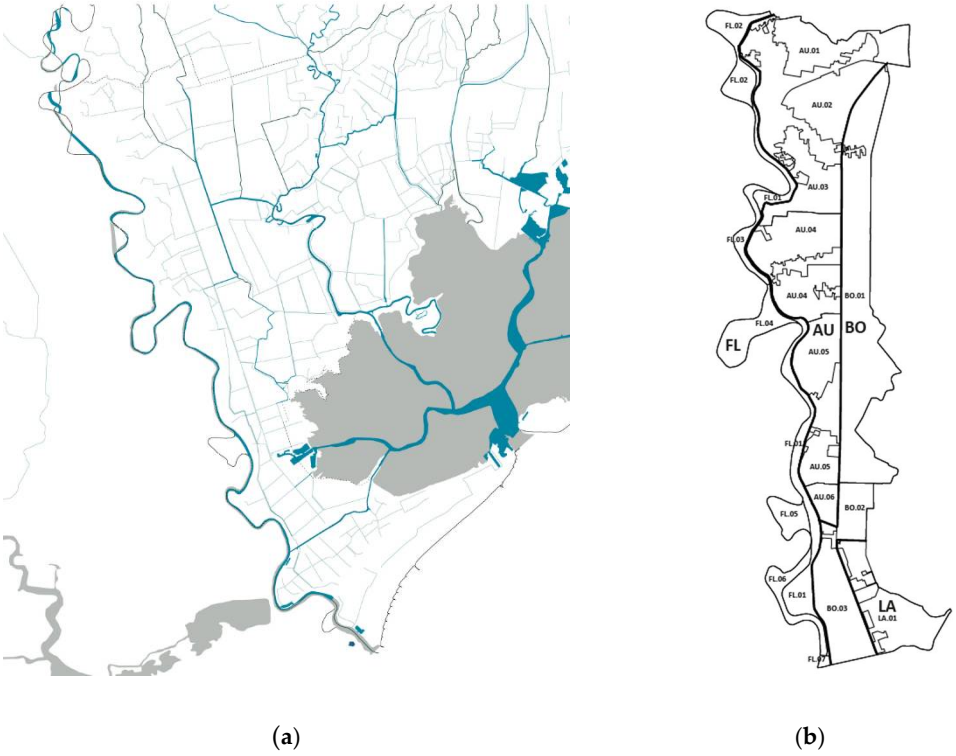
A very interesting opportunity regarding the mapping of the linear and punctual agroecological infrastructures is the increasing availability of LiDAR (Light Detection and Ranging) high-resolution remotely detected data, which enables a three-dimensional representation of vegetation infrastructures to be obtained. In these analyses, LiDAR data freely accessible through the IRDAT-FVG infrastructure (https://eaglefvg.regione.fvg.it) dated 27 March 2018 was used. For calculating the density of these infrastructures, the intensity values provided by the LIDAR images through open source CloudCompare software were interpreted.

For the identification of the areas used for conservative agriculture, we based our findings on optical remote sensing, making use of one of the fundamental characteristics of this cropping technique, i.e., maintaining a permanent soil cover which enables the fields managed conventionally to be distinguished from those managed conservatively. The methodology used is based on the different spectral responses of soil and vegetation in visible and infrared wavelengths. These were then analysed using a temporal series (June 2017–December 2021) of the Inverted Red Edge Chlorophyll Index (IRECI) [20], one of the best indices for estimating Leaf Area Index (LAI) and chlorophyll content in the canopy and in leaves, calculated from Sentinel-2 L2A satellite imagery. The index varies from minus

infinity to plus infinity, with values close to zero for bare soil, gradually increasing in areas with residual crop presence and at higher LAI.

All of the data processing was done using free and open source GIS software (QGIS, SNAP, Google Earth Engine, and CloudCompare).

Hydrographic matrix (Figure 5a):



(**a**) (**b**)

Figure 5. (**a**) The hydrographic network; (**b**) Municipality of Latisana, identifying the Landscape Sub-Units and the Landscape Cells.

The local area has deep roots, detectable in the structure itself, with water, which has a technical role (discharge and irrigation), a historical and testimonial role (the settlement and port origin of all of the inhabited centres along the river Tagliamento), and a landscape value (the riparian corridor of the Tagliamento and the lagoon embankment). The river Tagliamento, the Marano lagoon, the Veneto coastal canal, and the complex network of natural canals and artificial canals resulting from land reclamation are the main environmental and landscaping framework characterising the layout of the land, and specifically the form, structure, and, especially, the settlement origins of the main town (Latisana) and also of all of its hamlets (Pertegada, Gorgo, Bevazzana), including those of more recent construction (Aprili Marittima and Latisana Marittima). The hydrographic network, which has literally designed the urban layout of the Municipality of Latisana, is also one of the main supplies of natural resources in the area.

The landscaping analysis of the area includes the analysis of the physical landscaping units, defined as forms or complexes of forms of the land to which specific geological processes and mechanical, geotechnical, soil, and optimal use characteristics can be attributed. By adopting a hierarchical approach, the Landscape Sub-Units (LSU) of a local nature can be identified: these are areas that are consistent from the viewpoint of the morphological and evolutionary process that distinguish one from the other by the scale of the local area. Four LSU have been identified within the LU, on the basis of the two landscaping matrices of the area around Latisana (Figure 5b):

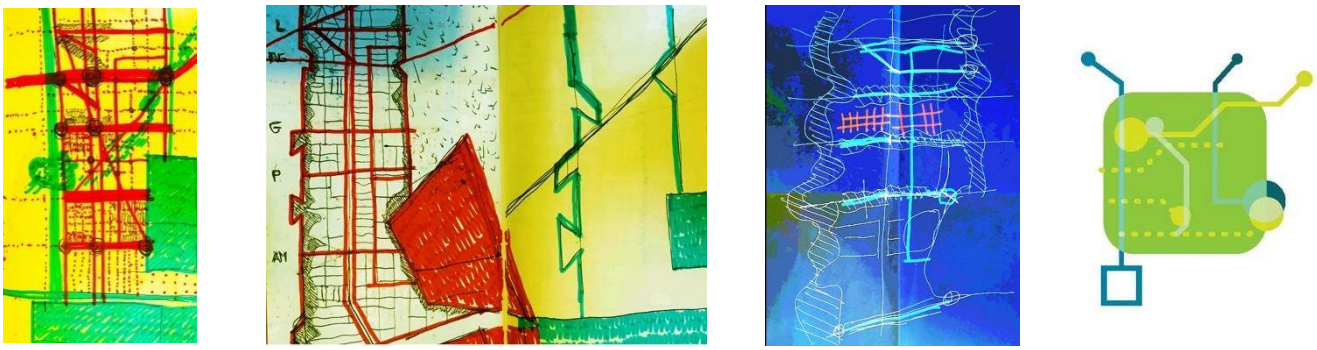
1. River Landscape (FL)
2. Landscape of the Agro-Urban area of Latisana (AU)

3. Reclamation Landscape (BO)
4. Landscape of the Lagoon (LA)

3. Results

3.1. Ecopolitana

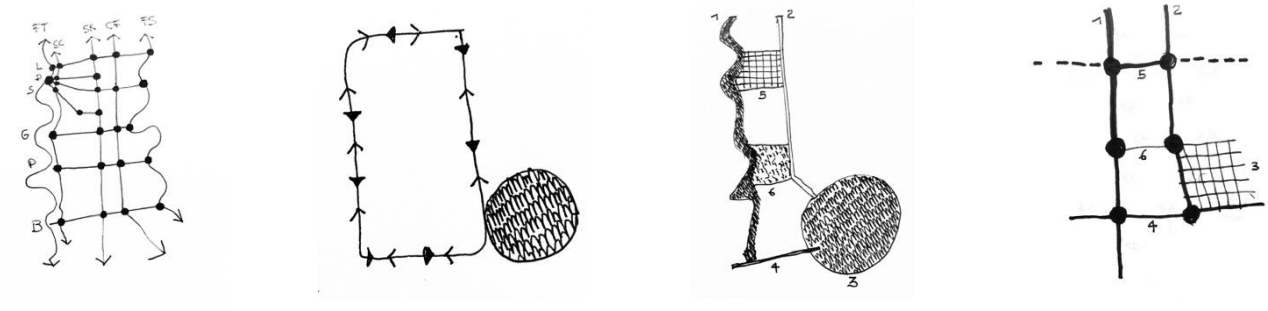
The plan's general idea, Ecopolitana, is based on a figure that is both vision of transformation and process, as well as hypothesis of structure and territory framework (Figure 6). It is a concept whose objective is the construction of a layout that integrates the urban-infrastructural dimension with the landscape-environmental one. "*Using principles is not difficult, and leads to more integrative designs and plans. It helps reduce the landscape fragmentation and degradation so evident around us*" [21].



(**a**) (**b**) (**c**) (**d**)

Figure 6. Ecopolitana concept images: (**a**,**b**) first studies that summarise the structure and function of Ecopolitana; (**c**) Ecopolitana structure diagram; (**d**) Ecopolitana logo.

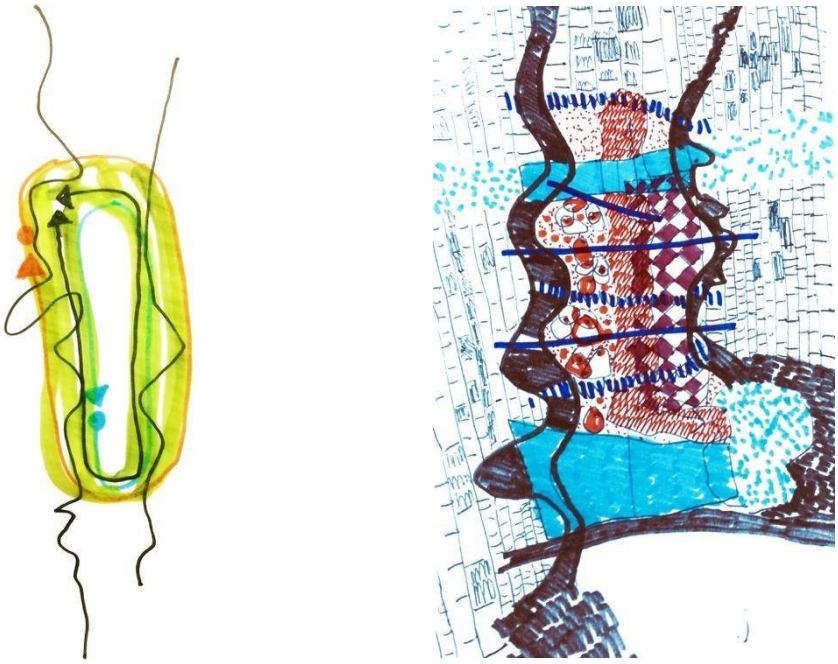
Ecopolitana is an idea of city and of territory that is structured firstly on natural systems, and only secondly on infrastructural and settlement ones. It is a concept that utilises ecological networks as looms and organises the connection and sustenance relationships on transport infrastructure or on economic and energetic infrastructure: design (the city) with nature [22]. "Redesign the territory with nature", in this presented case study, has meant utilising the environmental systems (woodland, fluvial, agrarian, etc.) as territorial figures and urban form [23] (Figure 7). Hence the use, in the planning general process, of the "environmental figures" of the Local Ecological Network (Rete Ecologica Locale REL), that are the corridor (environmental), the node (core-area), the filter (buffer-zone), and the spot (stepping stones) as behaviours of the new territorial structure (natural systems, settlement systems, infrastructural systems, etc.) of the new connective structure between countryside and inhabited centres and of the reorganisation of the functions (inhabited centres, countryside, productive areas, touristic and attractive areas); and of the relations between natural systems (rivers, lagoon, waterways, riparian woods, etc.) and settlement systems. These figures then, find different project forms inside Ecopolitana, declined as park, from the extra urban scale (theming of the territories) to the urban one (ground design, public spaces, urban greenery), as both implementation instruments (regulations, technical standards, and abacus), and territorial configurations and delimitation of areas (theming and zoning).



(**a**) (**b**) (**c**) (**d**)

Figure 7. Diagrams of the environmental components as "territorial figures" of the Ecopolitana: (**a**) nodes and corridors that constitute the environmental network and the new urban structure; (**b**) the ring corridor (Fi.La.Re. network) and the Marano Lagoon node (core-area); (**c**) nodes, corridors filters and spots: the components of the environmental/Ecopolitana network; (**d**) functioning principal of the Ecopolitana on nodes and corridors.

Ecopolitana is a large green infrastructure, a sort of "green subway" (Figure 8), made up of lines (corridors and ecological transects) and stations (core-area, hot-spot, and areas of high naturalistic value) that will connect all the range of landscapes (parks). Ecopolitana will, this way, guarantee the capillary connection of the territory, of the landscape patterns [24], the mending of all those rural clusters that are currently the cause of the ecologic discontinuity, and of the high level of environmental fragmentation [25] of the land mosaic of Latisana.



(**a**) (**b**)

Figure 8. Diagrams of Ecopolitana as green infrastructure and as a settlement-territorial loom: (**a**) "green ring" that connects the Tagliamento river and the Stella river and becomes environmental structure: large ecological corridor of general connection; (**b**) the "green subway" constructed from the network systems of rivers, ecological transects on rural fabrics, "forest of Latisana", core-area of the Marano Lagoon, settlement systems of inhabited centres, and infrastructural network.

The Ecopolitana, then, proposes itself as an ecological concept [26] and at the same time as a structural outline.

On the vast scale (intercommunal) it is a large green infrastructure that is a naturalistic skeleton, placed between two important rivers to the east and west, and the lagoon to the south, with a central ridge (the Fossalon canal), and a secondary system of transversal corridors, which serves as connections between the two rivers that "bind" the whole landscape unity (Figure 9).

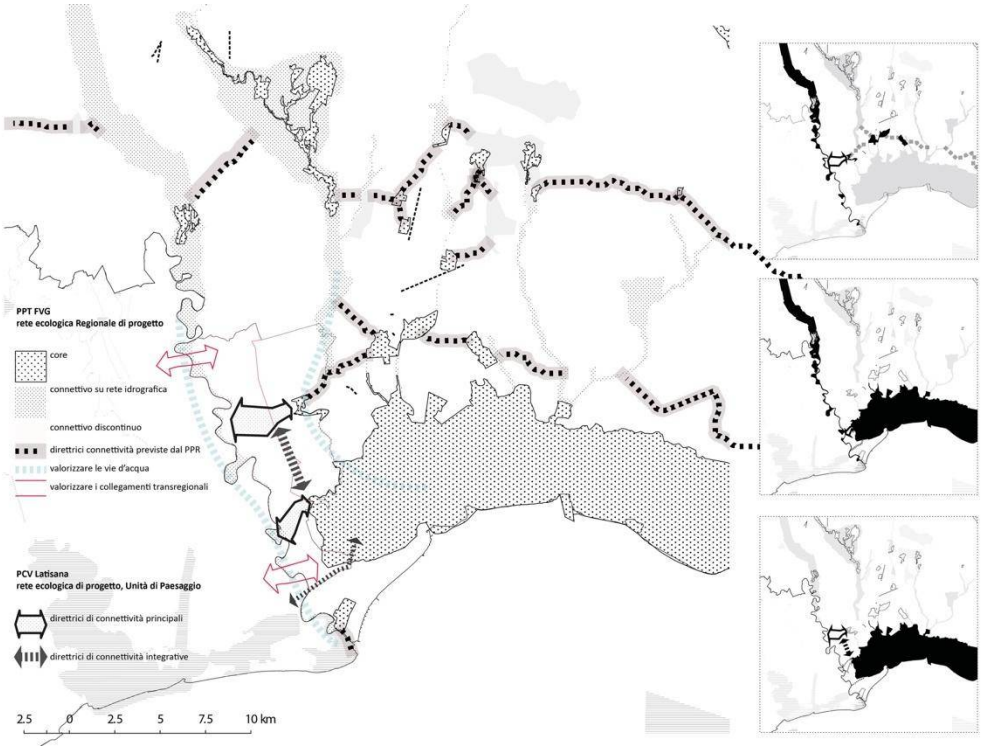


Figure 9. Local Ecological Network foreseen by the Ecopolitana in relation to the RER, Regional Ecological Network, wide area relationships with nature's macrosystems (Marano Lagon, Tagliamento river, "boscovia", regional corridor along the lagoon eaves) and the main and secondary lines (diagrams on the left).

On the local scale (municipal), it is an environmental infrastructure, but also a landscape one, conformed as a large green ring (primary structure) made up of linear connectives on hydrographic networks and from rural connective fabrics (mainly reclamation campaigns), to which it attaches a capillary green network (for ecosystem services [27–31]) spread over the whole territory (Figure 10).

Ecopolitana is also a development perspective for the municipal area of Latisana towards the green city model [32], which finds its structural reasons for reorganization (strategy of the plan), functional for use (environmental zoning of the plan), relational of conformation and evaluation (instruments for plan implementation) in systems of nature. The structure of the Ecopolitana is constructed from the Local Ecological Network. The zoning finds its development in landscape systems, through the three parks (Figure 10d) and the definition of the qualities and characteristics of the public space and of mobility is articulated through the five typologies/areas of the urban green and the large ring constituted by the net "Fi.La.RE" (the green ring).

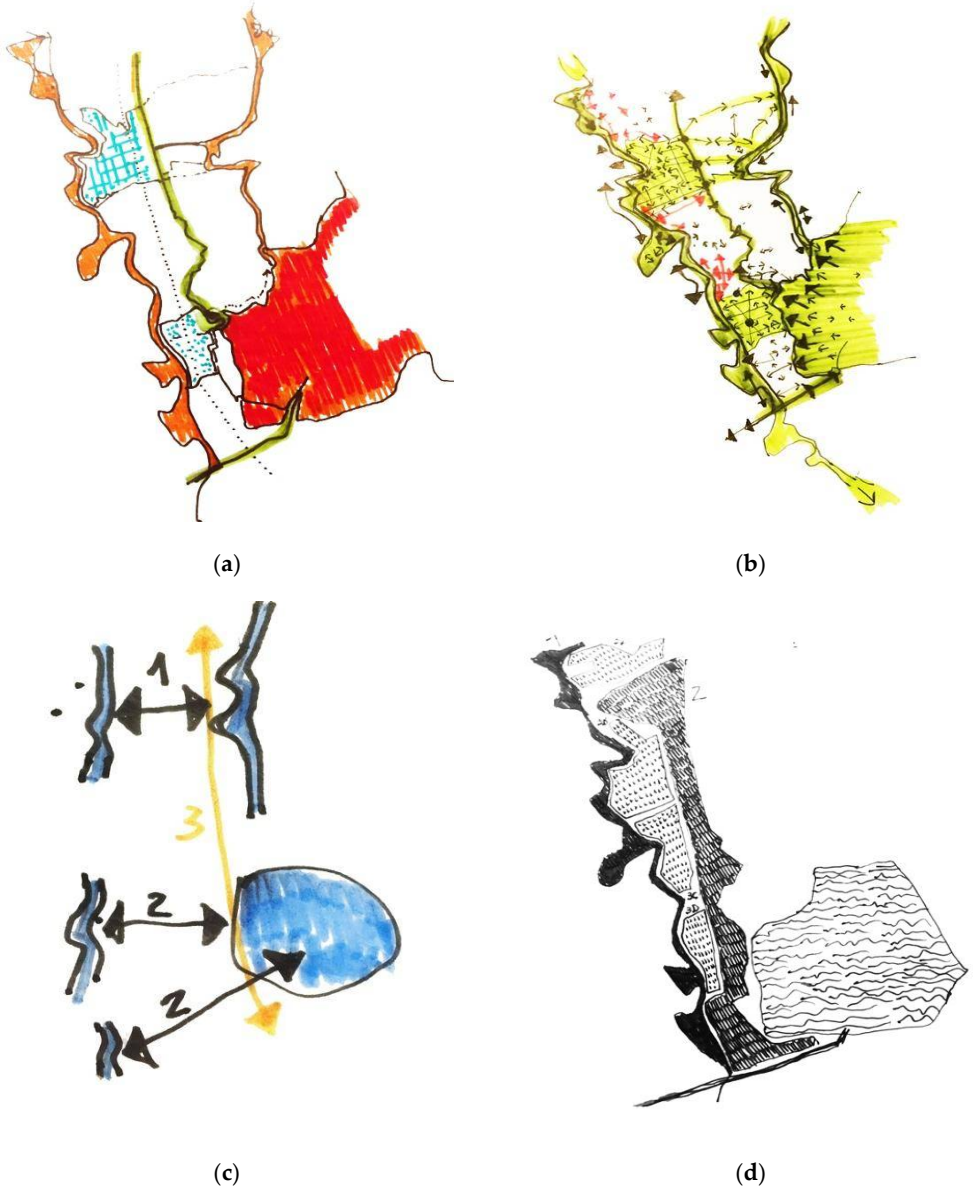


Figure 10. Local Ecological Network foreseen by the Ecopolitana: (**a**) structure of the local ecological network—REL—on the Unity of landscape; (**b**) schematisation of the ecosystemic functioning and of the target lines of the Local Ecologic Network—REL; (**c**) primary structure of the REL: 1. diffused corridor on agricultural fabric between the Tagliamento River and the Fossalon canal, 2. diffused corridor on agricultural fabric and continuous corridor on hydrographic network (Litoranea Veneta) between the Tagliamento River and Marano Lagoon (core-area), 3. new continuous corridor on hydrographic network: Fossalon canal); (**d**) landscape systems functioning as "pattern" or "ecological patch" for the ecological network: river landscape, agro-urban landscape, agricultural landscape of reclamation, lagoon landscape.

Ecopolitana develops five themes: Waters, Agriculture, Urban Green, Landscape Ecology, and Tourism network. The first three of these five themes are linked to the landscape matrix that characterises the territory of Latisana: Local Ecological Network and the territorial Parks (Figure 10).

The new environmental framework (Figure A1, Appendix A) affects macrosystems of nature, reclamation water networks, canals, river banks, and agricultural sectors: 1. the reclamation campaign; 2. the collector channel Fossalon; 3. the rural territory between Paludo and Gorgo; 4. the countryside between Pertegada and Maritime Aprilia; 5. the

river banks and the riparian areas of the river Tagliamento; 6. the Litoranea Veneta channel; 7. the agricultural lands between Gorgo and Pertegada; 8. the agricultural territory between Pertegada and Bevazzana; 9. the embankment of the Marano Lagoon.

3.2. The Ecopolitana as Territorial and Landscape Asset

In line with the theories of Landscape Urbanism [33], the realization of the New Environmental Framework (REL) [34] will also constitute the new urban, territorial, and infrastructural anatomy that will accompany the future settlement dynamics through the realisation of the three territorial parks and of the 100 interventions on urban green areas.

The new overall territorial structure envisages the enhancement of a widespread nature that exploits the fluvial corridor of the Tagliamento and the Marano Lagoon placing them in a system with the still weak, but extensive, potential environmental fabric (ecopatch), consisting of the agrarian matrix and the capillary hydrographic network of reclamation (Figure 11). This environmental matrix develops according to three dimensions: morphological, functional, and perceptive.

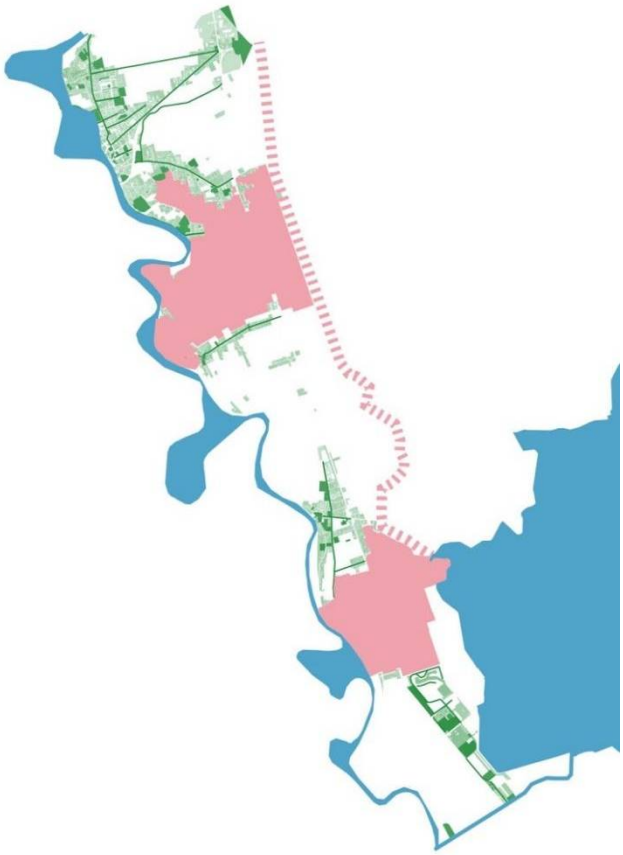
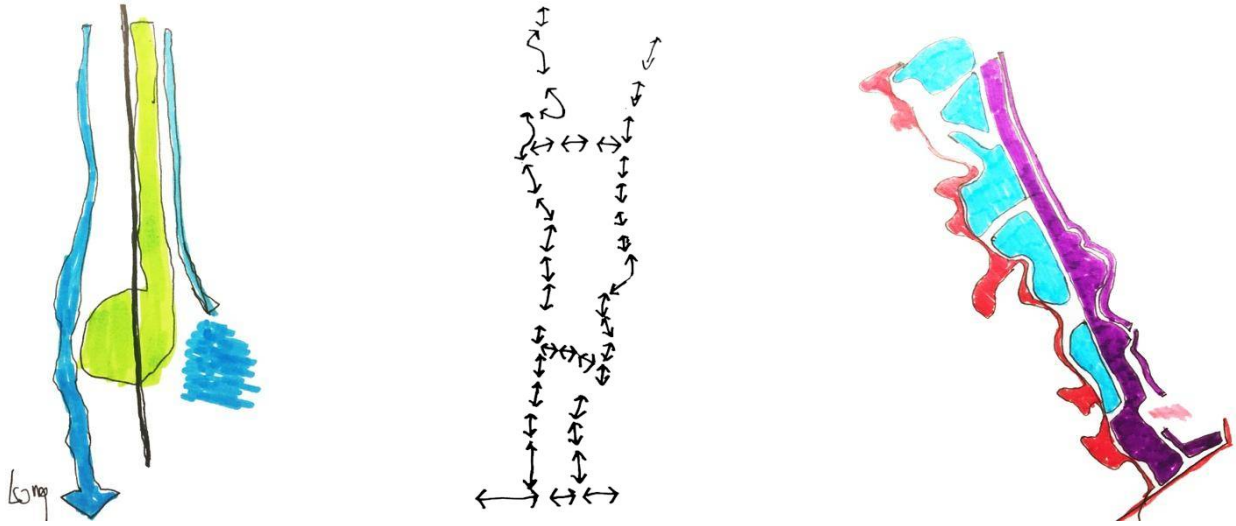


Figure 11. The new environmental and territorial framework is set on the integration of the extra-urban ecological network (in pink) and on the eight urban ecological networks (in green).

1. Longitudinal arrangement (north-south). Corridors and connectors: the interventions on the enhancement of the hydrographic network and on configuration of the three territorial parks (Figure 12c) foresees a north-south reorganization of the territory according to three parallel and continuous bands, increasing the sliding relations [21] (Figure 12b) and the connection between north and south; "terragrams" (Figure 13), continuous and homogeneous systems in which the "spacial patterns" are closely connected with ecological systems, and in particular, for movement of all species. This arrangement originates from the natural morphology with "parallel bands" (Figure 12a) and from the "peninsula", geographic structure of the territory, which is the "corridor landscape sequence" of the three parks. These three "bands" are three large tools for the homogeneous diffusion

of naturalness and an increase in biodiversity: "*Biodiversity and mobility of species can be increased by creating corridors or sinks (i.e., small patches) between patches*" [35].



(**a**) (**b**) (**c**)

Figure 12. North-south longitudinal structure: (**a**) system of three homogeneous and continuous bands; (**b**) sliding relations in the three longitudinal bands; (**c**) system of territorial parks (River Park, Agro-urban Park, Bonifica Park) set on the three longitudinal bands.

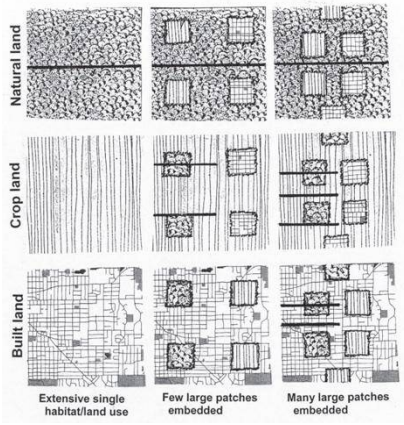


Figure 13. "Terragrams" Forman, 2013.

2. Transverse structure (east-west). Stepping stones and patterns: the "room" configuration (Figure 14) of the agro-urban park and the two ecological corridors spread east-west (Figure 15) aim to reverse the current transversal fragmentation of the habitats, which over the years has increased due to the compartmentalisation caused by the traffic volumes of the SR354 regional road. However, starting from the fragmentation of the different landscape fabrics and cells that function as patterns, it will be possible to build a new ecosystem connection organism [36], which will also be followed by the infrastructural and later settlement system. In line with the forecasts of the Regional Landscape Plan FVG, the Ecopolitana foresees two large transepts, which function as stepping stones, which have the aim of mending (through the eco-patterns) the environmental and landscape east-west split, (Figure 14). This reorganisational prevision will also constitute new possibilities of east-west relationships for the whole territory, connecting the great systems of naturalness (Tagliamento river, the Stella river, and Marano lagoon) (Figure 15).

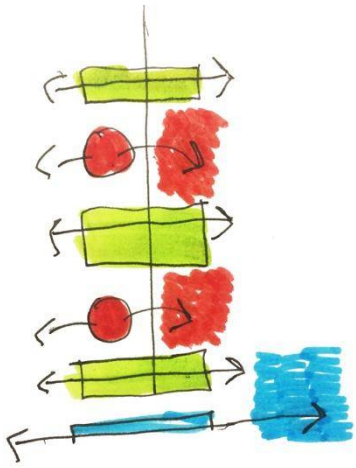


Figure 14. East-west transversal structure of the diffused corridors (stepping stones and eco-patterns).

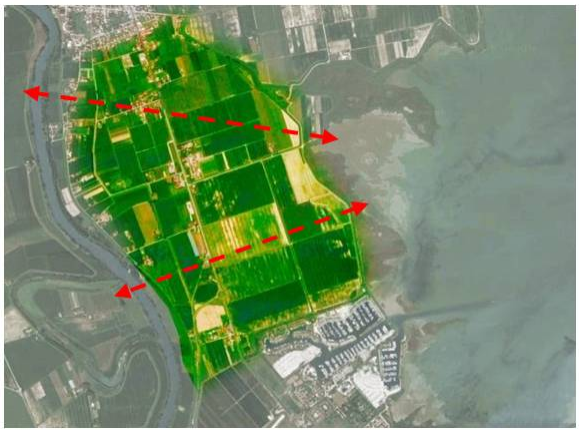


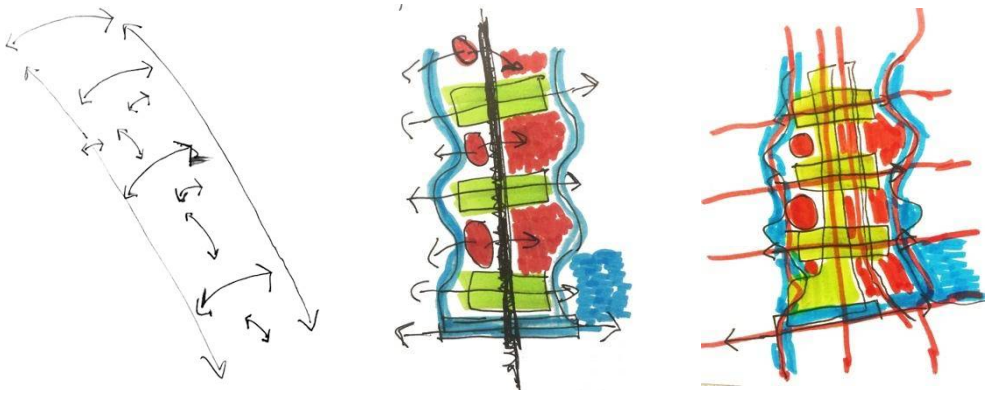
Figure 15. Example of one of the diffused corridors (stepping stone): corridor 2 located south of the territory that connects the Marano lagoon with the Tagliamento river.

3. Overall territorial structure: the integration of the two previous primary "linear" structures (Figure 16a) will lead to the formation of a more complex structure, made of a "net" (Figure 16b,c): the green network of the Ecopolitana. This new overall structure will give rise to a new functioning of the nature systems, more capillary, but also more structured, from which a new landscape quality can develop on the recovery of the main matrices that characterise this Landscape Unit:

Level 1: environmental frame: structure (Figure 17a)
Level 2: system of the three territorial parks: areas (Figure 17b)
Level 3: urban green and "figures": landscape system (Figure 17c)

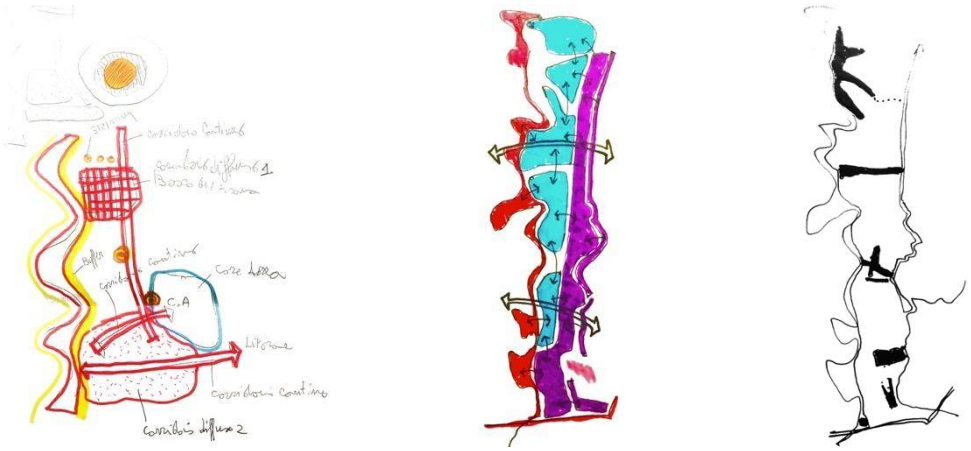
The Ecopolitana as a "figure" of the new overall territorial structure is implemented through four systems, which also organise all the detailed projects envisaged by the plan. The four systems are:

- the new local ecological network (REL)
- the Fi.La.RE ring, a slow mobility network and greenway system
- the urban green and the eight ecological networks
- the three territorial parks



(**a**) (**b**) (**c**)

Figure 16. Overall "network" territorial structure: (**a**) new connection lines; (**b**,**c**) Ecopolitana green network.



(**a**) (**b**) (**c**)

Figure 17. Overall "network" territorial structure: (**a**) The landscape framework; (**b**) Three landscapes: river, agri-urban, agri-drainage; (**c**) The settlement systems.

3.3. REL, Rete Ecologica Locale

Ecopolitana introduces a method not exclusively for the protection and enhancement of existing resources, but for the definition of an new ecological and landscape network, by building new corridors where they are lacking today [37] (Figure 18). This will constitute a landscape-environmental frame aimed at characterising the entire structure of the open space, contributing as much as possible to the formation of the RER [38], and also directing local urban planning towards a vision more ecological [16].

The structure of the local ecological network introduces elements of protection and enhancement and totally new elements that will have to deal with a scarcely connective context; each component *(core area, corridors, stepping stone, etc.)* will, therefore, be characterised by specific modes of operation in relation to the estimated ecosystem services.

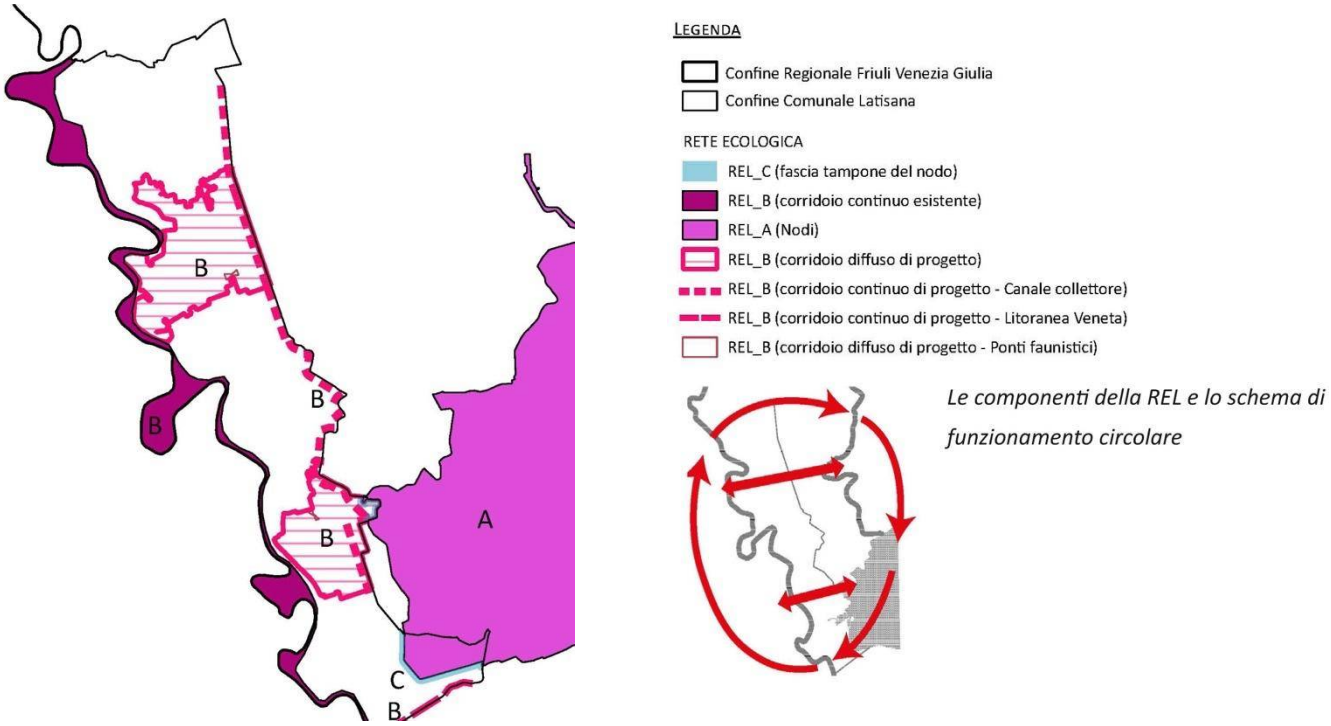


Figure 18. Diagram of the new REL, Local Ecological Network: components and operations.

The REL construction strategy first of all foresees the conformation to the RER confirming:

- the Tagliamento as connecting corridor on the hydrographic network;
- the Lagoon as Core Area;
- the corridor suggested on the regional scale (bends of the Stella river—bends of the Tagliamento river);

And adds a further corridor to exploit the mutual proximity between the Tagliamento River and the Lagoon, and, therefore, connect an effective core-area (the lagoon) with an area that is not currently defined as such, but has the environmental characteristics to become one.

The two diffused corridors planned in the east-west direction represent the main lines of connectivity.

Also foreseen are:

- an integrative connectivity route, in a south-north direction, which connects the lagoon with the main corridor to the north, to be built along the drainage canal (Fossalon canal—Figure 19) on the border between Latisana and Precenicco;
- a secondary integrative route is also to be built along the Litoranea Veneta (corridor on a hydrographic basis).

This way, the REL composes a frame structure (Figure 19), with circular operation in every direction (Figure 18), which maximises—given the scarce existing connectivity—the potential local ecological connectivity in relation to that of the regional scale [39].

3.4. The Three Territorial Parks

All the necessary interventions for the territorial and landscape reorganisation described in the previous paragraphs are organised by means of the three territorial parks (Figure 20). Within the municipal area, three homogeneous areas have been identified in terms of formation, landscape structure, settlement, and functional characteristics: the Bonifica Park, the Agro-Urban Park, and the River Park.

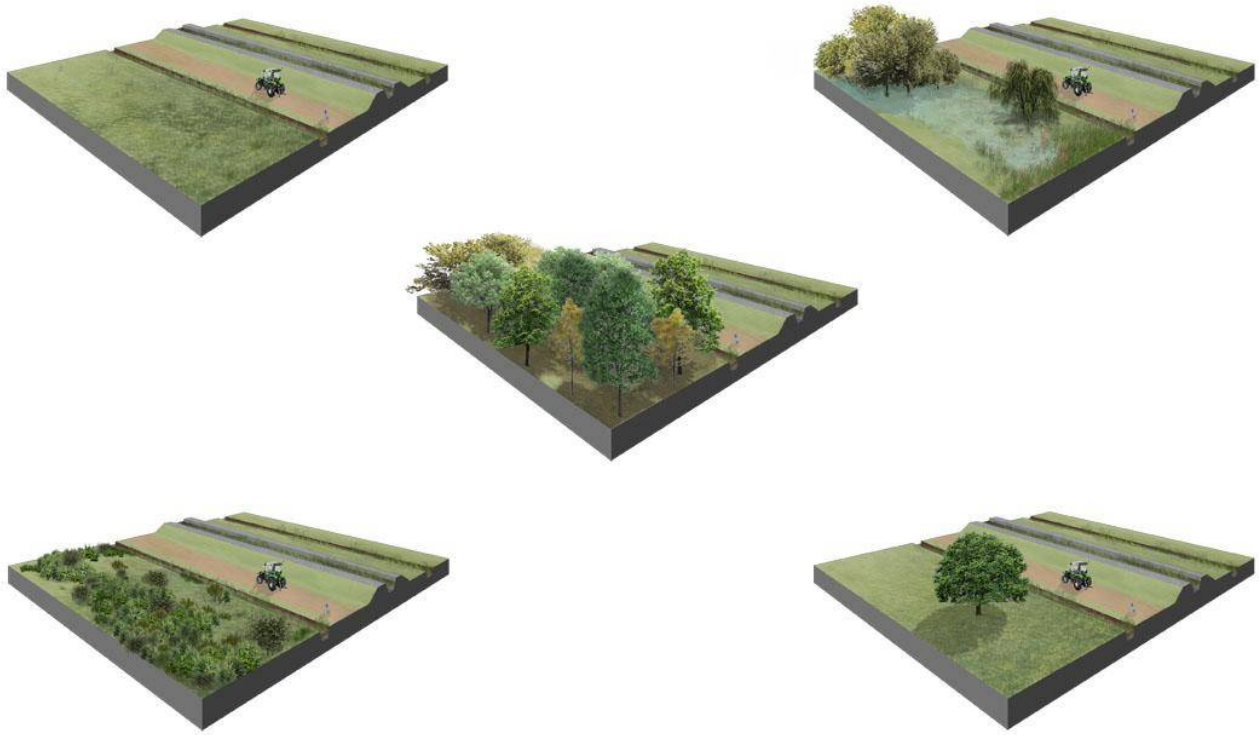


Figure 19. REL, Local Ecological Network: photo simulations of the minimum environmental units for the formation of the continuous corridor on the hydrographic network along the Fossalon canal.

The "park" constitutes the territorial unit of reference and the instrument of territorial governance in order to achieve the objectives set by the Ecopolitana:

- enhance and develop the landscape and environmental dimension of the territory;
- contribute to the construction of the Local Ecological Network (REL);
- implement interventions and activate use practices related to the environment and landscape as attractors;
- characterise the territorial areas with themes linked to local productions or landscape excellence;
- to encourage the economic, touristic, and socio-cultural development of the area, the territorial parks will be created through specific projects that will enhance its peculiarities related to water (Figure 21) or to agriculture, into thematic categorisations, working on territorial marketing to develop new economies, productions, and hospitality.

3.5. The Fi.La.RE, Slow Mobility Network and Greenway System

Introduced primarily as a solution to the problems related to urban traffic congestion, over time, slow mobility has taken important values, referring to the use of the landscape, leisure, physical wellbeing, and cultural education.

The project of the large territorial ring of slow mobility, called "Fi.La.Re.", contains the layout of the cycle network within the municipal area, along the perimeter), as well as the interventions and objectives envisaged by the Ecopolitana (Figure 22a):

- integrate the network of the planned cycle paths with landscape projects;
- enhance the attractiveness of the cycle network in relation to the landscapes (Figure 23);
- connect the network with the Local and Regional Ecological Networks, and with the circuit called "Boscovia";
- The large ring "Fi.La.Re." develops the following interventions:

- incorporates the ReCIR (Regional Cycle Network), completes the overall circuit, integrating it with two new important sections at the local level: the cycle path of the Collector Channel (Canale Collettore) and that of the Litoranea Veneta;
- integrates the network of municipal cycle paths into the system of the three territorial parks, foreseeing rest areas, information systems, connections with the waterways (Figure 22a);
- builds sections of cycle paths like greenways, to contribute to the landscape valorisation of the territory and to the recognisability of the routes;
- activates a territorial marketing process (Figure 22b) for diffusion of the Ecopolitana project, through the definition of a logo for the name Fi.La.Re.

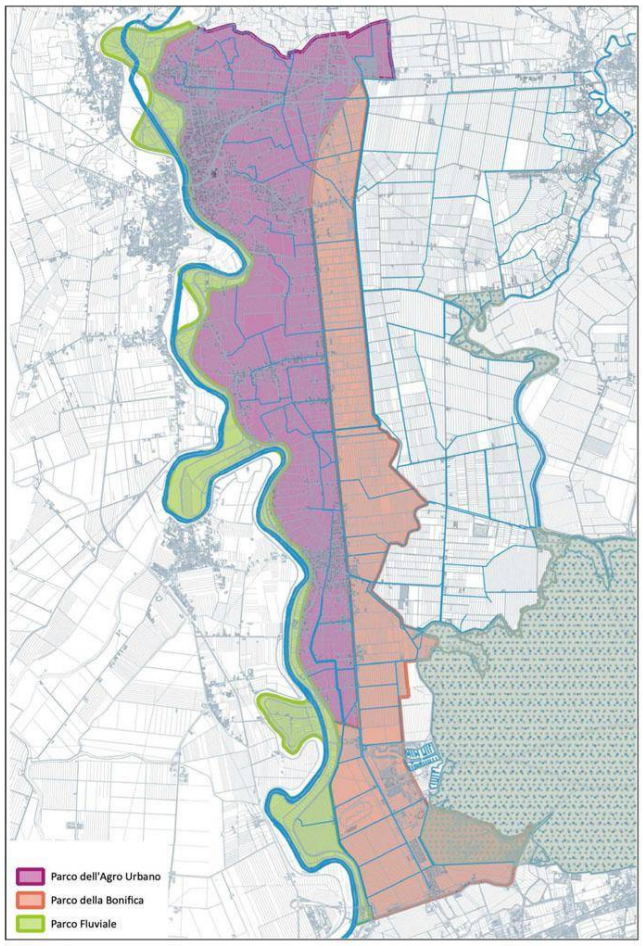


Figure 20. System of three territorial parks: (left) River Park, Agro-Urban Park, Bonifica Park.

3.6. Urban Green and the Eight Environmental Networks

The urban green system identified by the Ecopolitana involves the eight inhabited centres of the Municipality of Latisana (Figure A2, Appendix A) and organises the entire landscape and environmental system in "structural green", the one aimed at creating the ecological network (Figure A3, Appendix A), and in "scenic green", (Figure A4, Appendix A), the one that contributes to the construction, definition, and characterisation of urban scenes and public space.

Ecopolitana, in line with morphotypes identified in the analysis phases, plans the Urban Ecological Networks of each urban centre of the municipal area. Specifically, the Ecopolitana assumes the structure of the private urban green as a basic structure (latent landscape) completed by that of the project of the public urban green. The result is an autonomous structure, for ecosystem services, for environmental continuity, and for landscape layout: the Urban Ecological Network (REU). The system of the eight Urban

Ecological Networks (one for each inhabited centre) constitutes an important step in the completion and stabilisation of the Extra-Urban Ecological Network. Together they form the Local Ecological Network of the Municipality of Latisana, which in turn is a piece of the Regional Ecological Network (RER), and in particular of the great east-west ecological corridor along the low Friuli, Isontina plains, and lagoon eaves.

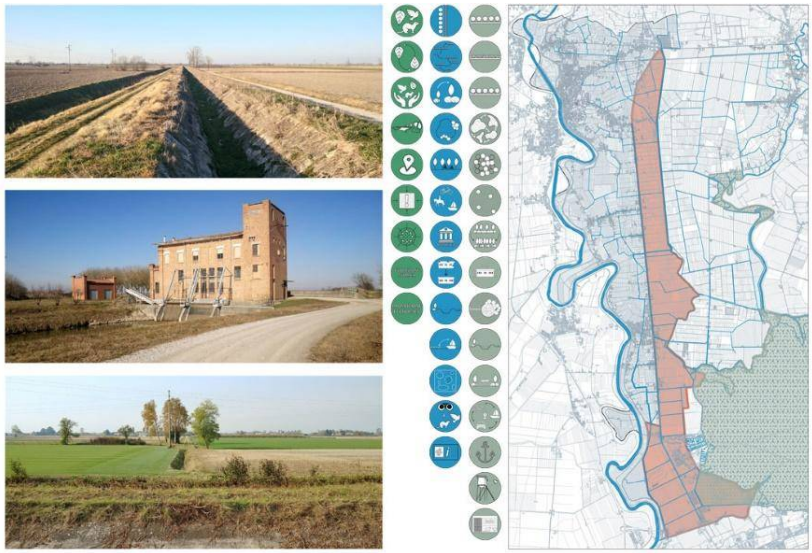
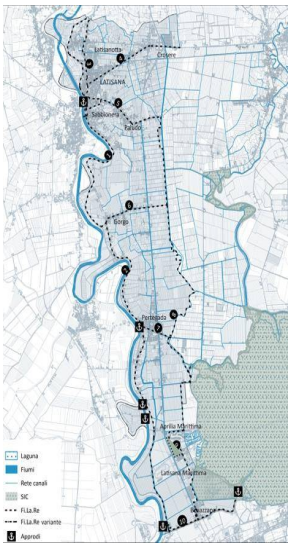
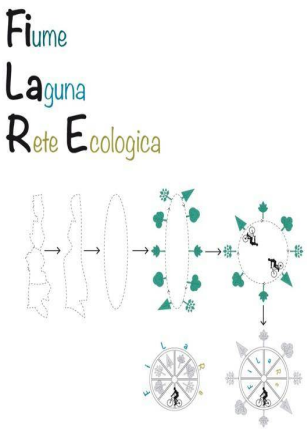


Figure 21. Images of Bonfica Park with the building of the Idrovora "Lame", which will become the visitor's center and the museum of the park.



(**a**)



(**b**)

Figure 22. Slow mobility ring "Fi.La.Re.": (**a**) diagram of the Fi.La.Re. path; (**b**) logo, logotype, and first indications for the coordinated image of the "Fi.La.Re." for territorial marketing actions.

Figure 23. Abacus of landscapes crossed by the ring of slow mobility "Fi.La.Re." foreseen by Ecopolitana.

The general strategy of the Ecopolitana for urban greenery foresees the creation of east-west (from the Tagliamento towards the interior of the territory) continuity systems of ecological landscape (urban) through linear ecological corridors and widespread urban corridors, continuous and, in some cases, discontinuous, (according to the "stepping stones" model) essentially constituted by the sequence of environmental tiles formed by parks and gardens, green areas pertaining to buildings, road rows, and flower beds (Figure 25). For the formation of these frames, the private gardens of residences and buildings were also considered (Figure A1 Appendix A), which still provide an ecosystem service and, in many cases, play an important role in ecological training and structure for the landscape layout of each individual urban centre (Figure A3 Appendix A).

Ecopolitana organises urban green in five sections, types/areas of intervention, and each section is located in the eight urban centres, within which the 96 interventions are located (Figure A2 Appendix A). The five types/areas with which the interventions are organised are:

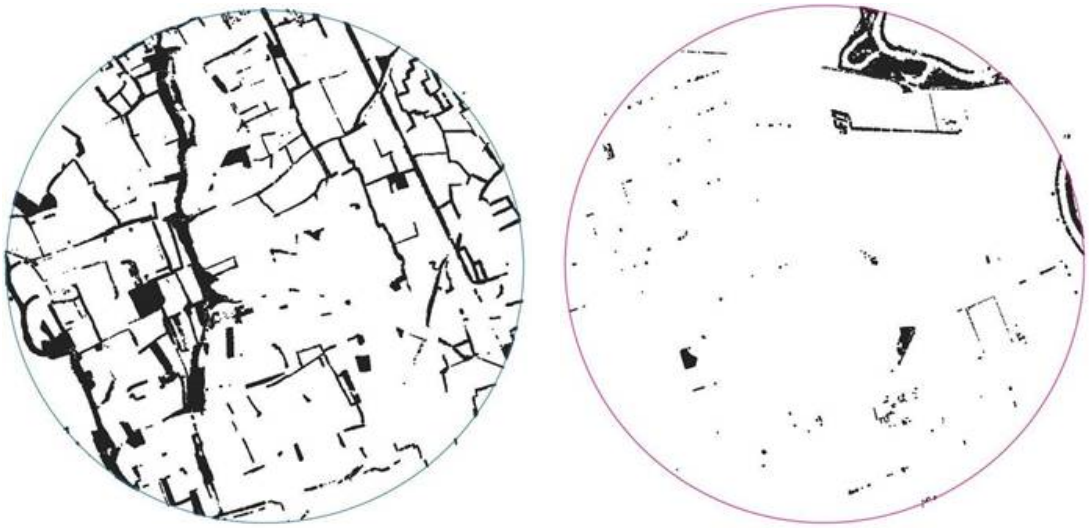
- road green: the 19 areas are mainly made up of rows of trees along the street networks, whose main purpose is to stabilise the internal structure (and scenic green) and to create ecological continuity with the Extra-urban Ecological Network.
- gardens, parks, and public green areas: this type involves 23 sites including parks and gardens. These are equipped green areas with an explicit function as dedicated space for public and community use.
- green spaces belonging to public buildings (31 sites): this type involves all green areas belonging to public buildings, which often have a limited public not always explicitly dedicated to open collective use. It is, therefore, a public green that is not always equipped, but given the location, the numerosity (31 sites), and the arboreal heritage present, it has an important consolidation function for urban corridors.

- areas of expansion and completion subject to unitary planning (17 zone): Ecopolitana, within the Urban Green scope, addresses the solutions for the "standard or assigned green" of all areas subject to implementation planning. The objective of Ecopolitana is to insert the 17 interventions of the related "strategic" sectors in an overall framework for the formation connection nodes between the Extra-urban Ecological Network and the Urban Ecological Network.
- "strategic" unitary projects: a determining role, on different scales and areas is assumed by the "Strategic unitary projects" foreseen by the Ecopolitana, as they are environmental nodes of connection with the Local Ecological Network, but also with the most important landscape and naturalistic systems of the territory, such as the Tagliamento River or the Litoranea Veneta. All six cases foreseen by the plan play an important urban role with respect to the settlements, the urban functionality, the local mobility, the provision of public space, and overall accessibility to urban centres.

3.7. Detailed Analysis: Ecopolitana and the Agricultural Fabric

In line with the purposes defined by Ecopolitana, the following are the results of the comparison made between the current state of the Latisana countryside and the sustainable farming ecosystem already in place in the Plasencis countryside.

As can be seen in Figure 24, the agro-ecological infrastructures within the sample area of the Plasencis countryside are visibly more consistent and numerous compared to the Latisana countryside. They cover a surface area of 65.8 ha out of 676 ha of farming land, which corresponds to 9.7% of the total surface area examined. The fields declared by IRDAT-FVG to be used for conservative agriculture, illustrated in Figure 25 for the Pasencis area only, constituted 14.9% of the sample area, covering a total surface area of 100 ha. As a result, 24.6% of this area is formed by natural and semi-natural elements and by "sustainable" soil.



(**a**) (**b**)

Figure 24. (**a**) Vectoral representation of the linear and punctual elements of the "Plasencis" sample (**b**) the "Latisana" sample, obtained by processing the LiDAR data.

Figure 25. Vectoral representation of the fields declared to be used for conservative agriculture in the study area located in the Plasencis countryside (https://eaglefvg.regione.fvg.it).

However, the linear and punctual infrastructures within the sample area of the Latisana countryside (Figure 25) only covered 11.2 ha out of a total surface area of 676 ha of agricultural land, in other words 1.7% of the entire area analysed. Furthermore, the vectoral data made available by IRDAT-FVG showed that there were no fields in the area used for conservative agriculture. This portion of the municipality of Latisana is characterised by an agricultural production fabric oriented towards the intensive cropping of semi-native plants and shows both a strong vulgarisation of the covering vegetation and the sporadic presence of natural formations.

Figure 26 shows the logarithmic scale trends of the IRECI index referring to the period July 2017-December 2021. The orange line shows the trend of the index within a parcel managed through conservation agriculture in the Plasencis countryside, while the blue line shows that of a plot cultivated with conventional techniques in the Latisana countryside. The distinction between the two methods of agricultural management is based on one of the fundamental characteristics of conservation agriculture, i.e., the maintenance of a permanent soil cover with crop residues or cover crops, taking advantage of the fact that soil and vegetation reflect incident light differently.

The logarithmic scale allows for a better appreciation of the differences in the index during periods of time (usually the winter months) when conventionally managed fields remain devoid of crops (bare soil), while conservation fields have a layer of vegetation cover, which preserves soil fertility between one profitable crop and the next, as well as providing a range of ecosystem services that are vital in terms of maintaining the agricultural ecosystem [40].

In fact, the blue curve shows IRECI values close to zero for most of the winter period, indicating a permanent persistence of bare soil, with all the related ecological problems [41]. In contrast, in the winter months the orange curve shows consistently higher index values.

The highest values of IRECI, recorded mainly during the summer period, represent, instead, cash crops, such as *Glycine max*, *Zea mays*, or *Sorghum bicolor*, typical at these latitudes in Italy, or summer cover crops, often a mixture of leguminous or graminaceous plants.

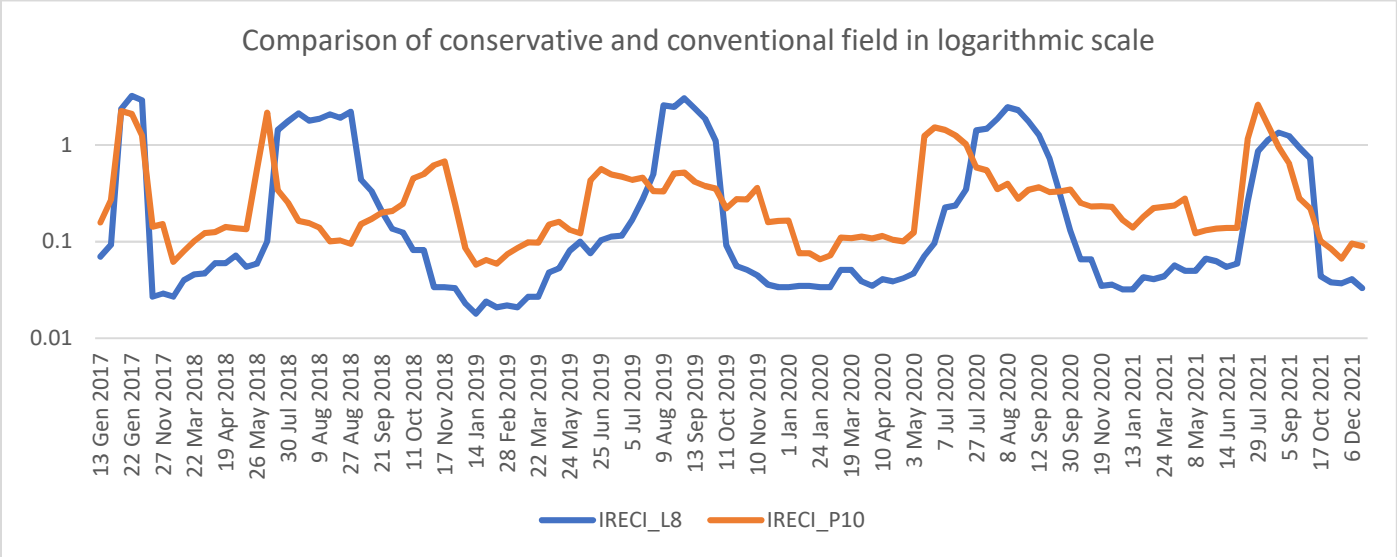


Figure 26. Logarithmic scale trends of the IRECI vegetation index referring to the period July 2017–December 2021 on two plots of land: one used for conservative agriculture (P10) and one used for conventional agriculture (L8).

4. Discussion

If we consider the strategy developed and the various technical solutions implemented by the Ecopolitana plan, we can say that the set of results to which the scientific and operational objectives of the working group were aimed has been achieved. As a whole, this article constitutes a very useful case study with technical and scientific solutions for the planning of ecological networks in contexts of high ecological fragmentation, valid not only for the area of Latisana. On the contrary, this study can serve as a guideline for the drafting of other green plans, as it presents a "methodology" applicable to other contexts and environments. We believe that the result obtained is useful to make up for the current lack, in Italy, of legislation and tools for the definition and implementation of green plans.

Both the strategic, operational, and analytical part of the Ecopolitana plan aim at the construction of an environmental continuity integrated with the landscape and urban reorganisation, using configurations that favour the increase of biodiversity and biopermeability as a technical-scientific solution that responds to the problem of fragmentation of the territory (a very common case in Italy, especially in the North, in that territory defined by Eugenio Turri as "the Padana Megalopolis") [42].

At the base of all the analyses was the Landscape Unit, the first important methodological aspect, while the phase of interpretation of the data and elaboration of the model allowed for the identification of the territorial matrices, another essential element for the elaboration of a "Municipal Green Plan". These two initial phases have thus found various declinations in the resolution of the condition of fragmentation of the territory and have guided the general design (the configuration of parks and the ecological network and the elaboration of specific naturalistic, environmental and ecological solutions) that has served for the reconstruction of the continuity of the landscape unit, both internal and external. The strategic "figure" of the Ecopolitan and the solutions it brings draw a "territorial tessellation" that defines:

(a) the overall consistency of the fragmentation of the territory of Latisana, current, potential trend;
(b) the "parameters" and "figures" useful for describing the relationship between the settlement structure of the eight urban centers and the landscape matrices;
(c) ecological connection units and technical devices to restore landscape and environmental continuity.

Thinking about settlement structures in relation to environmental frames and landscape matrices means identifying the Local Ecological Networks and the landscape system as a tool for governing the territory, defining management policies of inhabited contexts in relation to the countryside, which here occupies 80% of the municipal land (a widespread value in many regions of Italy), but also reprogramming the infrastructural networks, with particular attention to slow mobility as a greenway, and finally planning the future settlement structure and the related regulatory and planning tools necessary to achieve it from the point of view of the ecological footprint.

This is a complex of "actions" that concretely define the way to create, in a context with a low settlement density (recurring case in Northern Italy), of a real green city, within which strategies are applied and projects for sustainable urban development.

Not surprisingly, the recent strategies defined by the Friuli Venezia Giulia Region for green cities refer to the environmental quality of cities as the first priority area of action—in accordance with the targets of the 2030 Agenda and its Global Goals and with the National Strategy for Sustainable Development—with particular attention to the protection of urban and architectural quality, the provision of urban and peri-urban green infrastructures and the development of networks and practices of sustainable mobility.

The Ecopolitana proposes to give concrete form to these requests, in particular to respond to the objectives of prevention of natural and anthropogenic risks through projects capable of strengthening the resilience of the territories, to restore and counteract the fragmentation of ecosystems through the study of more effective "Urban-rural ecological connections", and, finally, to meet the need to ensure the care, sustainable management, and development of the potential of landscapes and the complex of cultural heritages that innervate them.

Another important result of this operational research activity is constituted by the identification of structural figures for the territory, both with respect to the landscape dimension and to the naturalistic-environmental dimension, since they represent the theoretical-operational passage carried out during the journey of work, from the analytical to the design phase. The territorial-environmental figures are linear, areal, and punctual structures (the park, the compact or linear corridor, the diffuse corridor, the cluster, the backbones, the pattern, the ring, and the barrier or filter) that aim to identify "system prefigurations" and "naturalistic-environmental frames" integrated with the settlement structure and infrastructural networks, looking for a synthesis in the landscape matrices to plan the territory in an integrated way and to "designing with nature".

The interpretative figures made it possible to build the interpretative models of the territory. These models are an operative synthesis of the analyses on vegetation, land use, landscape structure, agricultural consistency, ecological corridors, fauna, wood species, lithology, and hydrography in relation to the systems settlements, infrastructures, flows, and urban dynamics.

The interpretative models propose a "design reinterpretation" of the functioning of landscape systems and environmental dynamics, which examines the criticality and potential of the territory according to three dimensions: ecological, landscape, and urban planning. The interpretative models led to the construction of the scheme-structure, which constitutes a possible new environmental framework on which the local ecological network (REL) has been set up starting from the regional one (RER) and at the same time integrates the extension, the forms, and the themes for the landscape sub-areas located within the landscape unit.

The structure-schemes then found a functional (parks, itineraries, and paths, renaturalisation, crops, etc.), naturalistic and environmental (core-areas, hot spots, ecological networks and corridors) declination in defined perimeters and areas (fluvial, agricultural, urban, wooded).

Ultimately, the study presented proposes monitoring through GIS and remote sensing techniques of one of the landscape matrices identified as a methodology capable of helping the body in charge of overseeing the implementation of the Ecopolitana plan.

In this regard, measuring the density of the agricultural and ecological, linear, and punctual infrastructures has proven to be a very interesting landscape ecology index in assessing the structure of the agricultural mosaic [43]. This index has enabled attention to be focused on aspects that do not generally appear immediately in the perception of a specific landscape, proving itself to be effective both in determining its effective "fragility" and also as a "decision-making support" in making management choices. On the basis of this index, the countryside of Latisana has been shown to be particularly vulnerable and fragmented [19], since less than 11 ha of natural and semi-natural elements capable of connecting the area were detected, compared to 66 ha in the sample area of the countryside in Plasencis.

In addition, in assessing the sustainability of the agricultural matrix it was decided to use an economic and fast tool capable of distinguishing between two systems of farming management, conventional and conservative. The latter practice is aimed at ensuring stable and sustainable productivity, at the same time preserving and enhancing the agricultural resources and the environment. Based on the IRECI vegetation index calculated through the processing of Sentinel-2 images (from July 2017 to December 2021), it was seen that the comparison between two conservative and conventional plots of land provides positive results (clear differences) in the time periods when there is a cover crop, usually from October to May, confirming the results of other studies [44].

From the analysed, and in agreement with the goals of the 2030 agenda [2], we have identified conservative practices, combined with integrated fertilisation strategies, crop defence, and the use of water, as the technical foundations on which to construct a sustainable intensification of agricultural production in the countryside of Latisana.

We also believe that it is vital to follow the guidelines suggested in the LGP to construct the ecological network in the same area and encourage biodiversity.

Author Contributions: L.D.F.M., A.A., J.B., F.Z. and A.G. have developed Sections 1, 2 and 4; Adrian Venudo developed Section 3; results and conceptualization, L.D.F.M., A.A. and A.V.; methodology, L.D.F.M., A.A., A.V., J.B., F.Z. and A.G.; software, L.D.F.M., A.A., A.V., J.B. and A.G.; validation, L.D.F.M., A.A. and A.V.; formal analysis, A.A.; investigation, L.D.F.M., A.A., A.V., J.B., F.Z. and A.G.; resources, L.D.F.M., A.A., A.V., J.B., F.Z. and A.G.; data curation, A.A.; writing—original draft preparation, L.D.F.M., A.A., A.V., J.B., F.Z. and A.G.; writing—review and editing, L.D.F.M., A.A., A.V., J.B., F.Z. and A.G.; visualization, L.D.F.M. and J.B.; supervision, L.D.F.M. and J.B.; project administration, L.D.F.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

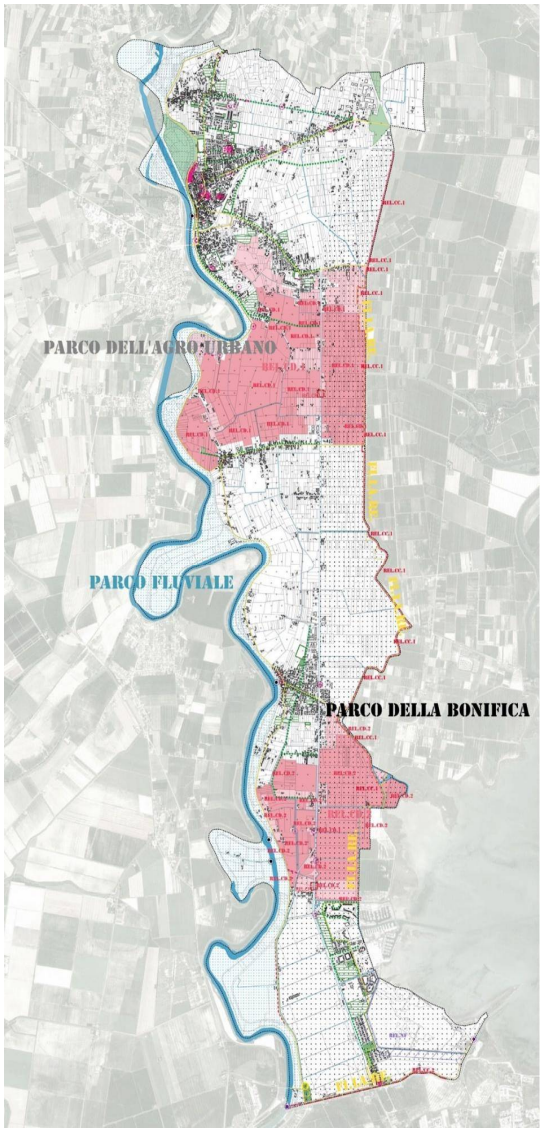

Figure A1. Ecopolitana, new overall structure with the Local Ecological Network (continuous and scattered corridors, nodes, filters, transects), the Territorial Parks, the Urban Ecological Networks and the interventions on the Urban green, the greenway constituted of the perimetral ring (Fi.La.RE. bicycle network).

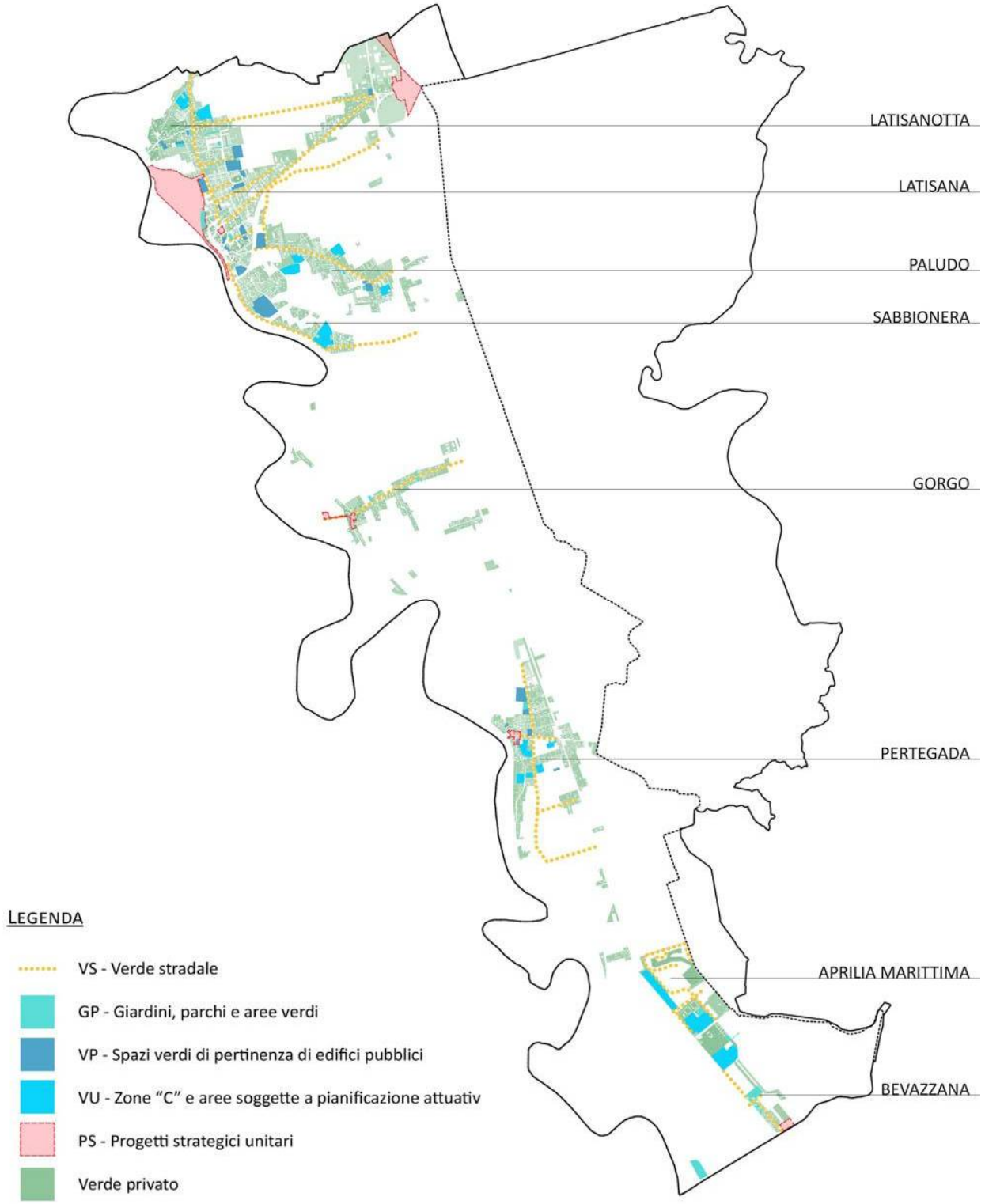

Figure A2. Urban green systems of the 8 inhabited centres in relation to the five types/areas of intervention for the formation of Urban Ecological Networks.

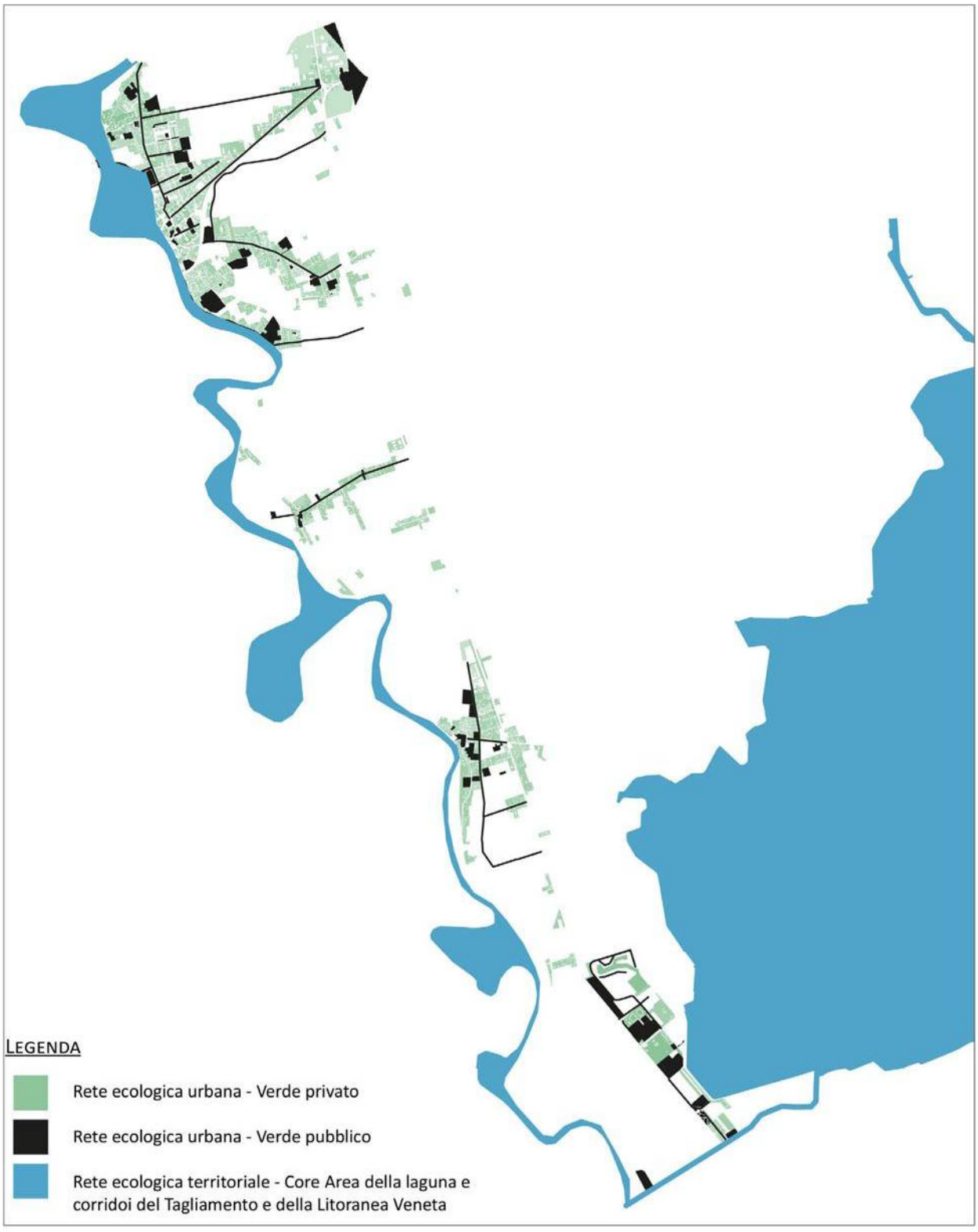

Figure A3. The Urban Ecological Networks in the 8 inhabited centres.

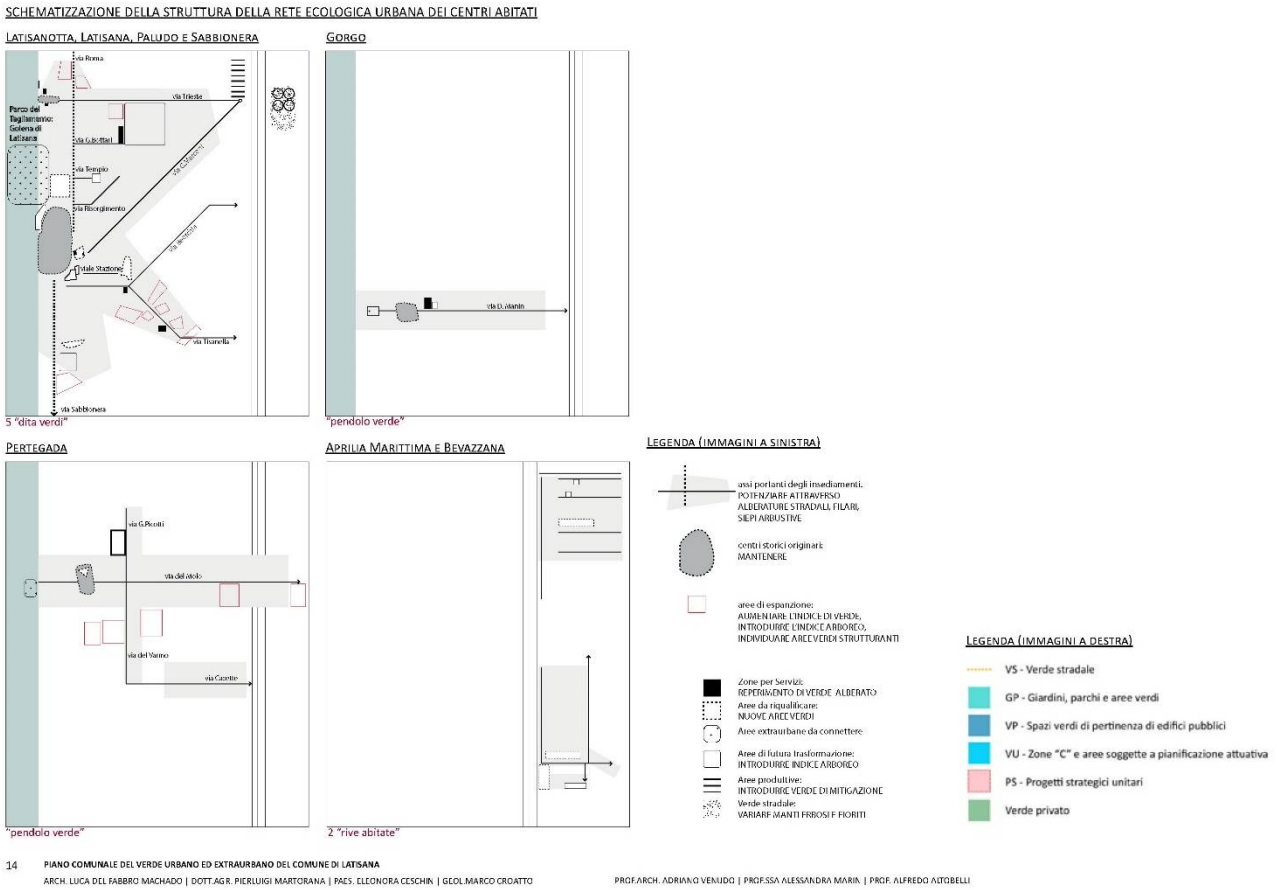

Figure A4. Outline in "urban figures" (structure and functioning) of the Urban Ecological Networks foreseen by the Ecopolitana for the 8 inhabited centres.

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