A Methodological Contribution to Landscape Design and Improvement

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ABSTRACT

The main themes of this study are based on the observation that in most rural areas, landscape has undergone deep structural, morphological, social and economic changes. This is in part due to the criteria of extreme functional and technological rationalization adopted for the design of rural service buildings, which are usually precast concrete structures, and thus prove incongruous with the rural landscape and with territorial traditions.

The study, which is part of a broader research project undertaken in collaboration with the Emilia-Romagna Region and the Province of Bologna, sought to define a methodology for assessing the visual impact caused by the rural built system and for evaluating the mitigation potential of different typologies of solutions that may be found.

The definition of reproducible models for designing vegetational systems to mitigate the visual impact of inadequate rural buildings, which also represents a goal of the broader regional research project, is only outlined in this paper, with the in-depth analysis of some study cases. Full discussion of the definition of these models will be the subject of future work.

Keywords: rural territory, rural buildings, visual impact mitigation, landscape architecture.

1. INTRODUCTION

The conceptual basis of the study derives from the observation that most landscapes in the flat rural areas of the Emilia Romagna region have undergone deep structural, morphological, social, and economic changes, which are ongoing, due to the evolutions imposed by agricultural policies, which continue to influence the territory greatly, because of its prevalent vocation for agricultural production.

Over the centuries these areas have been subject to transformations that, from Roman colonization onward, have changed them from marshy into agricultural land. Each era left clear signs of these actions on the landscape, and analysis of their semiotics underlines the anthropological contributions, consisting in the Roman centuriation grid, the primary and secondary water system, and the road system, which are all easily recognizable across the broad stretches of the region’s plains.

The matters dealt with by this study mainly originate in the second half of the last Century. At that time, the rapid evolution imposed on the agricultural sector by policies and markets, together with the lack of resources that agriculture has always faced, led to an extreme functional and technological rationalization of rural buildings, often constructed using prefabricated structures. Most existing precast concrete structures, whilst satisfying the need for economy, are absolutely irreconcilable with both the landscape and the history of the rural

territory, thus causing a veritable rift in the landscape.
In the past, the built system was the visible materialization of a place, because it contained its "chromosomes": the materials used were those available in the surrounding area and shapes and layouts went well with geomorphologic and climatic conditions. However, the globalization process has brought the same rules, processes and customs everywhere, leading to a uniformity of the territory, which looks almost the same, sometimes even at very different latitudes.

In particular, with reference to the considered area, it is possible to notice how the agricultural sector on the one hand has paid particular attention to the implementation of opportunities furthered by agricultural policies to improve and integrate farm incomes, whilst on the other hand it has also been conscious that its own potential for offering services, such as accommodation facilities and recreative activities, has been considerably compromised by the continuous defacement of natural and landscape resources.

The study, which is part of a broader research project undertaken in collaboration with the Emilia Romagna region and the Province of Bologna, started with the observation of the incongruity within the landscape, and at times also the functional inappropriateness[1] of modern rural buildings. The main goal was the definition of systems and procedures to upgrade important territorial components - such as its built system - by trying to combine the functional demands of farming activities with the historical and landscape quality of rural areas.

2. AIMS OF THE STUDY

The general aim of this study is to define a logical and reproducible path for landscape valorization and improvement of rural sites, by seeking multifunctional design solutions applicable in cases ranging from farm scale up to wide areas. Local or wide area solutions were thus defined, respectively, according to the design scale.

The specific aims mainly refer to two typologies of in-depth studies, as follows. The first regards the setting up of a methodology for both the evaluation of the potential visual impact created by the rural built system according to the generic site where it is placed, and the subsequent assessment of the mitigation capability of the different typologies of solutions that can be adopted. The second focuses mostly on the definition of vegetational systems capable of mitigating the aesthetic-perceptive impact caused by rural service buildings, built in the past decades, featuring formal, dimensional and material solutions totally out of keeping with the context of reference.

This work consists of the full discussion of the first of the two above-mentioned studies, which involved the elaboration of several suitable indices and parameters and of the relationships between them. For brevity's sake, we will not report the complete results of the second study here; only the preliminary analyses and some of the proposed design solutions

[1] *Unlike in the past, when the agricultural sector was capable of creating functional architectural models, respecting compatibility with local traditions (e.g. rural buildings designed by Dotti and their reproductions which can be seen in several rural areas), the trend in recent decades has seen the construction of rural buildings which were not specifically designed for that particular use. Industrial building typologies have been preferred instead, in order to obtain covered spaces cheaply.*

will be explained.

Considering the widespread and general diffusion of the themes mentioned, the methodologies and typologies of solutions elaborated in the study also proved to be reproducible, comparable and applicable on wider areas than the one investigated by this study.

3. STATE OF THE ART AND CONTRIBUTION TO FURTHER ANALYSES

Several authors have dealt with topics concerning landscape architecture, landscape ecology and in particular the role of vegetational components in the landscape. In particular, some studies refer to the landscape impact of various typologies of development and to strategies for its mitigation. Several papers with this purpose are available in scientific literature, in which rural territory and landscape are the specific subject of study. In almost all such research a considerable role is attributed to vegetational components, due both to their capacity for performing aesthetic and perceptive functions, biological connection, and biodiversity preservation, and to their aptitude for mitigating and compensating for the impact of numerous anthropic, structural and infrastructural constructions.

Some authors focus their attention on the study of landscape ecology (Dramstad et al., 1996; Ingegnoli, 1993), others on landscape and environmental planning and design (McHargh, 1969), and yet others on forest preservation and environmental restoration of specific decayed areas (Muzzi and Rossi, 2003; Rossi et al., 2001). These studies are often conducted with sectional approaches: some deal with biology and ecology, such as studies about ecological networks and greenways (Franco, 2000; Malcevschi et al., 1996; Canter et al., 2000), others with agronomy or landscape architecture and design, such as studies on the design of gardens and parks (Agostoni and Marioni, 1993; Di Fidio, 1996; Maniglio Calcagno, 1983).

The author of this paper, together with her research team at the Division of Territorial Engineering of the Department of Agricultural Economics and Engineering of the University of Bologna, has for a long time carried out research into landscape and environmental preservation and improvement of rural areas, including projects on behalf of institutions responsible for territorial planning. More precisely, these studies focus on the analysis of landscape impacts of the most widespread typologies of constructions built in rural areas, and consider the numerous components of landscape, paying particular attention to perceptive aspects and visual connotations (Tassinari and Torreggiani, 2006).

In previously published papers, the author has mainly looked at the elaboration of methodologies and criteria supporting the planning process, and the definition of design guidelines. The goal was to improve both the architectural quality of buildings and their suitability within the landscape.

This paper, as part of the above-mentioned scientific framework, aims to suggest a methodological approach to support landscape improvement and the visual impact mitigation of existing or new buildings, by means of vegetational systems. This work adopts an original approach, seeking to integrate the study of territory and rural built systems with landscape architecture.

The study draws inspiration from the European Landscape Convention (Council of Europe,

2000), which proposes the adoption of specific goals of landscape quality, to be closely linked with criteria for directing possible strategies of action.
The method proposed by the author draws upon the experience of the international scientific community regarding the definition of indices and parameters for assessing the quality and vulnerability of landscape and territory and the formulation of visual quality standard objectives with reference to the level of quality measured (Senes and Toccolini, 1998; USDA Forest Service, 1974; Sheppard, 1989; Smardon, 1979; Smardon et al., 1986; Colombo and Malcevschi, 1999). For discussion of these subjects, reference can be made to a work already published by the author (Tassinari and Torreggiani, 2006). The method also relates to the goals clearly expressed by the latest European codes – amongst which the European Landscape Convention cited above plays a predominant role – which are highly pertinent to the aim of the study. It is a well-known fact that the European Landscape Convention was a core reference for the subsequent agreement between the Italian Ministry of National Heritage and Culture, the Emilia Romagna region, and the associations of local authorities in the region (Regione Emilia Romagna, 2003), as well as for the Italian code of cultural heritage and landscape (legislative decree 42/2004).

The study proposed by the author seeks to suggest an original methodology, developed with reference to the rural territory and built system of a study area in northern Italy. The methodology was organized as follows: assessment of the level of damage and real or potential sensitivity of rural landscape; classification of significance and mitigation capability of the various vegetational design solutions; integrated evaluation of these aspects in order to find criteria for the rationalization of the mitigation strategies.

The analysis of the definition of landscape and of issues about its preservation resulted in the following considerations, which proved to be important topics for this study:

- perception of landscape by local inhabitants and users plays an overriding role;
- the recognizable characteristics of a place are natural and/or cultural factors (i.e., anthropic): landscape is perceived as evolving over time, as a consequence of natural forces and/or human action;
- landscape forms a whole series of interrelated natural and cultural elements, which should be considered as a whole;
- *"Landscapes have always changed and will continue to change, both through natural processes and through human action…";* thus *"the preservation or "freezing" of the landscape at a particular point in its lengthy evolution"* is not possible[2];
- preservation of the character and quality of a given landscape, which people identify as valuable, plays a strategic role, for both natural and cultural reasons. Such preservation should be "active", that is, it should allow the transformation of places without compromising their conservation and, if necessary, it should be combined with such conservation measures as can "...preserve significant features of a landscape... [3]";
- permissible transformations should be regulated by harmonizing economic, social and environmental requirements, aiming to "...ensure a regular upkeep of the landscape

[2] *Explanatory report of the European Landscape Convention, art. 1, paragraph 42.*
[3] *Explanatory report of the European Landscape Convention, art. 1, paragraph 40.*

and that the landscape evolves harmoniously and in a way that meets economic and social needs[4]".

The complex organization of landscape, understood as a "system of ecosystems"[5], which should be considered as the inseparable union of its various natural, anthropic-cultural, and perceptive components, leads to several approaches to the perception and interpretation of the landscape. The table in figure 1 summarizes the organization of these components.

LANDSCAPE		
natural components	**anthropic-cultural components**	**perceptive components**
• hydrology • geomorphology • vegetation • fauna	• social and historical c. • historical-architectural c.	• visual c. • formal-semiological c. • aesthetic c.

Figure 1. Landscape components.

A short description of the most relevant vegetational and perceptive components for the purposes of this study, is provided below, together with an outline of the main critical issues.
It is a well-known fact that vegetation is the result of natural and anthrophic actions that influence the landscape in terms of formal, aesthetic, and especially ecological issues. Critical issues for vegetation are the safeguard of indigenous species, woods and forests, and residual and minor components, such as isolated or aggregated trees, vegetational components along border, hedges and bushes.

Landscape perception should be seen in relation to its visual, formal-semiotic and aesthetic components, which are outlined below.
The visual quality of landscape depends on many factors: the integrity and rarity of the physical and biological environment, the expressivity and readability of figurative and historical values, and the harmony between land use and landform.
All these conditions are thus subordinate to the preservation of visual qualities and landscape image, remarkable sights and views, remote and close-up sights, terrain profiles and existing built-up areas.

The formal-semiotic component refers to the merging of landscape constituents into a form that distinguishes the identity of several types of landscape. The protection of the forms that structure the territory, of the overall homogeneity, and of zones with high expressivity values requires the identification of all the elements that can characterize the landscape, and of all the signs which allow it to be recognized and identified.
Finally, according to another philosophy, landscape is considered as a kind of aesthetic identity of a place, seen as the permanent and distinctive character which contributes to its physiognomy and to the specificity of its parts, thus relating the aesthetic concept of

[4] *Explanatory report of the European Landscape Convention, art. 1, paragraph 40.*
[5] *The academic discipline known as landscape ecology studies the landscape, defining it as "a system of interacting ecosystems that is repeated with a recognizable pattern in a defined area" (Forman and Godron, 1986). It was established in Europe at the end of the Seventies and developed in Italy from the beginning of the Eighties. According to Vittorio Ingegnoli's definition, landscape ecology "deals with the study of the system of ecosystem, intended as a specific upper level of biological organization that follows the ecosystem, and with the ecological events, in relation to changes in scale and in multidimensional and hierarchical configuration of ecosystems".*

landscape to the cultural and historical identity of the territory.

In order to plan in a more conscious and qualified way, it is becoming increasingly necessary to perform investigations and analysis that aim to look in more depth at the complex articulation of the landscape together with its proper characterizing elements, and to identify its frailties and strengths. A design methodology of this kind should take into consideration[6] concepts such as biodiversity, stability and balance, as well as the introduction of natural elements and ecological connections, in order to integrate environmental and landscape needs into territorial transformations.

4. ORGANIZATION OF THE STUDY INTO PHASES

The study consisted of the following phases:

A. analysis and evaluation of the legislative context (section 5);
B. definition of both the study area and the sample of sites (section 6);
C. development and elaboration of the analysis methodology (section 7);
D. development and elaboration of the design methodology (sections 8.1 and 8.2);
E. definition and design of different solutions for mitigation (section 8.3).

Phases D and E define the logical sequence of the criteria considered for the evaluation of the site's perceptive quality[7], in a multidisciplinary sense, (including the group of buildings to be mitigated), and lead to the identification and design of the most appropriate types of solution to mitigate the visibility of the sites. Both the proposed design methodology and these types of mitigating solutions are the results of the study. For brevity's sake, these solutions will be illustrated here only by means of a few synthetic example schemes, whilst they will be discussed more fully in future works.

The design methodology, conceived for both the evaluation of site conditions and the definition of different typologies of solutions, should be considered as an experimental test bench, which needs to be implemented, calibrated and validated by means of further experiences, both theoretical and practical. This should be done following a virtuous procedure for progressive improvement, leading to the definition of a method that can offer useful contributions to specialist studies.

5. OUTLINE OF CURRENT PLANNING REGULATIONS

Close examination of current regulations, the main contents of which are summarised in the following paragraphs, revealed that there is an increased interest, at all levels of the town planning process, in the limitation of the aesthetic impact caused by the creation of structures and infrastructures, as part of a broader perspective aiming at landscape valorisation and improvement. Further proof of this is seen in the above-mentioned agreement between the Italian Ministry of National Heritage and Culture, the Emilia Romagna region, and the associations of local authorities of the region, and in the Italian code of cultural heritage and

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[6] *The European Union has defined actions aiming at forming "ecological networks" as a predominant theme of its policies. By "ecological networks" we mean natural and environmental infrastructures which allow areas showing elements of naturalness to be correlated and linked. Such actions should tend towards the enhancement and development of natural and cultural values, in order to preserve existing biodiversity and overall environmental quality.*

[7] *The term "site" means the specific area, which can be established using visual and perceptive boundaries, and which surrounds the emerging element being studied. It includes both the buildings and the nearby vegetation.*

landscape. Emilia Romagna, in regional law n. 16/2002, promotes the rehabilitation and valorisation of historical and artistic buildings and places, the improvement of architectural quality and the reclamation of landscape value, including the removal of unsuitable buildings. Moreover, regional law n. 20/2000 marked the dawning of a new era in town planning, overhauling the previous one, and requiring all Municipalities to adopt new planning instruments.

Some of the most significant results of this process are, for example, the replacement of the "old" general town planning scheme with the new municipal plans (the "structural municipal plan", the "municipal plan of operation", the "urbanistic and building code", and the "urbanistic implementation plans"), and the introduction of a new zoning concept, dividing the territory into different categories (rural areas prevalently of landscape importance, agricultural areas with a high productive vocation, suburban agricultural areas, areas of particular natural and environmental importance), for which specific objectives are provided. In rural areas the aim is chiefly to rehabilitate existing buildings, and new constructions are only allowed if they are necessary to farm management or to the running of agricultural and related activities. The main objectives pursued by territorial and urban planning for each of the above-mentioned areas are summarized below.

In *rural areas prevalently of landscape importance*, urbanistic regulations provide for the conservation and the reconstitution of rural landscape, of biodiversity of animal and plant species and of their habitats, of natural processes, of hydraulics, hydrogeological and ecological equilibrium.
In *agricultural areas with a high productive vocation*, the main objectives are the safeguard and conservation of agricultural production land systems, in order to prevent damage caused by the introduction of activities incompatible with agriculture, and the environmentally sustainable development of competitive and structured farms.
In *suburban agricultural areas*, which may combine elements of both *rural areas prevalently of landscape importance* and *agricultural areas with a high productive vocation*, municipal town planning must pursue both the preservation of agricultural land management and promote activities to supplement agricultural income.

In *areas of particular natural and environmental importance*, municipal town planning must provide for the harmonization of settled areas and infrastructures with the goal of protecting the environment and its resources, by combining action to safeguard and restore the environment with action to protect and restore hydraulic and hydrogeological equilibrium.
Figure 2 shows an example of adoption of the above-mentioned set of rules in the Province of Bologna, as set out in its Territorial Coordination Plan (Provincia di Bologna, 2003).

6. STUDY AREAS AND SURVEYED SITES

The study area (figure 2) includes six municipalities in the northern part of the Province of Bologna (Baricella, Budrio, Granarolo dell'Emilia, Malalbergo, Minerbio, and Molinella), which together form an association called "Flat Lands". This territory is characterized by its predominantly agricultural vocation, and comprises all the elements typical of the plain of Bologna. It offers a varied panorama of situations and conditions in terms of cultivation vocations and agricultural production systems, in which large, extensive farms deriving from the recent land reclamations coexist with small, family-controlled, specialized ones. Complex surveys were required in order to obtain the information necessary for the design study, involving both the relevant offices of several institutions and a representative number of farms within the study area.

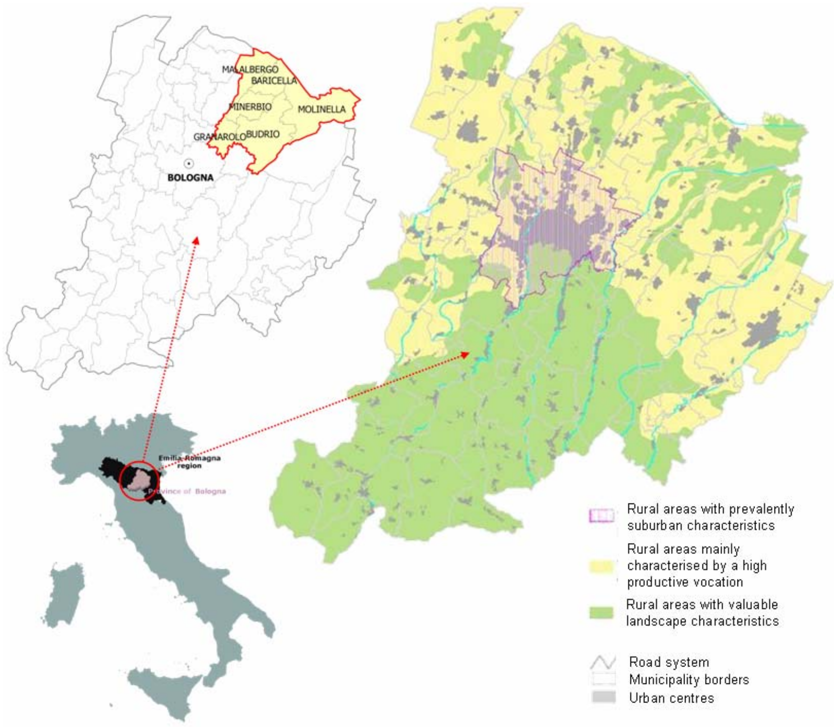

Figure 2. Territorial areas of the Province of Bologna (Territorial Coordination Provincial Plan, articles 11.6, 11.7, 11.8) and identification of the study area.

These farms were selected on the basis of several criteria, regarding both the farms themselves and their surrounding environment. However, the main selection criterion was the presence of recently constructed rural buildings. To that end, the decade 1992-2002 was defined as the reference time range within which to search for all building permits issued by the six municipalities. Because data about prior building permits were not available in digital format, it was not possible to extend the analysis to previous periods.

7. ANALYSIS METHODOLOGY

The operative methodology consisted in the definition of both the methods to be adopted for the analysis and the data to be researched and acquired during the surveys, which were performed on the above-mentioned sample of farms and at several institutions. Detailed survey forms were prepared, divided into sections and thematic fields for each element researched. The method used proved suitable both to detect existing connections among single elements and their relationships with the surrounding area, and to organize information about the objects analyzed. It enabled us to understand the main factors influencing the construction of the building, not only singularly, but also in relation to each other and to the surrounding structured environment. Survey forms were organized into three parts (A, B, and C). Part A, in turn, was divided into four sections (A1, A2, A3, and A4). There follows a description of the thematic content of the various parts and sections.

Section A1 contains data describing the farm site*: geographical and administrative location* (building location with reference to the territorial context), *legal status, reference cartography* (references and extracts from regional technical maps, identifying the site in question), *cadastral maps and data, constraints* (buildings subject to planning restrictions because of their architectural and environmental features are noted), and *town planning instruments* (specifying the town planning scheme covering the area in question, as well as zoning and permissible transformations for the individual construction).

Section A2 contains data describing the farmyard and the surrounding area: *development of the farm layout* (farm layout before and after the introduction of the building in question), *technological networks* (connections with facilities and grids), *physiognomy of the built area* (any valuable element located in the yard), *notes and observations* (information obtained through both interviews with operators and historical documents).

Section A3 contains data describing the characteristics of non-investigated buildings, i.e., of rural buildings constructed recently or in the last decades, that are located on the farm but were not analyzed. The aim of this census phase was to establish an impression of architectural history and development, material and constructive traditions, useful in highlighting connections and distances with reference to new buildings. The form specifies the following fields: *qualification* (typological class the building belongs to), *building development* (definite or presumed construction date and information about successive modifications), *horizontal subdivision* (the various levels of the building), *plan of the building* (building layout), *structure - infill panels - horizontal divisions - roofing* (construction morphology and predominant materials), *utilization* (original and current building use), *annotations* (information obtained from interviews with operators).

Section A4 contains data describing the characteristics of the building analyzed: *location* (position of the building relative to the layout of the farmyard and other buildings in the yard), *connection with the public road system* (location of the building as regards both the public road system and points of access to the farm), *building envelope* (a comparison is made between the layout and vertical dimensions of the considered building and those of the surrounding ones), *correspondence to the licensed project* (any changes made over the years are recorded). The following information is also reported: *qualification, building development, horizontal division, plan of the building, structure, infill panels, roofing*, and *utilization*, as defined in section A3.

Forms in part B are dedicated to gathering all the information necessary both to describe the territorial reference system and to evaluate the connections between each site and its surrounding area. The data collected concerned: the location of the buildings analyzed, inside a farmyard or in the open country; the presence of impermeable areas nearby, of drainage systems, shielding systems and impacting production activities, and their classification according to their environmental value.

The conditions of the landscape system in which the farms are located were also recorded in terms of: prevalent crops in the surrounding area, infrastructural linking systems, type of agro-forestry and natural elements on the site and in the surrounding area. Particular environmental and morphological conditions were also investigated as regards: conditions of both shading and wind exposure, significant meteorological events recorded, the aquifer level, water supply and soil type.

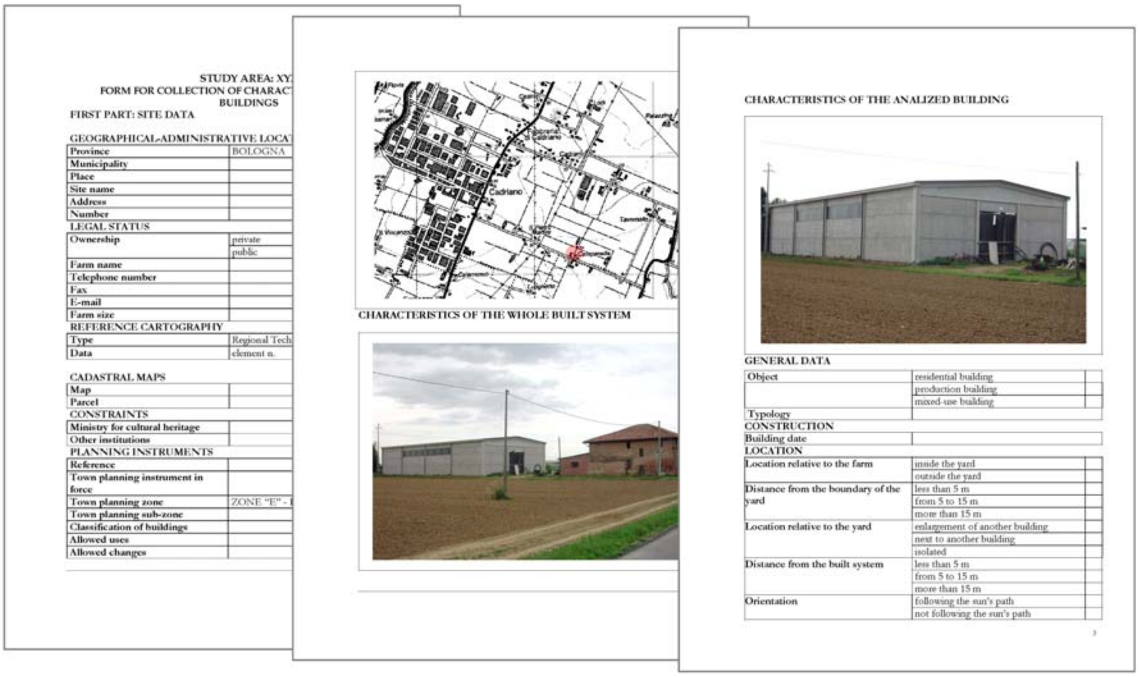

Figure 3. Extract from survey forms.

Finally, part C was dedicated to gathering the main information regarding the agricultural characteristics of farms, such as their overall dimension and utilized cultivated area, prevalent farming arrangement, presence and extent of areas assigned to EC contributions and presence and typology of animal husbandry. Figure 3 shows an extract from the survey forms.
Data about the farm size and the prevalent farming arrangement were collected both for the period of construction and for the present, in order to detect any changes. The analysis of the data collected, which is not shown here for brevity's sake, consisted of two fundamental steps. The first considered the buildings, and involved the elaboration of information regarding their architectural, technological and construction aspects, which proved to be fundamental to understanding the formal and compositional logic of the buildings; the second investigated the characteristic elements of the considered territorial system and the characteristics of the farm.

The individual and integrated evaluation of all these information levels also allowed the definition of several typologies of mitigating measures, offering differentiated effects according to the specific requirements identified (entities and types of various impact components and different farm requirements and connotations).

8. RESULTS OBTAINED: METHODOLOGY AND DESIGN

The design methodology was organized as follows:

1. analysis of perceptive peculiarities of the sites;
2. definition of the mitigation weight of each action;
3. definition and design of several typologies of solutions and assessment of their feasibility conditions.

As mentioned in section 4, for the sake of brevity this paper focuses on the discussion of phases 1 and 2, whilst only a few design solutions elaborated for phase 3 are reported here, with reference to two of the most representative typologies.

8.1. Analysis of Perceptive Peculiarities of the Sites

The results of the above-mentioned analyses served as preparation for the start-up of this phase, which involved the definition of several parameters, adopted in all evaluations required for the design of different typologies of mitigating solutions. These parameters are: the *Site Visual Potential* index (SVP), the *Site Visibility Importance* index (SVI) and the *Building Perceptive Importance* index (BPI). This phase consisted of several levels of in-depth studies that started with a critical analysis of the state of art and led to the definition of an analytical methodology elaborated by the author by means of personal revisions of known criteria and methods. These elaborations were also facilitated by the surveys performed on the various farm arrangements of the farms in the sample.

Once the methodology and the parameters had been defined, the next phase consisted in the definition of criteria to evaluate the perceptive impact of the site where the building in question is located. This is a necessary condition in order to implement the subsequent design phase, in which the various types of solutions are defined with regard to their specific mitigation efficacy. Analysis of the characteristics of the buildings, performed during the above-mentioned surveys, revealed that they share common characteristics in terms of typological, formal, material and chromatic solutions, which bear no relation to the building tradition of the sites or the character of the rural landscape. With this in mind, the proposed design methodology mainly centered on the analysis of the relationship between the building and its surrounding area, leaving aside any specific consideration about the building itself. It is quite conceivable that changes in the magnitude of potential impact depend mainly on the characteristics of the reference environment of the site, and in particular on the following factors: urbanization level, prevalent land use and potential site accessibility to viewers.

The methodological framework consists of sequential steps, each making use of matrices which consider different types of significant variables each time. The output is the definition of those parameters which are then taken as input for the matrices of subsequent steps. In particular, the prevalent farming arrangement and site isolation characteristics (as regards both urban centers and other built-up areas such as farmyards) are believed to cause the exposure level, also called intrinsic visibility, defined by the author using the above-mentioned *Site Visibility Potential*. The combination of this potential with new variables, such as the type of roads around the site, leads to the definition of a further index, with which to estimate the extrinsic visibility level, already defined as *Site Visibility Importance*.

8.1.1. Definition of Site Visibility Potential Index

The analyses and surveys mentioned so far have established the prevalent typologies of both farming arrangement (orchard, sown and horticultural lands, and greenhouse cultivations) and territorial systems of the analyzed area. The latter have been classified as follows:

- lands characterized by exclusive agricultural utilization
  - in non-built context;
  - in a rural yard characterized by both buildings for production and houses;
- territories where agriculture represents the main feature, but which are close to urbanized centers.

This interpretation refers to the different visibility characteristics of the site, caused by the different farming arrangements surrounding it: while orchard lands, and to a lesser extent sown and horticultural lands, can to some extent "hide" the site, specific considerations have to be introduced for greenhouses, which, on the contrary, are capable of increasing its visibility. Elements such as mulching films, tunnels and facilities for covered crops in general, which are classified as detractors of visual quality because of the particular characteristics of their materials (mainly in terms of color and reflection), can draw the viewer's eye, thus increasing the visibility level of adjacent areas. This cultivation system was therefore assigned the highest perceptive weight in the matrix elaborated (see figure 4). Likewise, the presence of a built system, a rural yard or a town near the site makes it less perceptible. In the same matrix, the above-mentioned territorial typologies were correlated with prevalent farming arrangements, and higher perceptive weights were assigned to classes characterized by higher visibility: higher values of SVP mean that the site, and consequently the rural building, have a high visibility level.

The assignment of values to the perceptive weights was based both on known criteria, available in scientific literature, and on in-depth studies and direct experiences of experts and of the author. Should anyone intend extending the same criteria to similar cases, suitable value scales would have to be redefined and calibrated according to both the characteristics and the predominant elements of the site.

8.1.2. Definition of Site Visual Importance Index

While the first step of the above-mentioned methodological framework led to assessment of the *Site Visibility Potential*, the second step focused on the definition of the *Site Visual Importance* index, which correlates the *Site Visibility Potential* to the level of exposure, depending on the road system from which the site may be seen. SVI evaluation focused on the analysis of the road system, since it is a well-known fact that this system is the primary key to the observation of emerging objects characterizing the territory. It is clear that, intrinsic conditions of the site being equal, the busier the road system is, the more visible the rural building appears. In the SVI matrix, the classes defined by the SVP matrix have been correlated with the different road types, country roads, rural link roads, local roads and freeways, assigning increasing perceptive weights from the first (mainly used by people who work on the farm) to the last (commonly used by the general public).

Thus the visual importance of the site depends on the relationship between its visibility potential and different surrounding conditions, which contribute to make it more visible. For example, a site with high perceptive weight, but visible only from country roads, will be less perceptible than a similar one which is visible from a freeway.

Site Visibility Potential: SVP

			Cultivation system	Orchard	Sowing Horticultural	Greenhouses
				a	b	c
Territorial areas			perceptive weight	1	2	3
territories exclusively characterized by agricultural utilization	Non-built context	A	3	Aa 3	Ab 6	Ac 9
	Farm yard	B	2	Ba 2	Bb 4	Bc 6
territories mainly characterized by agriculture, close to urbanized centers		C	1	Ca 1	Cb 2	Cc 3

Site Visual Importance: SVI

	ROAD SYSTEM	country roads		rural link roads		local roads		freeways	
		1		2		3		4	
SVP	Perceptive Weight	1		2		3		4	
Aa	3	Aa1	3	Aa2	6	Aa3	9	Aa4	12
Ab	6	Ab1	6	Ab2	12	Ab3	18	Ab4	24
Ac	9	Ac1	9	Ac2	18	Ac3	27	Ac4	36
Ba	2	Ba1	2	Ba2	4	Ba3	6	Ba4	8
Bb	4	Bb1	4	Bb2	8	Bb3	12	Bb4	16
Bc	6	Bc1	6	Bc2	12	Bc3	18	Bc4	24
Ca	1	Ca1	1	Ca2	2	Ca3	3	Ca4	4
Cb	2	Cb1	2	Cb2	4	Cb3	6	Cb4	8
Cc	3	Cc1	3	Cc2	6	Cc3	9	Cc4	12

Figure 4. Matrices of Site Visibility Potential and Visual Importance.

8.2. Definition of the Mitigation Weight of Each Action

Since the specific aim of the study was the definition of reproducible models for the design of vegetational systems capable of both mitigating the aesthetic-perceptive impact caused by existing rural buildings and improving several functional and structural components of farms, once the SVI index was defined, a system for evaluating the efficacy in terms of both mitigation and environmental improvement of vegetational mitigating systems was established. This capacity can be summed up using the index called *Mitigating Element Weight* (MEW), which provides a link between the site analysis phase and the design phase, at the moment of choosing the most suitable solution or set of solutions to reduce the building's visibility. It is thus assumed that SVI decreases where there are mitigating elements. This weight depends on the specific characteristics of the mitigating solution, and allows us to assess its mitigation capability and to relate it to the perceptive characteristics of the site. The assignment of this weight is the result of evaluations obtained both from a multidisciplinary panel of experts and from a sample of potential observers, and by means of the comparison of single and specific study cases.

The methodological procedure ends with the definition of the *Building Perceptive Importance* index, which takes into account all the aspects analyzed so far. The BPI index can be expressed as follows:

$$BPI = - SVI + \Sigma\, MEW \qquad (1)$$

A suitable combination of mitigating elements should be chosen, giving due consideration to their different values in terms of aesthetic, ecological and environmental functions (as described in the following section), in order to set a BPI index greater than zero.
This criterion allows the assessment of the efficacy of the mitigating solution or set of solutions that can be adopted, according to the specific visibility conditions of the site.
The indices defined by the author are an integral part of the methodology, and their development was the main conceptual goal of the study. The methodology should undergo subsequent revision processes in order to verify its practical applicability.

These processes call for in-depth studies of assessment methodologies, which may usefully draw on suitable simulation systems making use of the more and more sophisticated information technologies available. Specific in-depth studies about these issues are currently being developed by the research team to which the author belongs. These studies, which lie outside the domain of this study's aims, will be the subject of future work.

8.3. Planning of Different Typologies of Solutions

The study has defined several design solutions, with effects ranging from a localized to a broad scale, which aim not only to mitigate visual impacts but also to improve rural, ecological and environmental functions.
Indeed, it is a well-known fact that the general improvement of functional and structural components of both farms and sites where the buildings are located are matters of prime importance. These actions are associated with an increase in widespread naturalness and strengthening of ecological and environmental characteristics.

The consequent increase in their attractiveness for parallel aims and activities besides agricultural ones involves important social repercussions. The mitigating solutions mentioned,

if designed giving careful consideration to the main variables involved, could represent examples of efficiency in terms of control of several kinds of impact.
The development of localized solutions requires the collection of data specifically intended to give a precise multidisciplinary description of both the yard layout and the area near to the built system. As regards the development of broader-scale solutions, the information to be gathered should correspond with the territorial scale used.

Localized solutions (such as isolated arboreal specimens, arboreal-shrubby hedges, systems of rows with different heights, and wooded belts) are by their nature scattered across the rural territory, so that whilst they may have the same kinds of function as the broad-scale ones (green belts linked to road and water systems and to the Roman centuriation grid, arboreal hedges and hedgerows, series of windbreak barriers), they are characterized by moderate significance from a territorial point of view.

The above-mentioned functions, common to both localized and broad-scale solutions, can be classified as follows: *scenic-perceptive function* (visual mitigation of buildings); *connective function* (visual mitigation of buildings, increase of natural circulation, microclimate improvement); *resilient function* (visual mitigation of buildings, increase of natural circulation, microclimate improvement and anti-erosion action).
Figures 5 and 6 show the design of a local and of a wider-scale mitigating solution, respectively. The combination of indigenous arboreal-shrubby specimens with systems of rows offers visual mitigation of the presence of the building by rearranging the landscape skyline, causing a general improvement in the aesthetic quality of the landscape.

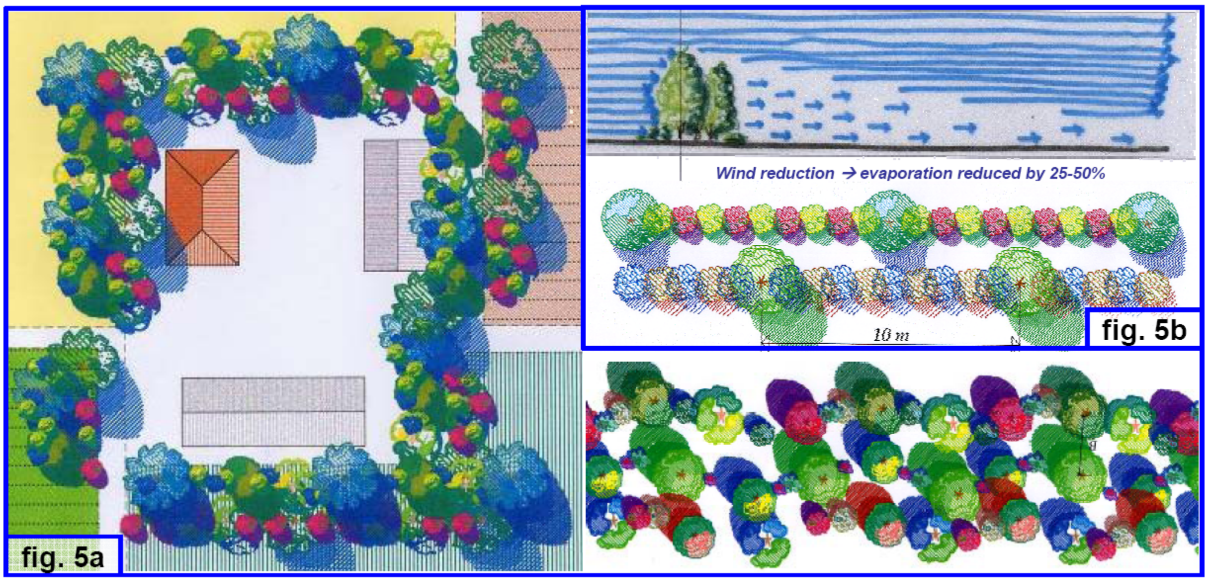

Figure 5: Localized solutions. Fig. 5a: wooded belts (non geometric waved planting, with alternated arboreal and shrubby species); fig. 5b: arboreal-shrubby hedges.

Suggested solutions were also evaluated in terms of feasibility conditions, good realization practices and realization costs. In-depth discussion of these aspects is not given in this paper because, as already stated, it lies outside the domain of this study's objectives.

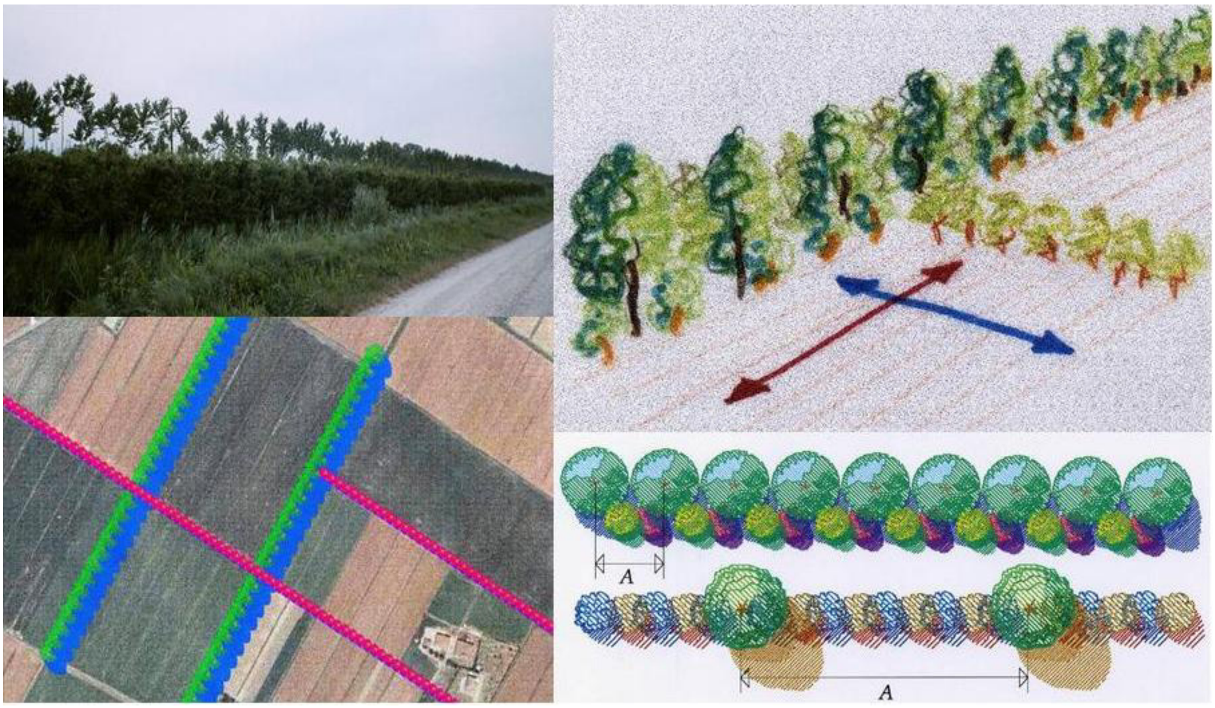

Figure 6. Broad-scale solution: multi-row system.

9. CONCLUSIONS

This paper focuses on the discussion of a design methodology for the evaluation of individual site-perception characteristics, which is one phase of a broader study belonging to a regional project of landscape upgrading. The project was undertaken, in collaboration with the Emilia Romagna region and the Province of Bologna, after the drawing up of the Territorial Plan of Provincial Coordination of Bologna and the issuing of Regional Law 20/2000.

The main aim of the project was to define reproducible models for the design of vegetational mitigation systems, capable of both visually mitigating existing rural buildings and improving several functional and structural components of farms. The project thus needed first of all to define a methodology allowing the evaluation of both the visual importance of the building and the weight of the mitigating elements, relative to the different typologies of solution. This line of investigation was the main goal of the project.

The combination of the in-depth theoretical studies, the surveys on a representative sample of farms and the analysis of the results obtained, allowed the definition of a methodology capable of evaluating an impact factor index (SVI), by means of matrices and the logical attribution of weights to the factors considered. The definition of SVI is the principal datum for both the identification and the design of the most suitable mitigating system. The methodology developed, whilst requiring further calibration and standardization by means of further case studies, may be considered as an interesting conceptual approach applicable to analogous studies, also on wider territorial scales.

The study showed how some of the issues analyzed regarding the elaboration of the proposed methodology call for further specific investigations, which will be the subject of future work. Methods such as Analytic Hierarchy Process (AHP) and fuzzy set may help improve the process for landscape valorisation, which actually represents a multi-criteria issue. Further investigation of techniques for visual landscape analysis and of design criteria for new constructions, restoration and rehabilitation of existing buildings in rural territory, as well as their integration, may bring useful contributions for the calibration of the proposed methodology. The author and her research group are now focusing their attention on these topics.

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