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Nature and Identity. Agro Pontino case study

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Abstract
Ecological issues are becoming increasingly important in urban planning and management. An integrated approach is needed in order to enhance the natural elements of the landscape within the built environment. The present research project shows a methodological approach aimed at supporting a landscape regeneration process. The methodology is applied to the case study of Agro Pontino, more specifically in the Latina municipality where the urban sprawl is progressively dissolving both the ecological quality of the territory and its original agricultural matrix. The methodological approach of this research project is structured following the purposes enumerated below. 1)Identification of the structural elements of the landscape identity. 2)Assessment of the level of conservation of the landscape in the Latina municipality. 3)Stratification of the Latina municipality into homogeneous Environmental Territorial Units (UTA). 4)Assessment of the level of isolation of residual natural fragments in the agricultural matrix. The results show how the methodological approach adopted is useful to set targets and priorities to regenerate the landscape structural and identity features. In conclusion, this interdisciplinary study is a significant contribution to the integrated approach because it faces the neighborhood requalification in ecological key and supports the urban reforestation project.

Keywords: Integrated Project; Environmental Design; Hydrographic Network, Potential Heterogeneity, Index of Landscape Conservation

1. Introduction

Ecological issues are becoming increasingly important in urban planning and management. An integrated approach is needed in order to enhance the natural elements of the landscape within the built environment. The natural elements of the landscape are often impoverished because of the urban transformations that are disrespectful towards the local geographical conditions. One of the main results of such an indifferent attitude consists in the landscape loss of naturalness and identity. At the present moment, the competence and the operative tools to preserve the landscape qualities, as projected by the European Landscape Convention are in progress (Council of Europe, 2000; De Montis, 2014).
This study focuses on the rural landscape whose naturalness and identity are compromised by the urban sprawl.
The urban sprawl is principally determined by the speculative dynamics of property market, and it represents one of the main challenges to the sustainable development (European Environment Agency, 2006; Johnson, 2001).The case study proposed here is representative of this particular condition. In fact, the *Latina* municipality has a surface

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of 278 kmq and it is part of the bigger lowland of *Agro Pontino*. While the natural vegetation is well protected and preserved within the natural adjacent areas ofthe *Circeo National Park* and the *Forest Reserve of Nettuno*, *Latina* naturalness represents the "lowest point" of the *Agro Pontino*. Here, the urban sprawl is progressively altering both the natural vegetation and the original rural matrix of the landscape.
Agro Pontino results from a drastic work of landscape transformation, known as "the Great Reclamation" implemented in the 1920s. In few years, the large territory, formerly occupied by marshlands, has been rapidly transformed in arable land and then divided in "*Poderi*" (little pieces of arable land) and "*Borghi*" (little rural settlements). In addition, a complex network of water-channels has been built in order to preserve the dry land. Along these water-channels river side "*Eucalypti*" have been planted as windbreak barriers.
Even now, the arable matrix characterizes the *Latina* landscape, but this matrix and its own natural and identity elements are disappearing because the original "*Borghi*" are actually merging, becoming a unique undifferentiated entity.
This study proposes a methodological interdisciplinary approach, based on an innovative application of ILC index, in order to enhance the urban landscape natural and identity elements. The results show how the methodological approach adopted is useful to set targets and priorities to regenerate the landscape structural and identity features. By doing so, it has been possible to develop a significant contribution towards the implementation of operative tools to support the Landscape European Convention. In addition, this interdisciplinary methodological approach is useful to face the neighborhood requalification in ecological key as well as to support the urban reforestation project (Dierna & Orlandi, 2005).

2. Methodology

The methodological approach of the research project is structured following the aims enumerated below:
1. Identifying the structuring elements of the landscape identity in an area characterized by a strong anthropization, starting from:
- A survey of anthropogenic conversions which has highlighted the landscape features throughout the ancient and recent history (Branchetti & Sinisi, 2005).
- Mapping the actual heterogeneity of the landscape mosaic; in order to reach this purpose the methodological approach has required a new use of ground map which has been necessary since the existing cartography did not provide adequate thematic details for a satisfying depiction of the local mosaic heterogeneity aimed at planning urban requalification interventions. Therefore, starting from the visual interpretation of the IT2000 Ortofoto and the other available data, CLC cartography of *Lazio* has been enriched by introducing new thematic classes for forests and woody plants cultivation.
- Identifying the potential heterogeneity of the area (the so-called naturalist imprinting), through the mapping of the area vegetation series.
2. Defining an assessment scale of the *Latina* district state of preservation through a new calibration of the ordinary scale, based on an acknowledged scientific index which is the Index of Landscape Conservation (ILC) (Pizzolotto & Brandmayr, 1996); the new

measurement has been conceived in order to denote exactly the different intensities of the *Latina* district anthropogenic conversions.
3. Assessing the state of preservation of territorial units with environmental homogeneity located in the district area; the territorial units mentioned above have been named Environmental Territorial Units (UTA-*Unità Territoriali Ambientali*). The *Latina* district area has been divided in environmental homogeneity territorial units named Environmental Territorial Units; despite the hierarchical categorisation of the area as methodological benchmark, UTA definition is based on more refined environmental variability factors than the ones usually used in great-scale projects (bioclimate, geomorphology) (C Blasi, 1996). UTA definition has complied with the criteria mentioned below:
- Lithological boundaries. This criterion has been adopted for a level ground separation of the district area, particularly *Littoria* and *S. Michele - Rio Martino* UTA have been separated from *Latino Scalo* and *Faiti* UTA.
- Territory morphology. This criterion has been essential to separate *Astura* UTA river valley, which is mainly a river valley, from the rest of the *Pontina* plain.
- Use of predominant ground (natural elements, arable lands and urbanization grade in particular way). This criterion has been adopted to separate *Littoria*, *Sabotino*, *Grappa-Lago di Fogliano* and *S. Michele Rio Martino* UTA.
- Elevation boundaries. Thanks to this criterion *Faiti* UTA has been separated, being a hollow within *Latina* district.
- Survey of the historical matrix.This criterion has been adopted in order to confirm the boundaries mentioned above and to prove the identity features of every single UTA (for instance, *Astura* UTA has historically been a separated unit distinguished by landscape features preceding the land improvement initiatives).
4. Survey of the landscape matrix:
- Survey of the structural features of the residual natural fragments located in the area;
- Survey of the landscape isolation and the environmental matrix permeability, which is ensured by the presence of consistent formations in several UTA.
5. Evaluation of the survey outcomes and definition of the landscape quality objectives.
6. Defining and programming reclamation interventions of the land structural and identity features, planning them in the short, medium and long term.

3. Results and Discussion

3.1 Identifying the structuring elements of the landscape identity

3.1.1 Survey of the area anthropogenic conversions

The main aim of this survey stage is the historical reconstruction of the area structuring process connected to the anthropogenic conversions. Starting from the contemporary period, it has been possible to point up the area conversions matrixes that have come to the present day from different historical periods, representing the area memory and identity after which future conversions process can be patterned. The most meaningful phases of the *Latina* district structuring process can be connected to three macro historical periods: Pre and post Roman (before 312-756 AD); "Popes

conversions" (756 AD- 1927); "The Great Reclamation" (1927-1936). Thanks to "The Great Reclamation", the land contemporary configuration has been structured around three main elements: the hydrographic network, the agricultural matrix and the urban settlements (Figure 1).

Figure 1 a) Large area occupied bya forest marshland; b) Rural communities settled in the new-born Agro Pontino; c) Territorial structure of the podere Latina 1936; d) City growth lacking any differentiation and recognisability.

3.1.2 The landscape mosaic actual heterogeneity

Thanks to the historical facts and the dynamics described above, the rural areas reclamation has been acknowledged as the key point of the recovering process of the *Latina* district identity features. Consequently, a fact-finding survey phase has been fulfilled in the district area in order to estimate the environmental quality of the district landscape mosaic, starting from a detailed land cover mapping.

The current mosaic of the *Latina* area landscape is composed of a landscape matrix of irrigated arable lands and of urban settlements - 58% and 22% of the district area respectively. Here, scant (in terms of number and extent) residual nature fragments (natural vegetation and moist areas) scatter, currently covering the 3% of the district area surface. Another landscape identity feature of the *Latina* district, which has been mapped in detail, is showed in Figure 2.

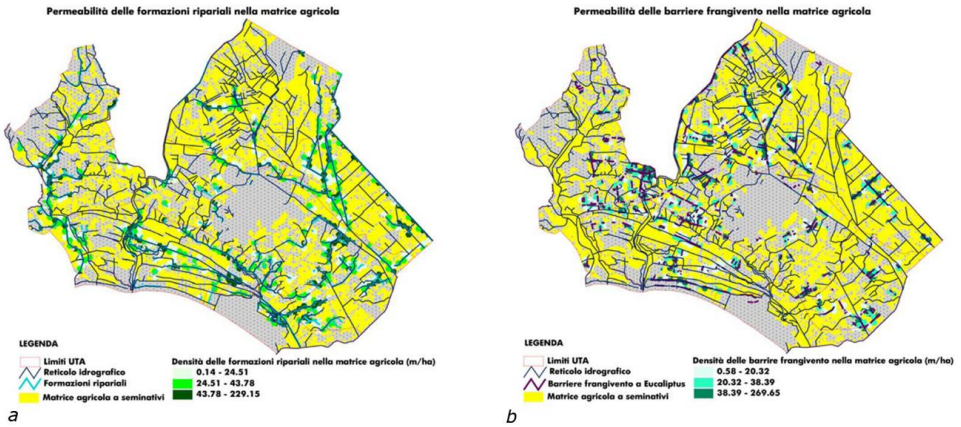

Figure 2. a) Riparian formations alongside the canals and rivers of the district hydrographic network b) Eucalyptus windbreak barriers located on the borders of farmed fields or alongside the reclamation trenches.

3.1.3 The potential heterogeneity of the landscape mosaic

The area potential heterogeneity is outlined by mapping the landscape structuring environmental features and the source of the vegetation sequences map. As far as the local and the environmental planning is concerned, the vegetation sequences map is a reference tool aimed at understanding the ecology, the biodiversity, the naturalistic value, the vegetation potentiality and recovery speed (resilience and resistance connected to each sequence stage) that characterizea given territory (Figure 3).

3.2 Assessment scale definition of the state of preservation

The land cover and consistent formations map has been used as a database in order to estimate on a district and UTA scale the local state of preservation, on the basis of the Index of Landscape Conservation (ILC) (Pizzolotto & Brandmayr, 1996). In its original formulation, the ILC index is obtained by conferring an ordinal value of state of preservation to every class of the Corine Land Cover legend, this value being growing and shifting from the classes of artificial surfaces to the farming areas, the natural and semi natural areas up to the moist areas. Within each macro-class the index value varies depending on specific criteria such as waterproofing (artificial surfaces), hemeroby condition (farming areas), proximity to mature stage vegetation (natural and semi natural areas).

In this methodological perspective, a new ILC ordinal scale has been outlined (Table 1) for the land use classes in the *Latina* district by diversifying in particular way, on the basis of the available data and a strictly typological approach, the different hemeroby level of the farming areas, these being the predominant elements of the landscape mosaic and, consequently, the areas which mostly affect the ILC.

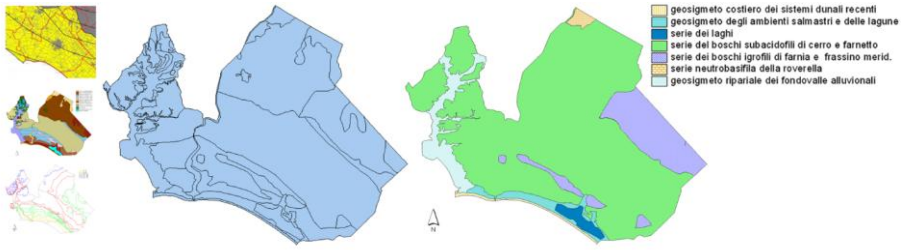

Figure 3. Latina vegetation sequences map includes 7 cartographic units (Biondi, 1996) and it was drawn up by means of the territory hierarchical classification (Carlo Blasi, Carranza, Frondoni, & Rosati, 2000; C Blasi & Smiraglia, 2003).

3.3 Assessing the preservation conditions (ILC) of Environmental Homogeneity Territorial Units (UTA)

The total ILC of the *Latina* district territory and its UTA are showed in Figure 4. As it is possible to infer from the estimation, the ILC index proves the low quality state of preservation of the district territory, but in this case, since the urbanization level is very high in such a territory, the index can be considered synthetic and indicative, but not complete in its contribution. Therefore, it has been necessary to complete the ILC calculation with additional specific surveys on the area, in order to mould the landscape matrix actual features.

3.4 Landscape matrix survey

The surveys implemented are the following.

3.4.1 Structural survey of the residual nature fragments

The patches concerning the land cover typologies with greater environmental quality (ranking ILC 8 and 9) have been observed from a structural point of view. The survey outcome has showed that beyond being distinguished by a limited extension, the patches have a prevailing lengthened structure, including the non-riparian vegetation typology, hence their being subjected to an edge effect. In addition, the vegetation typologies are mainly represented by several small-sized patches, rather than single patches with bigger dimensions, thus proving the habitat fragmentation problem.

3.4.2 Survey of the matrix permeability and the distances from mature stage fragments

As mentioned above, the consistent vegetation areas (riparian vegetation and windbreak barriers) play a pivotal role in such a simplified agro-ecosystem. The forest areas can functionas real corridors through which fauna moves to more beneficial areas, by passing through little bio-porous barriers, such as the farming arable matrix. By comparing the consistent development of the hydrographic network with the riparian formation one, it is possible to assess, on each UTA scale, the size of the vegetation areas which the hydrographic network, through the formation of permeability lines, preserves as areas potentially functioning like ecological corridors.
In order to provide additional tools aimed at estimating, in the district area, the spatial

arrangement of the recognisable structural elements of the ecological network,two different kinds of surveys on GIS environment have been implemented; the main aim has been to assess:

Table 1. ILC ordinal scale of the land use classes of *Latina* municipality and the correspondingranking criteria adopted.

ILC Class	Land Cover Cod.	Nomenclature	RankingCriteria
1	11	Urban fabric	Almost total waterproofing of the soil
1	12	Industrial, commercial and transport units	
1	131	MineralExstractionsites	
1	1321	Solid wastedumpsites	
1	1322	Liquid wastedumpsites	
1	1331	Constrcutionsites	
1	1332	Reworkedsoilsand artifacts	
1	5112	Channels	Artificialhydrography
1	5122	Artificialreservoirs	
2	141	Green urbanareas	Partially waterproofed soils in the urban and agricultural (greenhouses)field
2	1421	Sport facilities	
2	1422	Sportareas	
2	1423	Leisureareas	
2	143	Cemeteries	
2.5	2123	Vegetable crops in open fields, in greenhouses and under plastic in irrigated areas	
3	2111	Arable landmainly withoutdispersed vegetation	Annual intensive crops
3	2121	Permanentlyirrigated land	
3	2122	Nurseries in irrigatedareas	
3	242	Complexcultivationpatterns	
4	221	Vineyards	Permanent intensive crops, frequently realized with no nativespecies(e.g. *Actinidiachinensis*orchardsand *Eucalypti*)
4	222	Fruit trees and berry plantations	
4	2242	Eucalipteti from woodarboriculture	
4	2243	Eucaliptetiaswindbreaks	
4	2241	Wood Arboriculture	
5	223	Olivesgroves	Permanent crops realized with species ecologically consistent with the area (olives groves), extensive crops or crops with spatial micro-heterogeneity. Farming areas with a considerable presence of uncultivated land and spontaneous vegetation units; arboreal vegetation features far from the mature stage.
5	231	Pastures	
5	241	Annual crops associated with permanent crops	
6	243	Landoccupiedprincipally by agriculture with significant areas of natural vegetation	
6	312	Coniferousforest	
7	313	Mixed forest	Vegetation in a strong and dynamic recovery(presence of native species), potential natural herbaceous vegetation; hydrographic network and partially deteriorated moist areas
7	3243	Bushywoodlands	
7	331	Beaches, dunes, sands	
7	5111	Rivers	
7	411	Inlandmarshes	
7	321	Natural grassland	
7	4121	Exploredpeatbogs	
8	322	Moors and heathland	Potential natural shrubby vegetation
8	3221	Heathlands and moorlands	
8	323	Sclerophyllousvegetation	
8	3231	Sclerophyllous vegetation: bushy Sclerophyllous vegetation	
9	521	Coastallagun	Potential natural vegetation (mature stage) and moist areas in a good state of preservation.
9	421	Salt marshes	
9	311	Broad-leavedforests	
9	3115	Plantation of broad-leaved forest	
9	3116	(*Quercus* spp., *Ostryacarpinifolia*, *Carpinusbetulus*)	

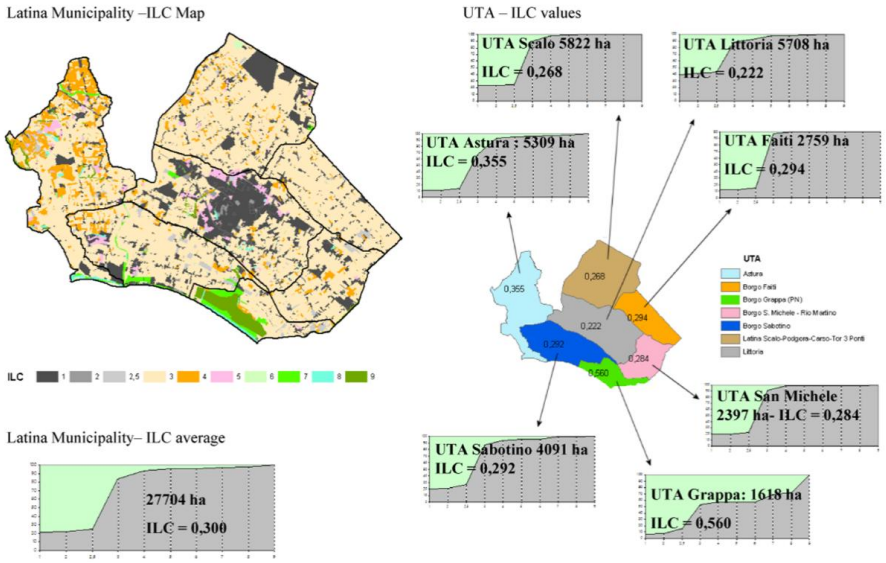

Figure 4. The total ILC of the Latina district territory and its UTA

- The distance of each point of the district territory from the mature stage vegetation existing fragments; the distance has been evaluated by devising a function of distance from the fragments. (Figure 5).
- The current permeability of the arable matrix; this permeability has been evaluated by dividing the matrix surface in sample units of 10 hectares uniform surface, and by estimating the percentage of units where the consistent formations cross the surface.

The surveys outcomes are summarized in Table 2, 3 and 4.

3.5 Evaluation of the survey outcomes and definition of the landscape quality objectives

The outcomes point out different criticalities connected with the natural and structural elements of *Latina* landscape. These criticalities are synthesized below:

- high artificialization and poor quality of the hydrographic network;
- low environmental quality of the agricultural matrix;
- high level of fragmentation of the natural vegetation patches and limited natural areas;
- growth of the urban sprawl and consequent loss of identity of the original settlements (*Borghi*).

In such a situation, it is difficult to face and solve all the criticalities identified here with a single planning horizon; therefore, it seems proper to formulate a proposal of environmental planning to begin the process of reclamation and/or development of the landscape structural and identity elements, thus settinga significant trend reversal. The proposal is based on the guiding principle of introduction of natural patches in the agricultural matrix. This kind of intervention fulfils synergetic and cross functions since:

- It begins a process of reclamation of the landscape naturalistic identity through the planting in the agricultural matrix of small-sized patches of mature stage forest

vegetation in order to respect the already existing agricultural activities.
- It enhances, through new structural elements, the functionality of the local ecological network, currently composed of riparian vegetation, windbreak barriers and mature stage residual fragments. Such an enhancement is possible by means of:
- a spatial distribution of the interventions aimed at limiting the isolation level of the mature stage residual fragments and at favouring the areas with a scarce or null domination of consistent formations
- the interventions able to reduce the distance between the structural junctions of the existing ecological network.

Table 2. Percent arrangement of the distances from the mature stage closer fragment in different UTA.

UTA	**0-0.5 km**	**0.5 -1 km**	**1-2 km**	**2-5 km**	**5-10 km**	**Totale**
Latino Scalo	0	0	3	40	57	100
Faiti	3	9	32	57	0	100
Astura	37	28	23	13	0	100
Littoria	24	29	41	7	0	100
S. Michele-Rio Martino	17	25	53	6	0	100
Sabotino	21	39	35	4	0	100
Grappa-Lago di Fogliano	29	40	31	0	0	100

More than a half of *Latina Scalo* UTA and *Faiti* UTA territory shows a wide distance (at least 2 km) from the Mature Stage existing fragments, contrary to more than 40% of the other UTA territory whose distance from the above mentioned fragments is less than a kilometre.

Table 3. Farming matrix permeability due to riparian formations.

UTA	Farming matrix not crossed byriparian formations (surface sample unit, ha)	Farming matrix with riparian formations(surface sample unit, ha)	Total surface of the farming matrix (ha)	Farming matrix permeability due to riparian formations.(%)
S. Michele-Rio Martino	896.923	514.568	1411.491	36
Faiti	1380.961	690.526	2071.487	33
Sabotino	1480.832	709.141	2189.973	32
Grappa-Lago di Fogliano	341.465	142.147	483.612	29
Astura	1833.065	646.936	2480.001	26
Littoria	1647.331	516.828	2164.159	24
Latino Scalo	3161.253	413.821	3575.074	12
Borderlands	825.119	614.335	1439.454	43
Totale Latina	11566.949	4248.302	15815.251	27

From the assessment of the overall matrix permeability (see alsoTable 4), it was possible to infer that: in *S. Michele-Rio Martino, Faiti* and *Sabotino* UTA, more than one third of the farming matrix is pervaded by the consistent formations. In *Latina Scalo* UTA the worst levels of permeability are observed. The windbreak barriers help in completing these levels of permeability; particularly in *Littoria* and *Sabotino* UTA, these barriers contribute considerably.

Table 4. Farming matrix permeability due to windbreak barriers.

UTA	Farming matrix not crossed by windbreaks (surface sample unit, ha)	Farming matrix crossed by windbreaks (surface sample unit, ha)	Total surface of the farming matrix (ha)	Farming matrix permeability due to windbreaks.(%)
Littoria	1592,89	571,27	2164,16	26
Sabotino	1665,07	524,90	2189,97	24
Latino Scalo	2901,55	673,53	3575,07	19
S. Michele-Rio Martino	1146,10	265,39	1411,49	19
Astura	2053,07	426,93	2480,00	17
Faiti	1798,12	273,37	2071,49	13
Grappa-Lago di Fogliano	480,25	3,36	483,61	1
Borderlands	*1187,22*	*252,24*	*1439,45*	*18*
Totale Latina	12824.265	2990,986	15815.251	19

- It attenuates the urban sprawl diffusion in the agricultural matrix and makes the "*Borghi*" recognisability stronger since the natural areas, if appropriately placed within the agricultural-urban interface, represent a sort of defence against the risk of obstruction from new buildings, thus lessening the level of convertibility of the agricultural matrix and bringing out its noticeability by using new technological tools linked to water (phytodepuration).

3.6 Programming and planning reclamation interventions of the land structural and identity features in the short, medium and long term.

Based on the guiding principle just described, the proposal of environmental planning suggests scenarios of interventionin the short and medium term in order to improve the single UTA landscape quality. The short-term scenario envisages doubling the mature stage surface (land cover classes with ranking ILC 9) present in the local area, for a total surface of intervention equal to 424, 26 hectares (1% of the local area surface). The medium-long term scenario sets out to plant large-sized and mature stage woody trees such as *Quercus cerris* and *Quercus frainetto* (30 hectares) for a total extension of 1385 hectares equal to 5% of the *Latina* municipality surface, this being beneficial to the naturalistic requalification of *Pontina* plain.

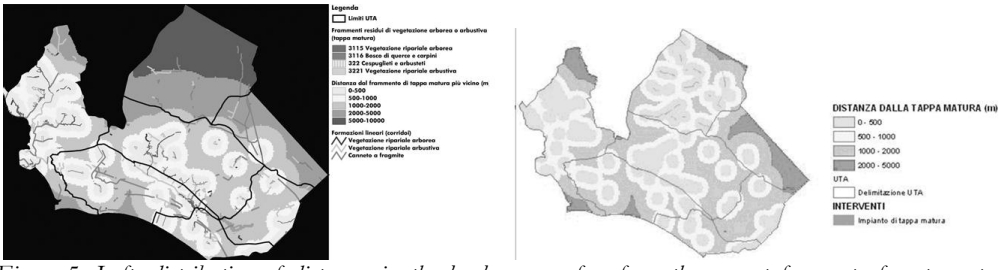

Figure 5. Left: distribution of distances in the local area surface from the nearest fragment of mature stage vegetation. Right: distribution of distances in the local area surface from the nearest fragment of mature stage vegetation after the supposed interventions.

4. Conclusions

As showed above, the recent historical identity of the *Latina* municipality area is closely related to three elements structurally and functionally integrated with the *Agro Pontino* features: the landscape agricultural matrix, the hydrographic network and the urban settlement of rural "*Borghi*". In the latest years, the increase of urban and industrial settlements, the change of the agricultural productive systems and a disrespectful use towards the morphological and natural features of the area have caused the loss of ecological functionality. Therefore, it is considered necessary that the reclamation process of the *Latina* municipality specific nature and identity should start exactly from the re-introduction of natural patches, that is, mature stage fragments spread out in the farming matrix since:

- it permits the preservation and enhancement of the matrix that protects the area from a further urbanization, thus reflecting the area peculiar identity;
- it allow seven the "*Borghi*" requalification, since their origins are closely related to the rural landscape, so it would avoid their further merger into the urban formations developed alongside the arterial roads;
- it enables the re-introduction of potential woody plants typical of the *Agro Pontino* through interventions on small-sized surfaces in the short-time and on more sizeable surfaces in the medium-long term;
- it entails an improvement of the agricultural farming permeability, with positive consequences on the hydrographic network functionality of the *Pontina* plain, a local area that, in spite of all its potentialities, is now considered unsuitable for some animal species.

In conclusion, it has been highlighted that starting from the main pattern of the territory hierarchical classification it is possible to define some specific sub-patterns applicable to each area, able to provide concise and significant answers about the state of preservation of the territory and its structural features. This proves to be a necessary knowledge to formulate environmental design proposals aimed at implementing several practices of requalification and reclamation of the environmental quality of the landscape on this specific area. In addition, the methodological approach adopted is also applicable to a wide range of different landscape typologies through the continuous updating of ILC ordinal scale in order to develop urban reforestation projects.

References

Biondi, E. (1996). La geobotanica nello studio ecologico del paesaggio. *Ann. Acc. It. Sc. Forestali*, *XLV*, 3–39.

Blasi, C. (1996). II fitoclima d'Italia. Plant Biosystem, 130(1), 166–176.

Blasi, C., Carranza, M. L., Frondoni, R., & Rosati, L. (2000). Ecosystem classification and mapping : a proposal for Italian landscapes. Applied Vegetation Science, 3(2), 233–242.

Blasi, C., & Smiraglia, D. (2003). Analisi multitemporale del paesaggio e classificazione gerarchica del territorio: il caso dei Monti Lepini (Italia centrale). Informatore Botanico, 35(1), 31–40.

Branchetti, M., & Sinisi, D. (2005). Lazio pontificio tra terra e mare: storia e immagini dai documenti dell'Archivio di Stato di Roma (secoli XVI-XIX). Roma: Gangemi.

Council of Europe. (2000). European Landscape Convention. Report and Convention Florence, ETS No. 17(176), 8.

De Montis, A. (2014). Impacts of the European Landscape Convention on national planning systems: A comparative investigation of six case studies. Landscape and Urban Planning, 124, 53–65.
Dierna, S., & Orlandi, F. (2005). Buone pratiche per il quartiere ecologico. Firenze: Alinea.
European Environment Agency. (2006). Urban sprawl in Europe - The ignored challenge. EEA report (Vol. 10).
Johnson, M. P. (2001). Environmental impacts of urban sprawl: A survey of the literature and proposed research agenda. Environment and Planning A, 33(4), 717–735.
Pizzolotto, R., & Brandmayr, P. (1996). An index to evaluate landscape conservation state based on land-use pattern analysis and Geographic Information System techniques. Coenoses, 11, 37–44.