A DSS model for the governance of sustainable rural landscape: a first application to the cultural landscape of Orcia Valley (Tuscany, Italy)

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1. Introduction and State of the Art[1]

The European Landscape Convention (ELC) defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" and underlines that "a landscape forms a whole, whose natural and cultural components are taken together, not separately" (Council of Europe, 2000). This not only asks for an integration of the methodologies and approaches that concern bio-physical and socio-cultural aspects, but asks also for the adoption of proper tools able to highlight the effects of human activities on landscape. Indeed, as highlighted by Conrad et al. (2011a), the Explanatory Report of ELC observes that landscape protection, management and planning can be a complex matter necessitating multi-disciplinary work. The need for public intervention in this field derives from the economic characteristics of landscape; indeed, rural landscape is a pure public good and an externality (positive or negative) of farming and other economic activities that exploit and modify the land. Although landscape protection could be pursued by means of "command and control" policies, based on the definition of standards to be respected on land transformation, nevertheless standards are usually scarcely effective and often opposed by people who suffer for their implementation. Besides, command and control policies are ineffective in opposing passive transformations due to an activity being abandoned that in some way contributes to the landscape maintenance (Tempesta, 2014), as in the case of agriculture, especially in some rural marginal regions. In recent years there has been a growing awareness of the multifunctional role played by agricultural activities (OECD, 2001), which not only provide food and fibre for producing goods but also services, such as environmental protection or landscape conservation. These services are

[1] Due to the specificity of landscape problems, we have preferred, when possible, literature on international journals referring to the Italian situation

usually defined as “no commodity outputs” and according to their type and the context in which they are produced, they can develop into proper economic activities (farm diversification, e.g. selling services relating to hydrological protection or forest management) or remain outside the market. In this last case it is important to understand if these services are necessarily provided, or not, by agricultural activities. Indeed, while in the first case policies aiming at maintaining agricultural activities may automatically maintain also an adequate level of no-commodity outputs, in the second case, specific interventions will be required in order to maintain such a level. De Groot et al. (2010) propose that the concept of ecosystem services and values should be integrated in landscape planning, management and decision making, changing the focus on ecosystem services production from agriculture to landscape, although agriculture remains the main driver for the change of rural landscape. In this framework it is paramount to study and to understand the impacts of agricultural policies, e.g. the Common Agricultural Policy (CAP) of the European Union, which can play both the role of driver of landscape change and that of response to landscape deterioration. Indeed, while the past policy of direct payments, with the consequent intensification of agriculture and the research of economies of scale, has brought about a simplification and homogenization of the rural landscape (see e.g. Agnoletti et al., 2011, van Zanten et al. 2013), Pillar 2 measures, by promoting rural development, have often prevented abandonment and land deterioration. The vast literature dealing with the ex-ante and ex-post evaluation of CAP impacts on rural landscapes (e.g. Brady et al, 2009, Lefebvre et al., 2012, Agnoletti et al., 2011) confirms the growing interest in the analysis of such policies as drivers of the level of ecosystem services provided by landscape. After the last CAP reform and the introduction of greening rules, landscape conservation and management can be directly promoted also under Pillar 1, although there is a concern that direct payment effects on landscape could be

– as in the past – significant and negative. Besides, albeit many Authors stress the need to reconcile production and environmental integrity (see, e.g. Costanza et al, 1997; Robertson and Swinton, 2005), there is the risk of an alteration in the balance between policies promoting productive and non-productive functions of agriculture. Thus, while in more productive agricultural areas there is the risk of an intensification, due to the increase in world population and the consequent increase on demand of agricultural products, which could cause famine and social tensions, less fertile areas risk the abandonment because of too high costs of production. Due to its spatial characteristic, landscape is also ruled by territorial planning, which states rules and standards about land use and transformation, usually through command and control tools, as stated above. Territorial planning is usually regulated by laws that are more area-specific than agricultural policies, being mainly related to the regional and sub-regional levels. Last but not least, there are other policies, mainly dealing with environmental issues (see, e.g. rules dealing with nitrogen use or the use of water), that can influence agriculture and landscape services. These policies deal with issues that have to be faced at different spatial units (e.g. landscape systems, hydrological catchments, administrative areas, ecosystems, protected areas, etc.), thus implying that analyses should be able to work at different scales and to integrate them. Besides "spatial" scales also "temporal" scales are very important, especially in the case of historical cultural landscape. A review of the methodological problems about scale arising in interdisciplinary research on landscape is provided by Higgins et al. (2012).

As we have above stated, landscape conservation, management and planning is a very complex task, implying not only interdisciplinary but also transdisciplinary approaches. The need for an interdisciplinary approach is due to the fact that landscape quality and the ecosystem services that it provides depend on many features belonging to different research fields. According to

Vizzari (2011) potential landscape quality relies on three different classes of components, namely “Physical-naturalistic”, “Historical-cultural” and “Social-symbolic”. Conrad et al. (2011a) stress that still “there appears to be a bias in academia towards ecological concerns, which contrasts with the more holistic approach adopted in landscape policy”. According to Agnoletti (2014), there is also a bias towards nature and environment at policy level, insofar international directives involving landscapes are often overlapping the idea of nature with that of landscape, encouraging renaturalization, particularly in the form of forest cover, and neglecting ancient landscape patterns. This “reduction” of landscape to elements mostly related to nature and environment emerges also from a survey on landscape aspirations in Ghent area (Sevenant and Antrop, 2010, p. 384).

As regards the need of a transdisciplinary approach in landscape research, this asks for an involvement both of academic researchers and non-academic partners, such as managers, administrators, and the local public (Sevenant and Antrop, 2010) with the aim to prevent the risk of an “expert-led” landscape elitism, focusing resources and attention only on iconic landscape (Scott, 2011). Following the ELC statement that, “landscape is an issue which affects the whole population and care for the landscape requires collaboration between a wide range of individuals and organisations” (Conrad et al 2011a) many researchers have focused on the problems of people’s perceptions (Howley, 2011; Howley et al., 2012; Conrad et al., 2011b; Tempesta, 2010; Tempesta, 2014), people’s aspirations about landscape (Sevenant and Antrop, 2010) and public active involvement in policies. This implies a shift from top-down “command and control” tools towards models of Governance where local population have a role (see, e.g., Scott, 2011; Southern et al., 2011).

As regards Tuscany, where the case study area is situated, although the high reputation of outstanding beauty of many Tuscany landscapes could bring about the risk of “elitism”, nevertheless the diffuse awareness of the importance of landscape, also for economic reasons, promotes the willingness of local stakeholders to participate to landscape governance (see, e.g. Gaggio, 2014).

In this framework, a proper tool able to support governance decision for sustainable rural landscape should be able to consider and integrate all the above mentioned aspects.

In this paper we propose a general framework model for the governance of sustainable rural landscape and a first, simplified application of this model that has been tested on Orcia Valley in Tuscany, a Region with a very high landscape reputation. According to Van Assche and Lo (2011) “The original drivers of value formation, and thus asset creation, are to be found in civic traditions and in early tourism (English, later German), in turn driven by literature, painting and by certain images of a well-rounded education for a gentleman”. In more recent times, also well-known movies set in Tuscany Region, such as “The English Patient” or “A room with a view” have contributed to the international reputation of its landscape. Tuscany landscape reputation is important also in connection with origin denomination food products (see, e.g. Miele and Murdoch, 2002), and could have a great economic relevance in terms of place branding in many fields (see, e.g.: Bellini et al., 2011; Gaggio, 2011). Inside Tuscany, Val d’Orcia is particularly well known as it is a UNESCO Heritage site, as detailed in the case-study paragraph.

This paper analyses and evaluates the connections and feedbacks between farmers’ strategies, agricultural policies and landscape evolution since it is assumed that the evolution of rural landscape (and of the ecosystem services it provides) mainly depends on changes of farms’ productive arrangements. These latter, in turn, depend on specific business strategies that are

conditioned by the specific set of available (physical, economic, human, etc.) resources and by external factors such as agricultural policies and commodity market trends. In the case of Orcia Valley, indeed, the CAP and durum wheat high prices have had a key role in bringing about the current landscape. At present, the Orcia Valley landscape is considered as an identity element and a strategic factor for this territory's good reputation (Antrop, 2005) and, although the local community would like to maintain or to develop it in a sustainable way (001, 2007 masked for blind review), it is nevertheless under threat due to the change of CAP. In this framework, the aim of this paper is to propose a decision support system able, for a specific area, firstly to improve the knowledge of the possible effects on landscape and its ecosystem services deriving from changes in farmers' choices due to internal and external factors, and then, to suggest possible area-tailored interventions to counteract the significant and negative effects that CAP can produce. Although the implementation on the case-study has focused on the main type of ecosystem services provided by the area, namely cultural ecosystem services, nevertheless it is the Authors' opinion that the results are able to highlight the potential usefulness of the proposed model.

The model is based on the integration of approaches, such as Geographical Multi-Criteria Analysis; advanced GIS-based geo-processing tools and participatory techniques aiming to understand local people perception and foresee local stakeholders' behaviours through focus-groups and dedicated interviews.

2. The model for the governance of sustainable rural landscapes: general framework and methodology applied to a cultural landscape.

2.1. The general framework

In this chapter, first of all an outline of the general framework methodology is provided; this general model, in our opinion, can be implemented in a vast range of landscape/areas. Then a more detailed description of the methodology that could be applied to a cultural landscape, such as the one of the case-study analysis, is given. In both cases, some adaptations may be needed insofar landscape evolution and governance of an area is deeply connected with the institutional, cultural and socio-economic framework in which public institutions and stakeholders operate (see, e.g. Gaggio, 2014); consequently the most relevant features to be taken into account vary from area to area.

The general framework for the governance model of sustainable rural landscape (Figure 1) requires:

- a evolutionary analysis based, from the one hand, on statistical and territorial analyses, and, from the other hand, on participatory tools, able to highlight the evolutionary path that has brought about the current situation of the area and its landscape;
- a current situation analysis based on the hypothesis that both territorial characteristics and farm characteristics, through farmers strategies, are having an impact on landscape and its ecosystem services. Farm strategies are also influenced by external factors such as commodity market trends, and policies, laws and regulations, which could be compulsory (e.g. environmental or land use standards) or voluntary (e.g. some of the aid given to the agricultural sector). Stakeholders could consider Ecosystem Services provision not satisfactory in the present situation or at risk for the future and thus could ask for some

intervention. Policies and laws are not only determinants of the initial landscape situation (see evolutionary analysis), but also tools for modifying it in the future, in the case that the effects of farmers strategies on landscape ecosystem services (see present time loop) ask for an intervention. In this case, the loop goes on through the identification of the priorities in terms of areas and ecosystem services whose production has to be improved, and the choice of actions (through existing or new policies, laws and regulations) that are more effective and efficient in facing the problem.

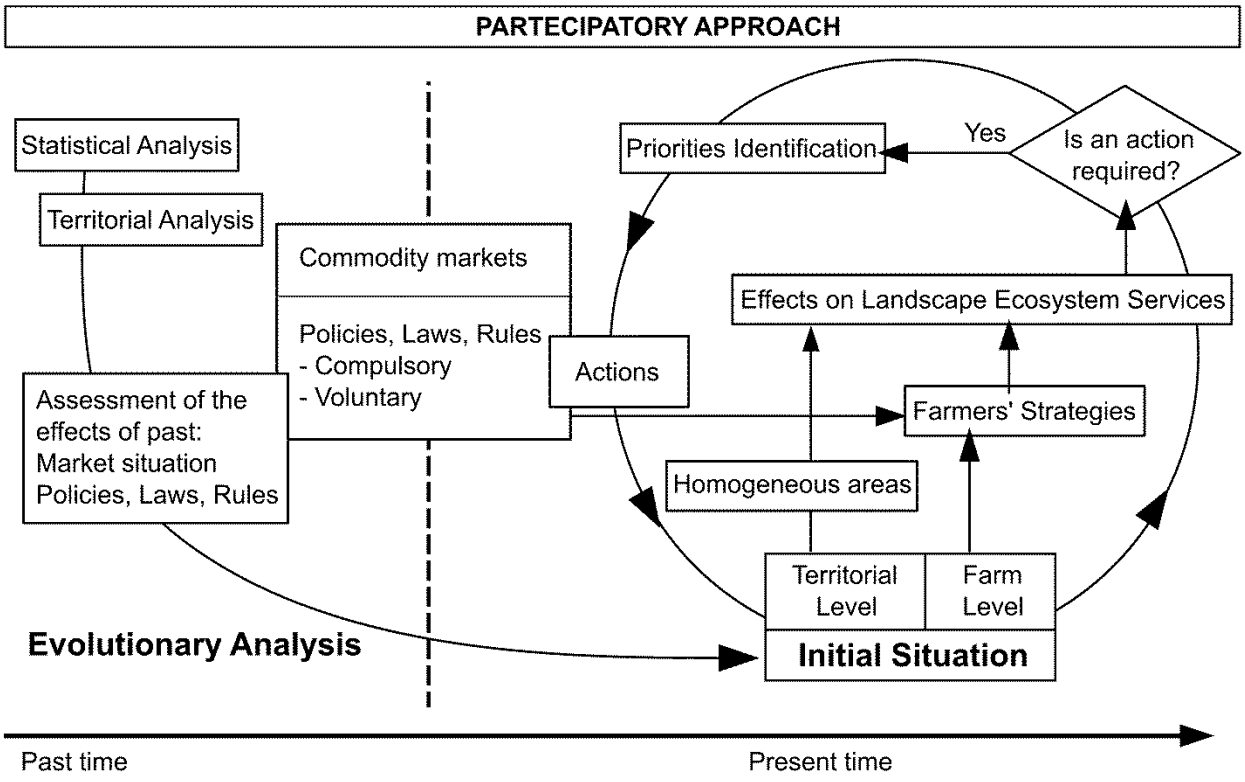

Figure 1. Flow chart of the model for the governance of sustainable rural landscape.

2.2. The role of GIS-based Multicriteria Decision Aid Techniques and participative approach

As above stated, in our "model for the governance of sustainable rural landscapes" all evaluations are based on the integration between tools proper of territorial and environmental analysis – as GIS-based Multicriteria Decision Aid Techniques – and participatory instruments

(Southern et al., 2011). In particular, both territorial and farm analyses are implemented via Geographic Multicriteria Decision Aiding Techniques able to rank the spatial decisional alternatives under study according to their specific and often conflicting evaluation criteria, which are represented through standardized map layers (Malczewski, 1999, 2006a, 2006b). Among the several multicriteria analysis techniques described in literature (Beinat and Nijkamp, 1998; Mendoza and Martins, 2006), the multi-attribute Saaty's Analytical Hierarchical Process (AHP) has been chosen (Saaty, 1980, 2004, 2008; Saaty and Vargas, 1994; Vargas, 1990). This method constructs the evaluation process through distinct phases, assuming as a principle the possibility to segment a complex decision-making problem into smaller and simpler sub-problems composing a hierarchical structure, within which it is always possible to measure the influence each part has on the whole system.

As a matter of fact, in the AHP method, three different stages can be identified: a) analysis, b) pair wise comparisons, and c) hierarchical re-composition. The analysis phase consists in defining a hierarchical structure able to encompass the most important elements for the decision problem; a first level is represented by the general aim of the evaluation (goal), then there are some intermediate levels represented by criteria, attributes and sub-attributes, while the last level is typically represented by decision alternatives. In a geographical multicriteria decision making analysis, criteria, attributes and alternatives are represented in the physical space of territory; thus the hierarchical structure generally ends at the attribute or sub-attribute level (Siddiqui et al., 1996). Therefore, decisional alternatives can be represented, under a GIS framework, via points, lines, polygons or pixels that contain the attributes values. In this study, alternatives are geographically represented by polygons that in the farm analysis locate farms and plots areas, while in the territorial analysis they locate landscape systems and subsystems since planning

rules could vary according to the system or subsystem. Since it is quite difficult to implement a general model, taking into account historical evolution and present farm and territorial features, able to adequately represent all the existing links, our model hypothesizes that – in order to indentify the relevant attributes – the score of criteria could be summed up by the weighted sum of the lower hierarchical level, according to the described methodology provided by Saaty. The results of the analysis should be validated by stakeholders, in order to check that there aren't significant impacts on the quality of results due to this simplification.

Within this model, the participatory method has a fundamental role as it allows to collect information at different levels (002, 2008 masked for blind review) and to involve the whole population – and not only experts – in the governance of landscape, as required by a transdisciplinary approach. During the initial phase, participation could allows to understand: a) the stakeholders' perception as regards present landscape distinguishing elements and the level of ecosystem services provided; b) the evolutionary dynamics they have had in time, c) the main determinants (market trends, planning and policy tools) that have influenced farmers' strategies up to the present situation and that could influence farm evolutionary paths. Evolutionary analysis is not only important for cultural landscape, since Italian recent history demonstrates that the "local memory" could have been a useful tool to avoid present land management mistakes, e.g. in the case of risk of floods or landslides due to the excessive weight of the vegetation cover.

In the farm and territorial analyses, participation mainly involves the discussion with different stakeholders about criteria, sub-criteria and attributes to be introduced in the analysis, to be chosen among those proposed by literature. The final choice of attributes should take into account also the interviews to key informants; e.g. the type of cropping technique and the type of

market channel have been introduced in the case-study analysis because the participative approach has confirmed that farmers that adopt organic techniques and sell their products directly on farm have a attitude towards landscape that is different from the one of "conventional" farmers. Scores to attributes are given by stakeholders through pairwise comparison. For this phase of the participative approach, mainly face to face interviews to key informants should be performed, while the results of the analysis should be discussed in focus groups with the participation of all the category of stakeholders.

Participation through focus groups allows also to individuate priorities for response actions able to promote a sustainable rural landscape, according to stakeholders' opinion about Ecosystem Services and their influence on well-being. The discussion has the aim to single out compromise solutions, able to involve in their implementation the highest number possible of stakeholders. Thus, the role of participation in the model is not only limited to informative or consultative processes, but it actively contributes to the results. For this reason in the figure describing the general model (Figure 1) the participatory approach is presented in the top part and it is supposed to contribute both to the evolutionary analysis and to the part of the governance model, aiming to highlight the best actions to be implemented, based on the present situation. From a public institutions viewpoint, actions should be chosen taking into account the level of effectiveness and efficiency characterizing each command and control and voluntary tool (see, e.g. Tempesta, 2014). The governance model should be able to individuate priorities and intervention methods for each homogeneous territorial ambit, in accordance with public priorities, farmers' strategies and specific rural landscape characteristics.

2.3. Testing the model on a cultural landscape: the applied methodology

Since the management of ecosystem services provided by landscape is very complex, in testing our model we have decided to focus on rural cultural landscapes where the main ecosystem services (ES) provided are cultural ones (Wu, J. 2013, fig. 6). As stated by Wu, "from a multi-scale perspective, Daly's strong sustainability at a broad scale may not be achieved without a proper combination of weak and absurdly strong sustainability on smaller scales". From a spatial point of view, this, in our opinion, could mean that on small scales it is usually not possible to require very strong sustainability for all the ecosystem services provided and thus it is necessary to focus on the ones that are paramount in the analysed context. Furthermore, on a small scale it could be very difficult to evaluate the contribution of an area in providing ecosystem services like the one relating to water regulation and climate change, since those have to be analysed at a larger scale. For the above mentioned reasons, the problem of sustainability in the applied methodology focuses on the research of a dynamic balance between human development and environmental protection (Bruntland Report, WCED 1987), namely the permanence of a landscape for future generation without compromising the chance of present generation to make a living in the area (social and economic sustainability).

In the following part we present the details of how this approach could be implemented in a cultural landscapes, mostly referring to the specific methodology that has been applied to the case study, although some hints on how the model could be adapted to different landscape contexts are given.

The evolutionary analysis

As already anticipated, firstly our model requires a historical and evolutionary investigation (Figure 1 - left part), in order to evaluate the effects of agricultural policies and other driving

forces on farmers' choices in relation to agro-territorial and landscape evolutions. While in our model we have considered only farmers as "agents" directly influencing landscape, it would be possible, if relevant, to widen the analysis to other landscape managers (see van Zanten et al., 2013). This phase aims to clarify the relations among the social, economic, and environmental systems, investigating their contribution to ecosystem services provision. When analysing a cultural landscape, the focus is usually on landscape configuration and on the forces by which landscape has been shaped. This phase includes the following steps: a) identification of social and demographic dynamics, b) analysis of the evolution both of agricultural and forest cultivations, and of the most representative vegetation for the study area and c) study of their connections with the local culture (Agnoletti and Maggiari, 2004; Sereni, 1997). Landscape is made of elements that cannot be simply summed, but rather it is formed by a multitude of historical (both present and past) relations that join such elements. It is therefore necessary to identify the cultural identity of a territory, which is expressed by complex links among natural and anthropic factors evolving during the time (Ihse, 1990; Mayes, 2010). The historical knowledge has been organized in two phases; a diachronic reading, with the aim to understand temporal transformations, and a synchronic reading, with the aim to find out traces of the past that are still present and in order to provide a comprehensive picture of the present situation. The comparison between cartographies and aerial orthophotos, relating both to historical and present situations, allows to individuate the permanencies among anthropic settlements and territorial contexts, which are visible in the scheme of spaces, materials, visual and symbolic features. Indeed, as Agnoletti et al. state (2011, p. 122) "the landscape is the result of the centuries-old interaction between man and the environment, and so to define an element of the landscape as *characteristic* the land use dynamics and changes to the landscape must be evaluated over a long

time span". Visual and symbolic features are important because landscape knowledge not only implies a study of physical and historical spaces as landscape is also the place of memory. The acquired historical knowledge permits to point out the characteristics that are specific of each landscape in order to direct planning choices in the correct way. Such knowledge can be acquired both via social and historical studies, and consulting the archives of local communities. Although in the implementation of the model, due to the role of cultural landscape of the case-study area, we have focuses on land use and elements of the landscape, such as hedges and isolated trees, in landscapes where regulating, supporting or provisional services are more important, statistical data and previous researches could be used for tracing the evolution of parameters that are more focused on the natural environment. In this case, the analysis should include, e.g., studies on the loss of biodiversity, on erosion or water management, on air, water and soil pollution due to the inputs and wastes linked to agriculture or other anthropic activities. Then, the analysis investigates the current scenario (right part; see "initial situation") both from a territorial and farm viewpoints.

The territorial analysis

The territorial analysis is necessary to classify a territory into homogeneous ambits as regards the level of ecosystem services that they are able to provide and the risk that anthropic activities could negatively impact on them. In the case of a cultural landscape, such as the one analysed in the case-study, the analysis needs to focus on landscape quality and sensitivity, related to the diffusion and density of several landscape identification elements and on the presence of relevant environmental resources, such as areas with environmental interest. Indeed, area with environmental interest are usually characterized both by a high value, and by a high vulnerability.

With this aim, a geographic multicriteria analysis has been used to create a thematic map of homogeneous areas, which have specific intervention priorities due to their landscape features. In case of landscape where cultural aspects are prominent, the analysis of the main features at spatial level should focus on sensitivity, which we propose to evaluate by combining two criteria called intrinsic value and vulnerability. The first one represents the absolute worth of the analysed element, while the second one indicates the landscape fragility connected with the modifications induced by anthropic activities.

In the case of cultural landscape where agriculture is quite intensive or where there are significant environmental problems, the analysis should broaden and include also aspects other than landscape sensitivity, by introducing parameters such as biodiversity, erosion, water regulation, water, soil and air pollution, etc.

The territorial analysis allows to determine landscape sensitivity values for each portion of an area, and consequently, to individuate and locate zones with similar level of adaptability to the modifications induced by anthropic activities. This analysis and the resulting zoning is therefore necessary to define the most critical zones for the territorial and landscape planning phases, namely the areas with high worth and high fragility, where anthropic activities could easily cause a noticeable loss in terms of cultural ecosystem services and of environmental quality in areas of high environmental value.

The methodology of analysis enables to elaborate all the information relating to landscape sensitivity and to summarize them into a synthetic index: the Sensitivity Index (SI). As previously described, the landscape sensitivity analysis is carried out via a geographical multi-

criteria decision making technique, by using the Saaty's Hierarchical Analysis. Evaluation criteria, attributes, sub-attributes valuation classes and scores[2] are shown in detail in Table 1.

Table 1 – Territorial Analysis: Criteria, attributes, sub-attributes, valuation classes and scores

	Valuation classes	**Score**
CRITERION: Intrinsic Value		
Attribute: Historical-Environmental Value		
Sub-attributes:		
Fragmentation	Shannon Dominance Index <0.2	3
	0.2>Shannon Dominance Index>0.4	2
	0.4>Shannon Dominance Index>0.6	1
	Shannon Dominance Index>0.6	0
Persistence	<10% of territory affected by modifications	3
	from 10% to 50% of territory affected by modifications	2
	from 51% to 80% of territory affected by modifications	1
	> 80% of territory affected by modifications	0
Uniqueness	>5% of territory involved	3
	3-5% of territory involved	2
	1-2% of territory involved	1
	<1% of territory involved	0
Integrity	ratio=1	3
	ratio from 1.1 to 1.5	2
	ratio from 1.51 to 5	1
	ratio>5	0
Visibility	ratio >0.15	3
	ratio from 0.11 to 0.15	2
	ratio from 0.01 to 0.10	1
	ratio=0	0
Attribute: Frequentation		
	>25% of affected territory	3
	from 11% to 25% of affected territory	2
	from 1% to 10% of affected territory	1
	0% of affected territory	0
CRITERION: Vulnerability		
Attribute: Intervisibility		
	high	3
	medium	2
	low	1
	null	0
Attribute: Environmental Value		
	>30% of territory occupied by significant environmental areas	3

[2] Although scores should belong to the analysis of the case-study, since they have been attributed in the framework of the participative approach, we decided to anticipate them rather than duplicate the table

6-30% of territory occupied by significant environmental areas	2
1-5% of territory occupied by significant environmental areas	1
0% of territory occupied by significant environmental areas	0

Score: 0=null, 1=low, 2=medium, 3=high

The four levels hierarchical structure and the score given were determined during the consultation phase with the stakeholders in the case-study analysis, and for this reason it is partly area-specific.

As above described, the territorial analysis is performed by measuring two criteria: Intrinsic Value and Vulnerability. The criterion Intrinsic Value is analysed through two attributes called "Historic-environmental Value" and "Frequentation". The Historic-environmental Value expresses the interaction between natural and anthropic factors and it is analysed through the following sub-attributes: Fragmentation, Persistence, Uniqueness, Integrity, and Visibility.

The Fragmentation is evaluated by Shannon dominance index (Farina, 2006; Shannon and Weaver, 1949), which enables to study the composition of the mosaic made by landscape pixels.

The Persistence is evaluated through the share of territory affected by modifications, in relation to the number and historical persistence of landscape elements, derived from the historic analysis and the interviews with local key informants. This sub-attribute is computed by Sharpe Change Index (SCI) (Farina, 2006; Sharpe et al., 1982). The higher the SCI, the lower the landscape elements persistence.

For the determination of the sub-attribute called Uniqueness, the most typical and unique landscape elements (Regione Toscana, n.d.) that occupy areas within the Orcia Valley have been singled out in the study area; high percentages of occupied surface correspond to high uniqueness values.

The sub-attribute called Integrity concerns the current state of conservation and the geographical extension of a historic landscape that may have worsened in time. This sub-attribute is calculated by computing the surface ratio of the various land use at different time (1954-2002)[3] and determining the average variation.

The sub-attribute Visibility is based on a visibility analysis (performed via GIS) from specific observation points (roads, panoramic points and paths, inhabited places, etc.). This analysis enables to compute the number of points that are simultaneously seen from each elementary cell, namely an area of 10 m^2, of a grid that covers the entire study area. The value of this sub-attribute is calculated by multiplying the visibility index of each i-subarea, where subareas are delimited on the base of homogeneous features as regards constraints and goals in terms of landscape quality level, by its correspondent extension; such products are therefore summed and then divided by the total surface of the entire area. The greater the value of such ratio, the higher the Visibility for the specific area. The aim of this sub-attribute is to give priority of intervention to those portions of rural landscape that, at parity of worth, have higher chances to be seen due to their spatial location.

The attribute called Frequentation concerns the presence of landscape observers in the Orcia Valley and it is calculated as a surface percentage of the most frequented zones, such as urban areas, roads, scattered buildings, panoramic paths, etc. From this point of view, at parity of worth and visibility level, priority should be given to the actions relating portions of landscape that have higher chances to be seen, due to the fact that there are observers which, either for work,

[3] The source of information for 1954 are the orthophotos (volo GAI) that is property of RT-IGM., while information at 2002 are coming from the orthophotos property of the AGEA, namely the Italian Paying Agency, made with the aim to verify the accuracy of farmer's declarations, see http://www502.regione.toscana.it/geoscopio/servizi/wms/OFC.htm

everyday life or leisure reasons, frequent the spots from which that part of landscape could be seen. Thus, while the Visibility provides an analysis of the areas that could more easily be seen, the Frequentation deals with the probability that there are observers on the points from which there is high Visibility, as in the case of noise pollution, where it is not only relevant the level of noise but also the presence of people that could be impacted by it. These percentages are therefore averaged out in order to obtain the total frequentation surface for the entire study region.

The criterion Vulnerability indicates the landscape fragility in relation to the socio-territorial context (i.e. productive assets, service industries, urban city, villages, etc.). This element is studied by using two attributes: “Intervisibility” and “Environmental Value”. The first attribute, when analysed via GIS, consents to compute and evaluate the Intervisibility within the study area, while the second is connected with the presence and extension of highly important environmental zones such as Sites of Community Importance (SCIs), Sites of Regional Importance (SIRs), Special Protection Areas (SPAs), Oasis, etc. Indeed, planning rules single out these areas, on the basis of previous and ad hoc researches, as important for the habitat and supporting ecosystem services that they are able to provide and for their environmental values. Thus these areas could be considered as an “indirect” indicator of a high environmental value.

For each decision alternative represented by the landscape subsystem areas, Saaty’s method computes a landscape sensitivity score that is expressed in a 0-3 numeric scale of increasing sensitivity; i.e. 0=null, 1=low, 2=medium, 3=high, as shown in Table 1.

While in this analysis, due the context that has been analysed, we have supposed that high values and high vulnerabilities tend to be correlated and consequently could be summarized into a synthetic index, in other contexts it could be necessary to have an approach similar to the one

used for summarising plots suitability and farm resistance to external solicitations. In this case, a table crossing landscape quality levels and vulnerability levels could be built and used to define situations that could be managed with the same approach.

The farm analysis

The analysis at farm level is conducted via a GIS-based multicriteria, as the previous one. This analysis aims to evaluate and map, from a short to a medium period point of view, farmers' likely future strategies adaptation capacity to changes of agricultural policies and resulting strategies (Brunori et al., 2008). This because, after the deep transformation that many agricultural areas of developed countries have gone through since the beginning of the 20th Century, a sudden reduction on farming activities could unbalance the landscape and territorial equilibrium. Indeed, the interest for the problems potentially deriving from a sudden reduction on agricultural activities is also apparent from the fact that, since 2006, the original set of IRENA Agri-Environmental Indicators has been reformed by introducing an indicator of the risk of farm abandonment (Corbelle-Rico et al, 2014). While statistics at European level are usually related to administrative units, our analysis goes to a more detailed scale, being based on plots and farm features. The integration of land use and cadastral information has allowed us to use an elementary unit that is very small (plot), while in other researches larger elementary units are used, e.g. a square grid of 1 km (see, e.g. Piorr et al, 2009). The attribution of each plot to an administrative area, landscape subsystem or other sub-area deemed to be important for a spatial analysis allows the model to reconstruct average values at different spatial scales. An analysis on how the drivers of agricultural land abandonment affect biodiversity and cultural landscapes has been performed on European and non-European case-studies from Beilin et al. (2014). In this paper, due to the specific characteristics of agriculture in the case study area, we have considered

farming abandonment a more threatening process than agricultural intensification. Indeed, according to Agnoletti (2014) both current socio-economic trends, which favour abandonment and industrialization, and conservation policies, which support and promote renaturalisation, may likely cause a loss of critical heritage resources. Besides, a sudden and uncontrolled spread of land abandonment could seriously affect the hydro-geological situation of the case study area, and many other similar ones.

In our model we consider farmers choices as affected by two sets of criteria, the first one relating to plots suitability to cultivation, and the second describing farms characteristics; these latter have been classified into the following three subsets (or criteria): a) structural, b) socio-economic, and c) management characteristics. While the first set (plot analysis) aims to analyse the level of plot resistance to abandonment, the second set (farm characteristics analysis) aims to analyse the resistance of farms, that is to say their ability to react to external solicitations. The first criterion (see table 2), namely Plot Suitability to Cultivation, is analysed by the following four attributes: 1) “Exposure”, 2) “Slope”, 3) “Soil texture”, and 4) “Scale/Morphology”. Plot suitability to cultivation differs from the more used concept of land capability in so far it depends from characteristics, such as scale/morphology, that are more influencing farm organization (and costs) than land productivity, while variables like climate (that is deemed to be quite homogeneous at a such small scale) are not taken into account.

Criteria, attributes, sub-attributes and scores relating to plot suitability to cultivation are presented in Table 2.

Table 2 – Criterion “Plot suitability to cultivation”: Attributes, Valuation classes and Scores

Attributes	**Valuation classes**	**Scores**
Exposure	SE-SW	1.00
	NE-SW	0.80
	SW-NW	0.80

	NW-NE	0.60
Slope	0%-5%	1.00
	5%-10%	0.95
	10%-15%	0.90
	15%-20%	0.80
	20%-25%	0.70
	>25%	0.20
Soil texture	loam	1.00
	sandy	0.80
	clay	0.80
Plot Size	<0,5 hectare	0.85
	0,5-2 hectare	0.90
	2-5 hectare	0.95
	>5 hectare	1.00

Score: 0=better adaptation ability; 1=worse adaptation ability

Farm Structure (see Table 3.a) is described by means of the following six attributes, 1) "Farm Acreage". "Incidence of Land Rented or on Lease", 2) "Level of Productive Specialization", 3) "Importance of Livestock, Vineyards and Olive Groves", 4) "Agro-tourism services", 5) "Incidence of Land Rented or on Lease", and 6) "Presence of on farm Agro-food Processing Activities".

Table 3.a – Criterion "Farm structural characteristics": Attributes, Valuation classes and Scores

Attributes	**Valuation classes**	**Scores**
Farmer's age	18-40	0.70
	40-50	1.00
	60-70	0.80
	>70	0.40
Rate of hired workers on total	>60% total workers	0.70
	30-60% total workers	1.00
	1-30% total workers	0.80
	none	0.40
Tie between family and farm	high	0.60
	medium	0.70

	low	0.80
Generational turn-over	possible (there are identified successors)	0.50
	not possible (there are not successors)	1.00
	uncertain (there are successors, but not interested in farming)	0.80
Ability to networking in business	high	0.60
	medium	0.70
	low	0.90

Score: 0 = better adaptation ability; 1 = worse adaptation ability

The criterion describing Socio-economic Characteristics (see Table 3.b) includes five attributes: 1) "Age of the Farmer", 2) "Presence of Regular Hired Workers", 3) "Farmer's Family Ties with the Farm", 4) "Generational Turnover (presence of a possible farming successor)", and 5) "Networking Capacity".

Table 3.b – Criterion "Farm socio-economic characteristics": Attributes, Valuation classes and Scores

Attributes	**Valuation classes**	**Scores**
Cropping techniques	conventional or low input	1.00
	organic	0.80
Level of mechanization outsourcing	uses only own machineries	0.40
	harvesting hired service	0.60
	harvesting and tillage hired service	0.80
	only hired services for machinery	1.00
Incidence of CAP aid	CAP aid on total revenue > 60%	1.00
	CAP aid 26-60% of total revenue	0.85
	CAP aid < 25% of total revenue	0.70
Market channels	direct sale to final consumer	0.60
	prevalent sale to retailers	0.80
	produce to co-op or associations	0.90
	prevalent sale to wholesalers	1.00

Score: 0 = better adaptation ability; 1 = worse adaptation ability

Farm Management Characteristics (see Table 3.c) are measured through four attributes: 1) "Cultivation Techniques (Conventional, Integrated, and Organic farming Techniques)" 2) Level

of Mechanization Outsourcing (hiring contractors)", 3) "Incidence of CAP direct payments on Total Revenue", "and 4) "Main Selling Channels".

Table 3.c – Criterion "Farm management characteristics": Attributes, Valuation classes and Scores

Attributes	**Valuation classes**	**Scores**
Farm acreage	0-5 hectares	0.70
	5-25 hectares	1.00
	25-60 hectares	0.80
	60-100 hectares	0.40
	100-200 hectares	0.20
	> 200 hectares	0.40
Level of specialization of arable land	high (only cereals)	1.00
	medium (50% cereals - 50% grassland)	0.80
	low (grassland for hay and grazing > 50%)	1.00
Importance of livestock, vineyards, olive groves	high importance (specialization)	0.60
	medium importance	0.80
	low importance (income integration)	0.90
	absence	1.00
Agritourism	Presence	0.50
	Absence	1.00
Share of rented or leased land on total land	high (>80%)	1.00
	medium (50-80%)	0.80
	low (10-50%)	0.70
	very low (<10%)	0.60
Small-scale food etc. processing plants	presence of both wineries and small food processing plants	0.60
	presence only of wineries	0.70
	presence only of small food processing plants	0.80
	absence both of wineries and small food processing plants	1.00

Score: 0=better adaptation ability; 1=worse adaptation ability

The three criteria relating to Farm features consent to evaluate Farm ability to react to external solicitations such as change in market trends or in policy context.

As in the case of the territorial analysis, the farm analysis is carried out via a Geographic Analytical Hierarchical Process, based on two spatial elementary units, namely plots and farms,

to represent the geographical decision alternatives to be ordered and evaluated. Indeed, while most of the studies dealing with land use focus on plot of land with homogeneous characteristics, changing in land use are very often influenced by the characteristics of the farms they belong to. Consequently, while the current description of the land use in a territory could be based only on territorial units such as plots, changes in land use due to socio-economic drivers have to take into account also the farm level. This problem has been stressed also by Brady et al. (2009), who perform an analysis of the potential impacts of decoupled agricultural support on farm structure, biodiversity and landscape mosaic in a sample of EU Regions by using a spatial agent-based model called AgriPoliS. While Brady et al. use a mathematical simulation model, our model is more qualitative, but allows us to include into our analysis the results of the participative approach and to take into account landscape elements that are not strictly linked to the agricultural landscape mosaic. Nevertheless, these models have some common features insofar that both consider dynamics and space, the relevance of farmers decisions and they work at a high spatial resolution (i.e. plot/field). In our farm analysis, the Saaty's decomposition phase provides two different hierarchical structures: in the first, the goal is represented by plots suitability to cultivation and the consequent risk of abandonment, while in the second the goal is to evaluate farms reaction to external solicitations on the base of their socio-economic, structural and management characteristics, which have also an impact on the risk of land abandonment. An important step of the entire evaluation process is the participatory phase; the definition of criteria and attributes, as well as the weights computation are all based on the information acquired both via interviews and via focus-groups with local stakeholders. For this reason, as in the case of the territorial analysis, the methodology described (attributes, scores, etc.) is partly depending on the feature of the case-study area. Once that the hierarchical structures have been defined, the

comparisons between pairs of the constituent elements (criteria and attributes) are performed in accordance with the Saaty's semantic scale (Saaty, 1980). Finally, the measurement of scores for each geographic alternative, as regards to each criterion, is developed in two steps: firstly the alternatives are ordered in conformity with a 0 to 1 scale where 1 indicates the maximum farm flexibility in relation to external changes and 0 the minimum flexibility; then these values are rescaled in a 1 to 5 scale in order to facilitate the discussion with the stakeholders (see figure 5a and 5b, relating to the case study analysis). Both in the case of plots and farm features analyses, the results of the hierarchical re-composition stage should be validated by stakeholders through a discussion about the effective meaning and the territorial consequences of the obtained values.

As in the previously described analyses, the criteria and attributes could be integrated to take into account other features, e.g. geographical location as regards accessibility. The study of infrastructure interconnecting farm plots and farms with the territory they are located in, asks for an analysis taking into account both the amount of roads, but also their level of quality/maintenance. Besides, in rural areas sometimes seclusion and "privacy", at least from a touristic viewpoint, is seen as a positive factor and not as a negative one. Thus in some cases the amount of efforts to properly measure this characteristic could be too high to justify its consideration. This is the case, in the Authors opinion, of the case-study area.

The final values of each geographical alternative category (plots and farms) are then parted into three classes (low, medium, high), which were necessary for the construction of a fuzzy membership function. In accordance with fuzzy logic (Boroushaki and Malczewski, 2010; Karsak, 2004; Sangalli, 1998) the probability of each alternative to belong to each class (low, medium, and high) is computed for both plots and farms spatial units, as in the following figure 2, which refers to the case-study analysis.

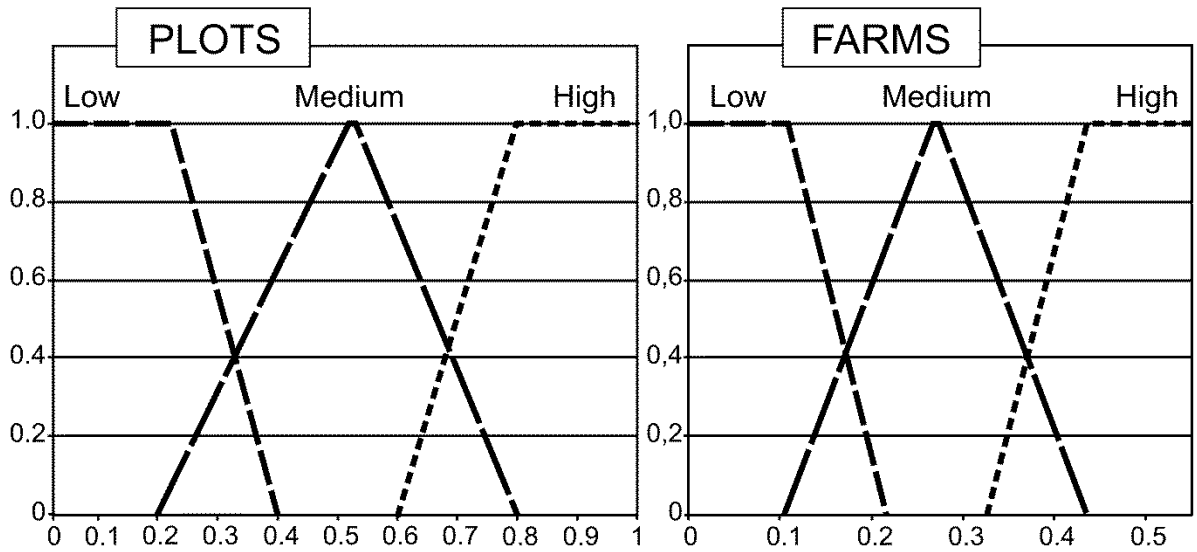

Figure 2. Fuzzy membership function for plots and farms.

In figure 2 the three lines represent the membership function relating the numeric scale (on the x-axis) and the linguistic scale "low-medium-high". The lines shows that, e.g., while for a score of 0.1 in the plot analysis the probability to belong to the class "low" suitability to cultivation is 100% (probability is measured on the y-axis), in the case of 0.3, due to fuzziness, the value could belong both to "low" and "medium" classes, but with a different level of probability.

Then, a cross-reading phase is carried out via a fuzzy logic in order to compare and integrate the synthetic index measuring farms reaction to external solicitations with the one summarizing plots suitability to cultivation. In this phase, a set of farm evolutionary paths/strategies are individuated on the base of farms adaptation capacity, that is to say their ability to survive as viable enterprises, and each combination deriving from crossing the classes (L, M, and H) of plots and farms is assigned to one of the defined evolutionary paths in accordance with the maximum probability value. The definition of farm strategies and the relation with the classes combining plot and farm resistance are, in part, area specific and consequently, the classification may need to be slightly adapted when analysing an area with different features. The following

table 4 presents – as an example – the results of this phase for the case study analysis. Nine fuzzy rules have been identified for the case study; these rules enable to determine, for both plots and farms, the probability to belong to one of the seven classes:

1. Very High (VH),
2. High (H),
3. Medium to High (MH),
4. Medium (M),
5. Low to Medium (LM),
6. Low (L), and
7. Very Low (VL).

Indeed, the elements belonging to some of the nine classes (coming from the crossing of the three levels plot analysis and the three levels farm analysis; 9 fuzzy rules are needed for defining these classes) are too similar to give origin to separate evolutionary paths (evolutionary paths are only seven), also due to problems of uncertainty in scores and weights attribution during the Multicriteria analysis. Table 4 presents, as an example, the final seven classes of farms evolutionary paths and their relation with the crossing of farm and plot analyses related to the case study that will be described in the next section. For each combination of plot-farm the final membership class (from VH to VL) is assigned in accordance with the maximum probability value.

Table 4. Fuzzy classes defining farm evolutionary paths for the case study according to their adaptation capacity.

	Plot "resistance" or suitability to cultivation		
	High (H)	***Medium (M)***	***Low (L)***

Farm "resistance" or reaction capacity to external solicitations	***High (H)***	**VH** *maintenance*	**H** *maintenance / multifunctionality*	**MH** *multifunctionality*
	Medium (M)	**M** *uncertain strategies*		
	Low (L)	**LM** *transfer to stronger farms*	**L** *transfer to stronger farms/abandonment*	**VL** *abandonment*

Level of adaptation capacity: VH=very high, H=high, MH=medium-high, M=medium, LM=medium-low, L=low, VL=very low.

The seven fuzzy classes shown in Table 4 relate to the following farmers' strategies and farms evolutionary paths:

1. The class VH includes farms characterized by a high adaptation capacity and by plots with on average a high suitability to cultivation. These farms will very likely maintain their present cultivation systems without relevant changes in their organizational structure.
2. The class H represents farms whose evolution may vary from the present status maintenance to an increase of multifunctionality (MH); they represent an optimal situation as any of these developments will increase both the agricultural and the landscape value.
3. The class MH represents farms with a high capability of adaptation to the external changes, with plots that have a low suitability to agricultural use. The evolution of these farms is almost inevitably directed to multifunctional agriculture (i.e. farm holidays, educational farms, eno-gastronomic tourism, etc.) or, alternatively, to the creation of value-added products; otherwise the low suitability to agricultural use could cause land abandonment with negative repercussions on both environmental and landscape resources.

4. The class M is typical of farms with an intermediate and uncertain evolution since their farmers may adopt strategies that vary from the maintenance of the present status (H) to the land abandonment (VL) or sale of some plots (LM), as well as from multifunctionality (MH).
5. The class LM includes farms with low adaptation capacity and whose plots have a high suitability to cultivation. The weak organizational structure of such firms and the high pressure of land demand will likely determine the cessation of these agricultural enterprises in the medium term. However, in this case, land will probably be acquired (rent, sale) and cultivated by other farmers.
6. The class L includes farms whose evolution may vary from land abandonment (VL) to sale of plots to stronger farms (LM).
7. The class VL is characterized by farms with low adaptation capacity and plots that, on average, have a low suitability to cultivation. These are the weakest farms, which will probably abandon all agricultural activities in the medium term, unless some supporting actions cause a rupture and a deep change of the farm development path.

Such crossover study is fundamental to be able to foresee farmers' strategies and behaviours and to provide public decision makers with operative guidelines.

2.4. The identification of the priorities and actions

The last phase of our study combines the results of the territorial analysis (where areas are classified on the base of their level of landscape sensitivity) with the ones of farm analysis (where farms strategies and evolutionary paths are analysed). At this stage, the territory is parted into homogeneous areas, for which – after defining priorities with stakeholders – some ad hoc response actions are identified, in accordance both with their specific landscape sensitivity and

peculiarity and the expected farm evolution. Priorities and actions should take into account not only the results of the analysis but also the institutional and cultural context of the area. In a very simplified scheme, we could individuate the following four situations:

- High landscape value and high farm adaptability. Landscape has a high value and farms are viable having a good adaptation capacity to external changes; in this case public actions aiming to promote the territory could be sufficient to guarantee a sustainable landscape;
- High landscape value and low farm adaptability. Landscape has currently a high value but there is the risk that a diffuse abandonment of agricultural activities undermines the present situation. In this case incentives aiming to maintain agriculture activities and to promote an entrepreneurial “cultural change” are needed;
- Low landscape value and high farm adaptability. In this case the economic viability of agricultural and rural activities are not at risk, but the quality of landscape should be improved through ad hoc interventions;
- Low landscape value and low farm adaptability. In this case both landscape quality and the viability of the agricultural economic fabric are in bad conditions; consequently both actions aiming to improve quality of landscape and incentives to maintain agricultural activities are needed.

Incentives should give preference to the groups of farmers that have a positive attitude towards multifunctionality and promote a cultural change able to improve the awareness of the important role that proper agricultural activities could play in the maintenance/improvement of the landscape quality level.

Response actions should take into account local stakeholders' point of view and be truly shared by the local community, since this usually makes policies towards a sustainable rural landscape more effective than bottom-up ones.

3. The case study: an overview of area characteristics the and results of the applied methodology

This chapter presents the results of a first, simplified application of our model, aiming to verify its validity. Due to the complexity of the analyses required by our governance model and to the specific features of the case study areas, we have decided to focus the analysis at territorial level on the issue of landscape sensitivity. This also because the agriculture of the case-study area is mainly related to winter cereals and grassland, with extensive livestock breeding, and has a great share of land that is managed accordingly to organic farming or integrated farming rules, thus reducing – in comparison with more intensive agricultural areas – the importance of ecosystem services related to environment and regulating functions. Contrariwise, its iconic landscape is very well-known both at national and international level and deserves special attention. Local population is aware of it and it is willing to preserve the actual quality level of landscape from further negative transformation. A further simplification that has been adopted for the case study relates to the spatial elementary units for the territorial analysis, as detailed in the relative section. The present chapter is organized as follow. First of all, a brief description of the study area and its features are given. Secondly, more information are given on how the participative

approach has been implemented during the case-study analysis. Then, results are given for the analyses that have followed the lines described in the previous chapter

3.1. The study area – main characteristics

The study area chosen for validating the model is the territory of Castiglione d'Orcia (Siena, Italy), one of the five municipalities (Castiglione d'Orcia, Montalcino, Pienza, Radicofani and San Quirico d'Orcia) belonging to the Orcia Valley, a Tuscany hilly area that, during the last decades, has been affected by deep changes in landscape due to farmers' adaptation both to market trends and to agricultural policies.

The territory has a strong rural character with several organic and holiday farms. While, as in the rest of Italy, most of the farms have an acreage below 10 hectares, the share of land accounted by medium and large farms is prevalent. All the municipalities of Orcia Valley are characterized by the presence of urban structures and architectonic furniture dating back to the medieval and Renaissance age. Other distinctive elements of the area are fortified villages, scattered rural and religious buildings set in a territory characterized by the presence of:

- Erosive forms (erosion furrow, named "biancane" or badlands) with a typical flora (Maccherini et al., 1998);
- Large fields where only durum wheat and forage are cultivated;
- Small extension of woodlands, usually located in areas with strong-steep slope;
- Isolated or small groups of monumental trees;
- Canyon and wide riverbeds of Orcia River with typical riparian vegetation giving a characteristic aspect and an ecological value to the landscape.

In July 2004, UNESCO has recognized the Orcia Valley as humanity cultural heritage in accordance with the Criteria IV and VI (UNESCO, 1972). This because this "landscape is part of

the hinterland of Siena, redrawn and developed when it was integrated in the territory of the city-state in the fourteenth and fifteenth century to reflect an idealized model of good governance and to create an aesthetical picturesque landscape. The landscape's aesthetics inspired many artists, whose images have come to exemplify the beauty of well-managed Renaissance agricultural landscapes. This agrarian and pastoral landscape reflects an innovative land-management system" (Rössler, 2010). Although the distinctive and appreciated features above described are still present, albeit sometimes with a much smaller extension (e.g. in the case of "biancane"), the current landscape of Val d'Orcia is very different from the one of those centuries (Phillips, 1998, Marignani et al., 2008). Indeed, current landscape, with its distinctive feature of having a different color in each season, is very much appreciated, and it is often present in gadgets, such as calendars with pictures of Tuscany rural landscapes. An analysis of the processes and actors, both local and extra-local, who have contribute to the emergence of Val d'Orcia as an iconic landscape is provided by Gaggio (2014). Although, on the one hand, the Orcia Valley has acquired a strong identity that has by now assumed the role of an economic resource thanks to a unique combination of natural and anthropic elements, on the other hand the agricultural activity presents signs of environmental weakness due to the presence of sites with a high ecological value and areas very important from a historic-cultural and architectural viewpoint. Pictures of Val d'Orcia landscape may be found on the Tuscany Region Atlas of Rural Landscapes[4] and on many sites related to Tuscany landscape and tourism.

According Agricultural Census data at 2010 (ISTAT, 2010) the Municipality of Castiglione d'Orcia, whose territory has been used for the case-study analysis, is characterized by:

4 http://www.regione.toscana.it/documents/10180/70960/ATLANTE%20DEI%20PAESAGGI%20TOSCANI%20val%20d'orcia/69995032-581b-46fe-b856-8a4b4b20ecf9

- a high share of Utilized Agricultural Area (UAA) on Total Agricultural Area (77,5%) and, consequently, a low share of Woodlands on Total Agricultural Area (15,6%);
- a high share of Arable lands on UAA (80,0%)
- a share of about 9-10% of both Olive groves and Permanent grassland on UAA, while Vineyards account only for about 1%.

Indeed, Val d'Orcia is quite heterogeneous from this point of view since the Municipality of Montalcino, e.g., presents a higher presence of Woodlands (40,7%) and consequently a lower share of UAA (50,0%), a lower share of arable lands (49,1%) and a very high share of vineyards (37,3%). In this case, the specialization towards vineyards and the consequent simplification of landscape is seen as a threat, while in the case of Castiglione d'Orcia this simplification (one season, one colour) is appreciated.

Breakdown data related to arable land is available only for farms that have all their land inside the municipality (ISTAT, 2010), that in the case of Castiglione d'Orcia account for about 69% of the total arable area. In these farms, arable land is mainly dedicated to Cereals (usually winter cereals) that account for 45,2%, non-permanent Grassland (25,7%) and Fallow land (23,9%). According to an annual survey of the Italian Institute for Statistics (ISTAT[5]), trends at national level seems to show an increase of fallow land, especially in the Regions of Central Italy, such as Tuscany. Although land could be kept fallow also for agronomic reasons, such a high share could also imply a low profitability of cropping that could bring about land abandonment due to economic conditions.

[5] Source: annual survey on "Early estimates for crops" (Indagine sulle intenzioni di semina degli agricoltori), agricultural campaigns from 2011-2012 to 2014-2015 http://www.istat.it/it/istituto-nazionale-di-statistica

According to Lorenzini (2011) Val d'Orcia is one of the Italian "peripheral areas of low demographic density, which in the 1970s have been subject to a progressive depopulation and abandonment of the agricultural activities, but where this trend has been inverted by the implementation of a strategy of valorization of culture-based goods and services linked to the local history or the traditional local savoir faire". For these reasons Lorenzini classifies Val d'Orcia as a Extra-Urban Cultural District, characterized by a "high integration, both horizontal and vertical, of the cultural industries with the other productive sectors of the area". Among these activities, in the agricultural sectors, there are certified (origin denomination or organic) products and agro-tourism. Indeed, while the Municipality of Castiglione d'Orcia had at 2011 a Resident Population of 2453 inhabitants (ISTAT, 2011), in 2013 the number of overnight stays was higher than 20000 and 2014 provisional data shows a slight increase[6]. On the five Municipalities of Val d'Orcia, whose population was 13570 inhabitants at 2011, the amount of overnight stays in 2013 was higher than 125500. From this overnight stays 50% are accounted by foreigners in the case of Castiglione d'Orcia, while in Orcia Valley the share was of about 61%. Although present and past foreign tourism has had a deep influx in the development of the area and its landscape, according to Gaggio (2011) "rural Tuscans have chosen to bear testimony to a disappearing civilization, imagining themselves as its heirs and stewards, but they have not done so merely to please the tourists. In a sense, the peasant civilization imagined (or believed to be true) by contemporary Tuscans is no more historically "accurate" than that imagined (or believed to be true) by tourists, and the same holds for the landscape that the former have built and the latter come to visit". Besides, the relations between the iconicity and branding of landscape and the inclusion of Val d'Orcia in a global context had some consequences also on the shaping of

[6] Source: ISTAT – Census of population at 2011; Siena Province: Statistical data on Tourism

agricultural landscape, e.g. although “Villa Banfi” has contributed to the growing reputation abroad of “Brunello di Montalcino” and the landscape it comes from, nevertheless it is assumed to have caused negative effects on shaping this same landscape, due the increasing specialization in vineyards and consequent simplification of landscape caused by economic reasons (Mopurgo, A., 2005).

3.2. The participative approach in the case-study analysis

In this paragraph we give a brief summary of the participative approach in the analysis of Castiglione d’Orcia case-study. Two different tools were mainly utilized:

a) Individual interviews to key informants, based on a questionnaire with open answer. Key informants were represented by different types of farmers, local residents, representatives of associations and other groups of stakeholders. Interviews have been mainly used to gather information for the analyses, such as attribute and sub-attribute to be considered and their scores;

b) Two focus groups. The first one has involved stakeholders – such as representatives of associations dealing with trade and shop-keeping, tourism, environment, hunting, etc. - whom, for various reasons, are interested in using the environmental resources of the territory under analysis. In this case the aim was to gather information from all the stakeholders which, for different reasons, could be involved in landscape governance. The second one has involved farmers, since they are the main actors in changing agricultural landscape and it is important to understand both their attitude towards its evolution and the different strategies that farmers would implement depending on the trends of market conditions and law and policy context. In this case, farmers have been chosen in such a way as to be representative of different types as regards farm acreage

(small – large farms), employed techniques (conventional, low input, organic), etc. This in the belief that not only economic reason (e.g. related to farm acreage) but also "cultural" reason (e.g. the multifunctional approach of many organic farmers, who value not only productive results, but also landscape and environmental values related to their economic activity) could influence the importance given by local stakeholders to Ecosystem Services provided by landscape, as highlighted by previous researches. "The concept of organic agriculture and the attitude in which they root do fully comply with the requirements for a sustainable land-use, merging the care of a healthy development of the land and society" (van Mansvelt and van der Lubbe, 1999, p. 147). Focus groups have been mainly used for checking the results of the analyses and discuss actions to be taken. In particular, focus groups have explored the willingness/motivation to develop actions/products within a participative approach with the aim to promote an "environmental requalification" of Orcia Valley landscape.

3.3. The results of the evolutionary, landscape and farm analyses

The evolutionary analysis

As we have already pointed out in the description of the general framework model, the historical evolutionary phase requires an accurate investigation on both public and private archives, with the purpose to collect cartographies, aerial maps, photographs, and postcards. The acquired information are successively controlled, processed and then integrated and validated by interviews, made i.e. to farmers, local associations, community members and people representing the categories involved with the territory under study.

The current structure of Val d'Orcia landscape, which is characterized by large hills with extensive cultivations, is the result of the deep transformation that, starting from sixties of 20th

Century (Phillips, 1998; Rossi and Vos, 1993, Marignani et al. 2008), has involved the agriculture of this area as well as that of a large part of Tuscany hills (Rovai, 1994). This transformation is due to three principal driving forces (003, 2012 masked for blind review; Neri et al., 2008).

- The introduction of supplementary payments for durum wheat in the CAP regime (Council of European Communities, 1976) made this cultivation extremely attractive from an economic viewpoint, also because there are no valuable alternatives;
- The technological development consequent to:
    - A high diffusion of mechanization, particularly promoted by credit policies,
    - The introduction of new durum wheat varieties, characterized by higher productivity, shorter size and higher lodging resistance.
- An increasing development of the industry and service sectors in the nearby towns, which has caused the progressive off-farm relocation of the farming family members because of higher wages and better quality of life.

The combined action of these three main driving forces has caused a progressive simplification of the agricultural systems, resulting in farms specialization in winter cereals, as well as an increasing incidence of arable areas at the expense of semi-natural zones (bushy grassland, natural areas, badlands, ecological networks, etc.) and a remarkable land property concentration (002, 2008 masked for blind review).

These transformations have caused the present landscape configuration that has made Orcia Valley famous and easily identified all over the world for aesthetic reasons (i.e. one colour for each season).

Figure 3 shows the empirical evidence of this transformation that produced a clear simplification and an increasingly anthropic aspect of the Orcia Valley landscape. Where in 1977 were present little arable plots interrupted by natural corridors (hedges, drainage ditches, etc.), in 1994 the natural areas had completely disappeared and only a large arable hilly plot remained. Another similar situation can be individuated by comparing the two maps: while in 1977 there was a mixed plot (arable land with scattered trees), in 1994 the same plot was completely converted to a bare arable soil.

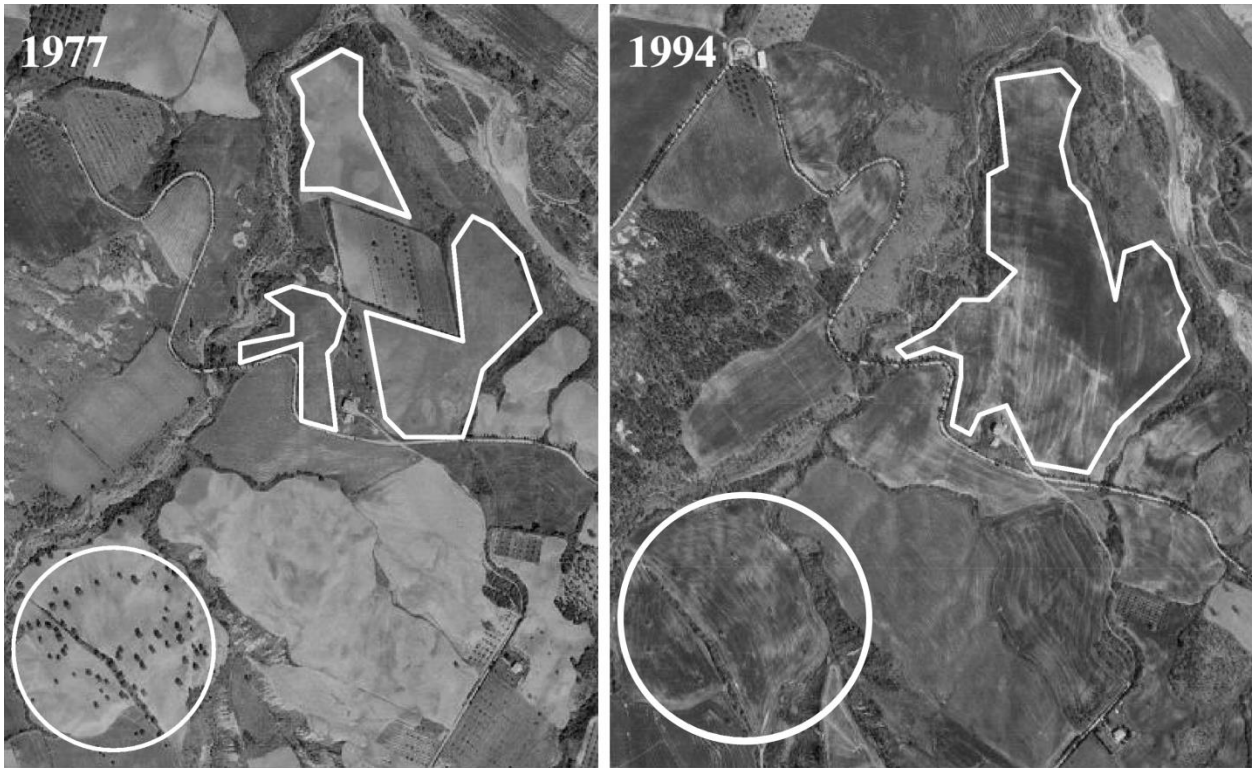

Figure 3. Aerial photos, whose comparison highlights Orcia Valley landscape modifications. Source Ortophoto cartographies from the Italian Military Geographic Institute

The landscape analysis

The territorial analysis for the case study, as already anticipated, has been focused on landscape sensitivity and performed using landscape systems and subsystems as spatial elementary units. This choice represents a simplified approach since these units have been defined "outside the

model". Although the use of these pre-defined units could be justified since they are recognized in official planning, in a more detailed and comprehensive analysis, or in a governance model built for an integration of tools relating to planning and sectoral policies, the individuation of homogeneous spatial units should be based on the results of the model itself. Indeed, different landscape system and sub-system have often different planning constraints and rules; for this reason, in this first and simplified application of our governance model, we have considered this classification as relevant, although it could have been possible, through the data gathered and analysed in the present paper, to hypothesize a different classification of the territory under study.

According to (Rossi et al, 1994), the case study area included two landscape systems and five landscape subsystems. The subsystems were the following: System of Pliocene hills – Subsystem of low Orcia valley (CP13), System of Pliocene hills – Subsystem of Arbia and Asso valley (CP8), System of Pliocene hills – Subsystem of Orcia and Paglia valleys (CP9), System of Antiappennine Range – Subsystem of Amiata Mountain (RA11), System of Antiappennine Range – Subsystem of Montalcino and Castiglione d'Orcia Mountain (RA8). Landscape systems are in fact quite ample ambits in which landscape characteristics may vary; for this reason they are detailed into different landscape subsystems. In more recent times, this classification has been slightly changed in the framework of the implementation of the Tuscany Region legislation on territorial government (Regione Toscana, Law 65/2014 and the "Piano Paesaggistico", i.e. Landscape Plan of Tuscany - Regional Council Resolution 37/2015).

The cartographic hierarchical tree (Figure 4) shows the results of the territorial analysis for the case-study area and highlights the most sensitive areas that need special attention in territorial planning process, i.e., the System of Pliocene hills – Subsystem of Orcia and Paglia valley, and,

in a lower degree, the System of Antiappennine Range – Subsystem of Amiata Mountain and the System of Antiappennine Range – Subsystem of Montalcino and Castiglione d'Orcia Mountains. They all have medium-high landscape sensitivity while the other subsystems present a low value. In general the landscape sensitivity value within the study area is included in a range which varies from 0.69 to 2.48 and then from low to medium-high in accordance with the adopted (0-3) scale. The Orcia and Paglia valley subsystem is the most critical one and this is due to its high score for the intrinsic value criterion, resulting from an elevated frequentation, a significant persistence of landscape elements and a high Visibility. The important presence in this sub-system of areas that are relevant from an environmental viewpoint also contributes to increase its sensitivity value.

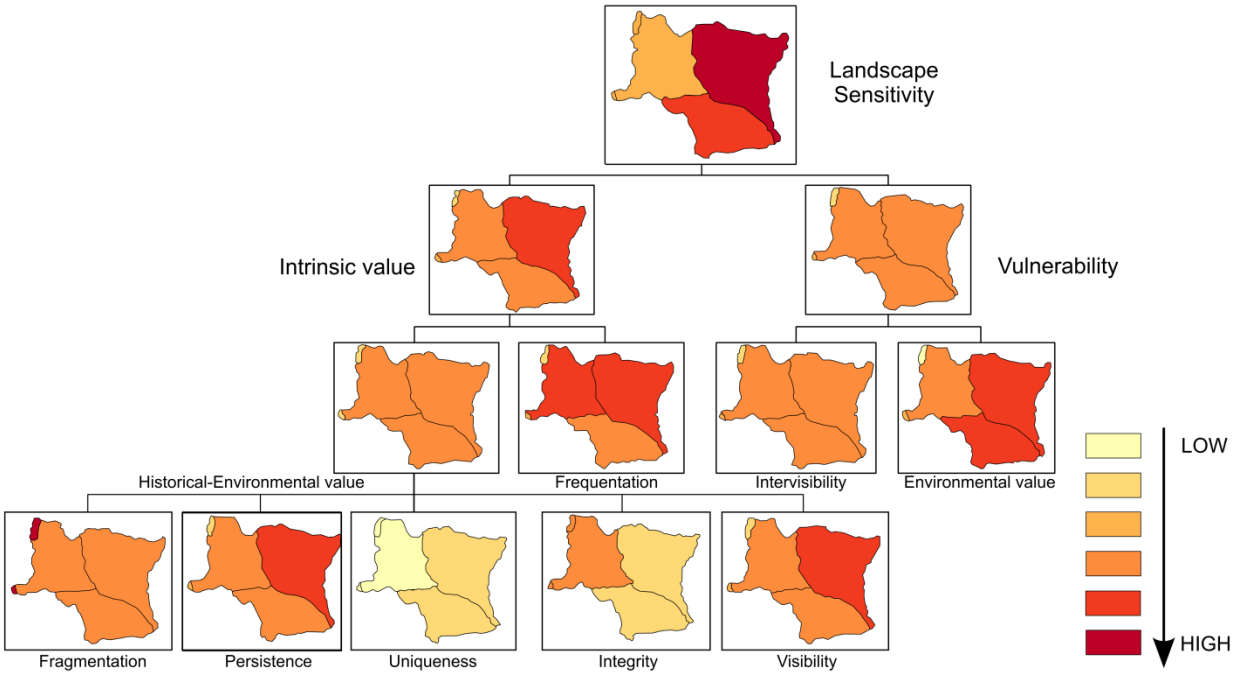

Figure 4. The cartographic hierarchical tree relating to the measure of Landscape sensitivity in Orcia Valley study area.

The Farm analysis

As described above, when giving the general outline of the adopted methodology, farm analysis has been performed by measuring the criterion relating to Plot Suitability to Cultivation and the ones relating to Structural, Socio-economic, and Management characteristics of farms. These criteria are described and measured by several attributes, which have been described in Tables 2 and 3.a, 3.b and 3.c in the previous chapter.

For the present research, 199 farms were analysed and their structural and socio-economic profiles were assessed. Such farms accounted in total for an area of 5637 hectares of cultivated land, nearly corresponding to the 60% of the total municipality utilised agricultural area (UAA). As above stated, the aim of farm analysis is to determine both plots natural suitability to cultivation and farmers' adaptation capacity to external changes in accordance with socio-economic, structural and management characteristics of their farms.

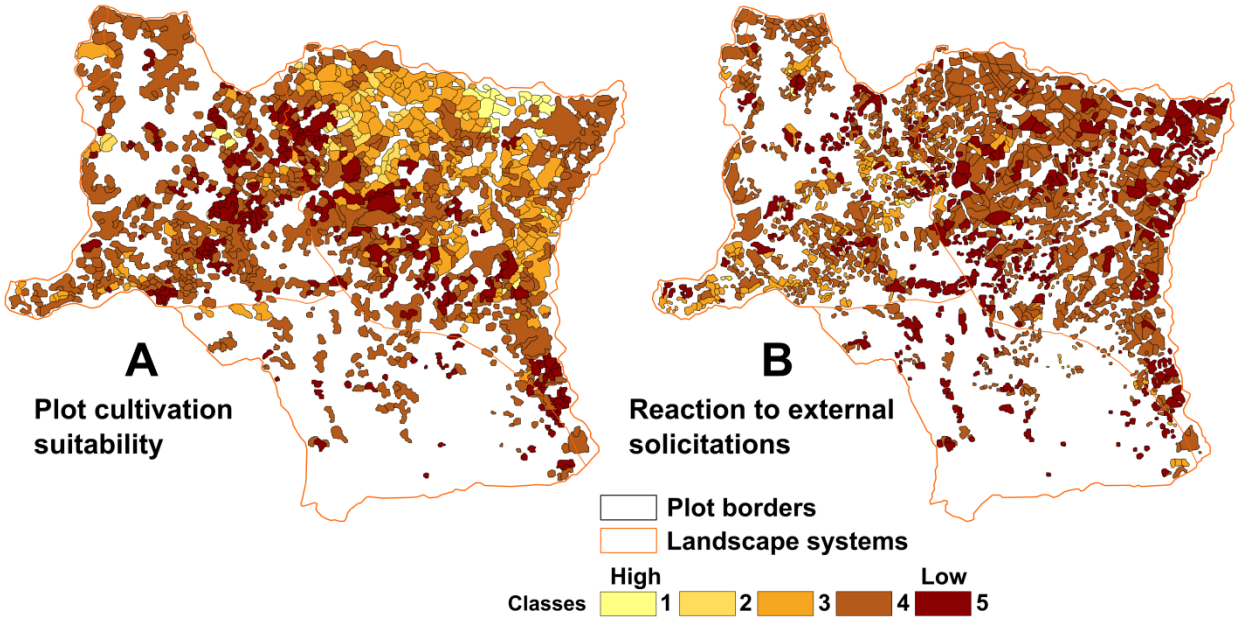

Figure 5. Results of the analyses at farm level a) plot's suitability to cultivation, b) farm's capacity to react to external solicitations, 1= highest level, 5= lowest level.

As already anticipated, the discussion with stakeholders have been made on the base of a scale from 1 to 5 in order to facilitate it. Figure 5a and 5b shows this five classes representation both for the criteria relating to Plot suitability to cultivation and Farm adaptation capacity.

Then, the final values of each geographical alternative category (plots and farm) have been parted into three classes (low, medium, high), which have been used to construct the fuzzy membership function already shown as an example in chapter 2 (figure 2).

The plot level analysis highlighted that over a quarter of the cultivated land (27%) presents a relatively scarce suitability to cultivation and, consequently, that there is the risk of abandonment in case of reduction of durum wheat prices or of EU subsidies. On the contrary, the remaining part of the study area has a good suitability to cultivation that would enable farmers to maintain adequate profitability levels even in case of a worsening of the economic situation due to external variables. This part of the area is mainly located in the northern part of the study region, close to the Orcia River, and it is characterized by a gentler slope.

Farm level analysis results highlight that about the 70% of the assessed farms have a high level of adaptive capacity to external changes, whereas the remaining 30% present a reduced adaptation capacity; this latter might cause the abandonment of some of the cultivated plots and even the cessation of farming if external conditions become exceedingly adverse. According to the results of interview and focus groups, a significant factor affecting strategies of farms is related to their territorial extension and morphology. Indeed, small and medium size farms seem to have a higher external changes adaptation capacity when compared with larger ones, these latter being more rigid in relation to cost structure (i.e. hired farm workers, purchase of external services, etc.) and consequently more fragile in case of market turbulence. The socio-economic analysis indicates that the agricultural productive system of the area is quite resistant, even

though a deterioration of market conditions might have a high impact on environmental variables and subsequently on landscape configuration.

From the crossing of farm and plot resistance level, seven farms evolutionary paths have been individuate, whose description has been anticipated, as an example, in the previous chapter. The importance of the seven evolutionary paths in the case study area, both in terms of surface and number of plots (see the column “Total” in table 5.a and 5.b) is described as follow:

1. A share of plots accounting for 41.6% in number and for 46.4% in surface belong to farms of the M class of adaptation capacity to external changes. This kind of intermediate situation may evolve in any of the above mentioned farms evolutionary paths, namely maintenance, multifunctionality, abandonment, or acquisition by other firms.
2. Almost a quarter (22.7%) of plots, accounting for 19.1% of the total territory surface, belong to the MH class and it is directed towards a multifunctional agriculture.
3. About a fifth (19.9%) of plots i.e. 18.5% of the total study areas, is included in the VL adaptation class whose land quite likely would either be abandoned or acquired by stronger farms.
4. Some 11.7% of plots accounting for 11.2% in terms of surface belonged to the H class and may evolve from the maintenance of current state to an increase of multifunctionality.
5. Only 4% of plots accounting for 4.8% in terms of surface belongs to class L.
6. There are no plot either in the class LM or VH

Tables 5.a and 5.b present the importance of the seven evolutionary paths in total and their break-down according to the level of sensitivity of the landscape subsystem where they are located.

Table 5 Breakdown of Number (part a) and Surface (part b) of plots according to farms evolutionary paths and landscape sensitivity – absolute (unit and hectares) and relative (%) values

Part a) Number		LANDSCAPE SENSITIVITY							
		Absolute values (number)				Relative values %			
		High	Medium	Low	Total	High	Medium	Low	Total
Farms evolutionary paths (farms adaptation capacity)	VL	450	342	0	792	11.3	8.6	0.0	19.9
	L	152	8	0	160	3.8	0.2	0.0	4.0
	LM	0	0	0	0	0.0	0.0	0.0	0.0
	M	1115	534	2	1651	28.1	13.4	0.1	41.6
	MH	267	630	6	903	6.7	15.9	0.2	22.7
	H	344	121	0	465	8.7	3.0	0.0	11.7
	VH	0	0	0	0	0.0	0.0	0.0	0.0
Number	Total	2328	1635	8	3971	58.6	41.2	0.2	100.0
Part b) Surface		Absolute values (hectares)				Relative values %			
		High	Medium	Low	Total	High	Medium	Low	Total
Farms evolutionary paths (farms adaptation capacity)	VL	636.0	387.5	0.0	1023.5	11.5	7.0	0.0	18.5
	L	251.0	14.20	0.0	265.20	4.5	0.3	0.0	4.8
	LM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M	1783.2	759.0	21.2	2563.4	32.3	13.7	0.4	46.4
	MH	342.9	692.9	19.9	1055.7	6.2	12.5	0.4	19.1
	H	505.4	111.7	0.0	617.10	9.1	2.0	0.0	11.2
	VH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surface	Total	3518.5	1965.3	41.1	5524.9	63.7	35.6	0.7	100.0

Figure 6 shows the geographical distribution of the analysed farms, in relation to their more likely evolutionary paths, based on their capacity of reaction to the external changes, and the suitability to cultivation of their plots.

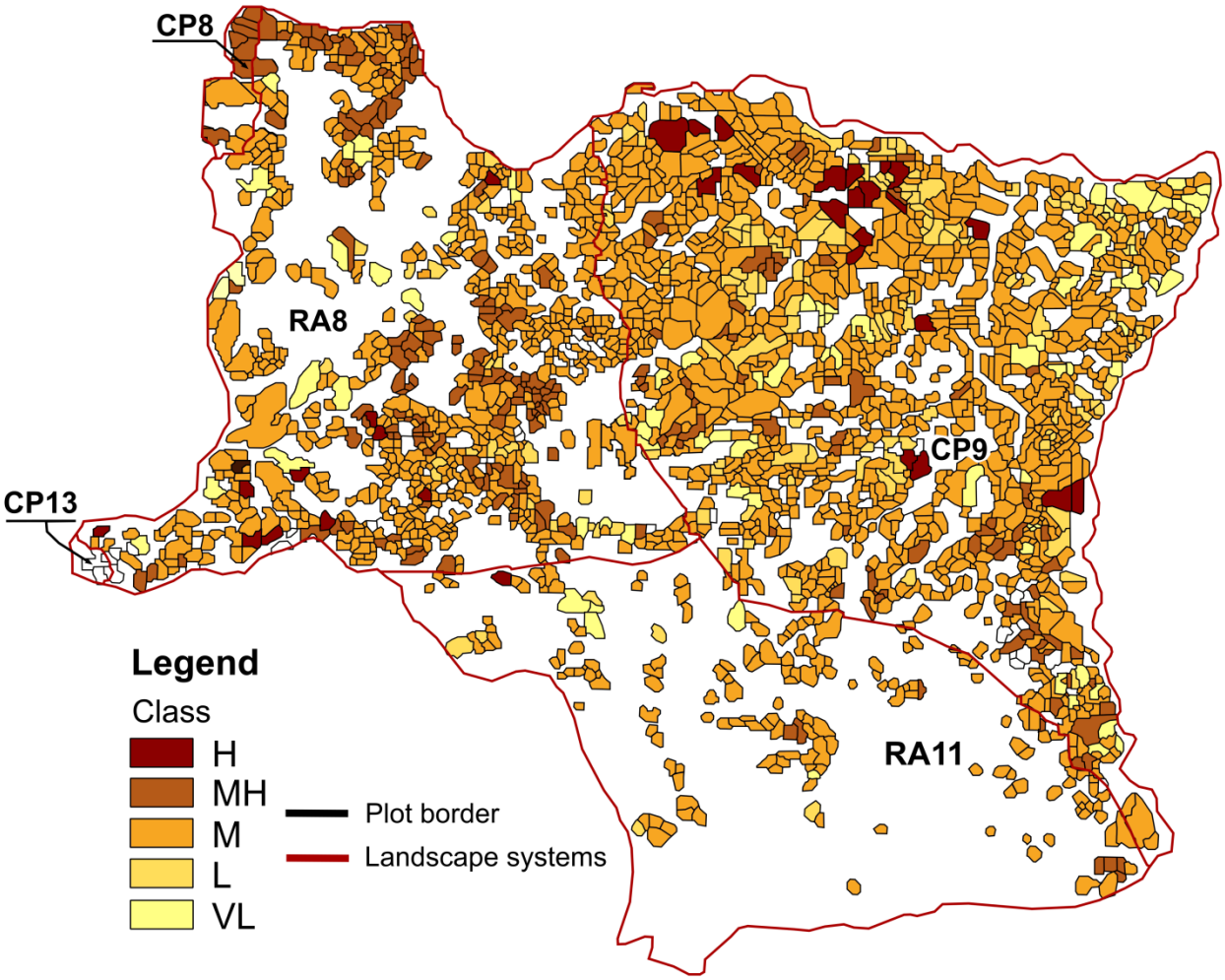

Figure 6. Spatial distribution of classes related to farms evolutionary paths[7].

Farms able to adopt a strategy of multifunctionality reinforcement are 59 and account for a surface of 1055 hectares, while farms with high risk of agricultural abandonment are 24 and account for a surface of 1023 hectares. Class H includes 16 farms that show an intermediate situation between the present status maintenance and multifunctionality reinforcement. Only 7 farms belong to the L-class and their evolution will likely vary from land abandonment to plots acquisition by stronger firms. All the other farms belong to the class M and occupy a surface of 2600 hectares.

[7] VH and LM classes have been omitted, since they are not present in the case-study area

Farms directed to multifunctionality are diffused on the western part of the study areas, whereas the ones with a high risk of agricultural abandonment are concentrated in the central and in the eastern part of Castiglione d'Orcia municipality. Finally, those farms whose prevalent evolution will likely be the status quo maintenance are mainly located in the northern part of the study area.

The results of farm analysis and their discussion with local stakeholders consent to derive some important remarks about the territory under study:

1. The local entrepreneurial class appears quite stable as a considerable percentage of farms presents a high adaptation capacity to the external transformations.
2. The potential impacts on environmental and landscape resources are anyway very critical as 4356 hectares, on a total surface of 5600, belong to farms run by farmers that may opt for agricultural abandonment if the external conditions (changes on CAP, market trends and the effects of climate change) become too adverse.

From a qualitative point of view, the results of the participative approach confirm a different attitude of organic farmers, in respect to conventional farmers, towards multifunctionality and agricultural impacts on landscape. Indeed, while very often conventional farmers consider landscape as a "by-product" of productive choices depending exclusively on market trends, organic farmers have a more holistic approach and tend to consider the impact of their choices on landscape, beyond bare economic convenience. This shows that the assumption made by some policies that maintaining agricultural activity could insure also the maintenance of a good quality landscape is not always true, but strongly depends on farmers attitude about the value of landscape.

3.3 The individuation of specific and effective response actions

Response actions depend both on territorial analysis and farm analysis results. As Table 6 shows, e.g. in a subsystem with high landscape sensitivity, depending on farms probable evolution, the response actions to counteract negative effects may vary from public institution actions for the promotion of the territory, to specific regulations and incentives for the preservation of landscape current state, up to incentives to improve farm viability in the specific territorial context. Public promotion could, e.g. include such interventions as the creation or improvement of existing countryside walking paths in order to improve territory and landscape fruition.

Table 6. Response actions for the sustainable governance of the case-study rural landscape

Farm adaptation capacity (resulting from farm analysis)	**Landscape sensitivity (resulting from territorial analysis)**		
	High	**Medium**	**Low**
H *Maintenance*	Public promotion actions	Incentives aiming to improve quality of landscape	Incentives aiming to improve quality of landscape
MH *Multi-functionality*	Incentives aiming to promote multifunctionality	Incentives aiming to promote multifunctionality and to improve quality of landscape	Incentives aiming to improve quality of landscape
M *Uncertain strategies*	Incentives aiming to maintain agriculture activities and / or promote multifunctionality	Incentives aiming to maintain agriculture activities and to improve landscape quality	Incentives aiming to maintain agriculture activities and to improve landscape quality
L *Transfer to stronger farms/abandonment*	Incentives aiming to promote entrepreneurial "cultural change"	Incentives aiming to promote entrepreneurial "cultural change" and to improve landscape quality	Low priority interventions
VL *Abandonment*	Incentives to promote entrepreneurial "cultural change"	Incentives aiming to promote entrepreneurial "cultural change" and to improve landscape quality	Low priority interventions

Besides compulsory and voluntary tools, the actions to be implemented relates also to cultural change both at entrepreneurial level and as regards the awareness of the importance of landscape management. In this case ES provision is pursued not by aid or constraints but spreading a positive attitude towards sustainability issues with the so-called “information instruments” or “sermons” (van Zanten et al. 2013). Steering intrinsic motivation represents an action that has more lasting effects and could reinforce the effects of other types of policies (mainly voluntary ones), nevertheless it usually asks for a longer time in order to give effects and this should be kept in mind in cases where faster responses are needed. The need of a GIS, able to collect and update all farm changes, is a consequence of the above defined response actions, since it is essential, especially for the monitoring of the most critical areas. Due to the adopted spatial scale, all those actions can be calibrated not only at farm level, but also at plot level, which makes such interventions potentially very effective.

Table 5.a and 5.b presented in the previous paragraph highlight that the majority of plots present high landscape sensitivity and belong to the class M in relation to the farm analysis. In such circumstances the definition of rules and incentives for the preservation of the current landscape configuration, together with public promotion actions for landscape valorisation, becomes absolutely necessary. A considerable number of plots present medium landscape sensitivity and are included in the class MH in accordance with the farm analysis: in their cases the adoption of regulations and incentives for the maintenance of landscape actual state are very appropriate. About 630 hectares of the study area (correspondent to 450 plots) have a high landscape sensitivity and belong to the class VL (Very Low) as for the farm analysis: this situation requires the definition of specific actions able to help agriculture as well as the devising of instruments

for the public promotion of landscape and typical or origin denomination agricultural products, in order to support farms persistence in such difficult circumstances.

In addition to the definition of some dedicated interventions for the landscape subsystems, the model enables to go into higher details, up to the identification of response action specific to each farm, especially in presence of large farms. Consequently, when it is necessary or useful, the model consents to diversify the management of plots belonging to the same farms, but located in areas with different landscape sensitivity.

Although the definition of proper actions for promoting a sustainable rural landscape is very important, it is not possible to remain in the "scientific domain" but these actions have to be seen in the normative and administrative context where they have to be implemented. As we have previously stated, in Italy there are several policy instruments aimed at preserving and improving landscape such as the decree law n. 42/2004, or "Codex of cultural heritage and landscape", and its subsequent amendments, the financial incentives coming through the CAP, the law relating the rules for land transformation and territorial governance, e.g. in Tuscany the Regional Law N° 65/2014 and, mainly, the "Piano Paesaggistico" i.e. Landscape Plan of Tuscany (Regione Toscana, 2015).

As regards participation, Tuscany has issued a Regional Law about "Rules on the promotion of participation in the formulation of regional and local policies" (Tuscany Region Law N° 69/2007). Although the Tuscany legislative context is considered as favourable, the results are sometimes considered as unsatisfactory. Gaggio (2014), in a paper focusing on Orcia Valley, affirms that "Tuscany is indeed the site of layers, of normative constraints and guidelines, ranging from local zoning regulations to the expectations associated with UNESCO's World Heritage Site status" and that "Rural Tuscany has become both a paragon of harmonious beauty

and a terrain of legal conflict and recrimination". Besides, according to the evaluation promoted by the Italian Ministry of Agriculture Food and Forestry Policies (MIPAAF, 2009) on the role of landscape inside the Regional Development Programmes (RDPs) 2007-2013, Tuscany, albeit its very good reputation about landscape and the policies aiming at preserving and improving it, has a very poor evaluation regarding the specific measures relating landscape. This report affirms that, although the Tuscany RDP is one of those where landscape is more cited, nevertheless its specific measures seem, from the one hand to promote a further reforestation and renaturalisation (although current share of forested land is higher than it was in the past, see Agnoletti, 2014), and, from the other hand, to consider landscape as an output that is "automatically" guaranteed by any type of agriculture, also in the case that farmers aim only at a rationalisation from a technical and productive point of view. Nevertheless, we have already stressed that not all farmers have a multifunctional attitude towards landscape management. However, landscape is something that is very difficult to manage with traditional tools; indeed, as stated by many Authors (e.g. Agnoletti et al., 2011) "it cannot be presumed in the Regional Rural Development Plans that hedges and rows of trees are always positive for the landscape; this can only be established if a study, at local level, identifies them as important elements of the landscape identity". This is also the case of Val d'Orcia where foreign land owners have spread traditional elements of the Tuscany landscape (e.g. Cupressus rows) in ways and amounts that are in contrast with the traditional landscape of the area. Last but not least, proper landscape and agricultural policies would very often benefit from a zoning that is more detailed than the usual one and that could make it possible to tailor interventions on the specific needs of an area. From this point of view, the new rules for greening that are intended to be the same through all Europe despite the differences in climate, agriculture and landscape of the EU countries, represent an

approach that is everything but local, and put constraints on eventual regional and local managements of agriculture that could be more suitable for a specific area.

4 Concluding remarks

The implementation of ELC brought about the need for an interdisciplinary and transdisciplinary approach to the problems of landscape. From this point of view, the general governance model that we propose:

- Represents an approach able to integrate methods and techniques belonging to different but complementary fields - as tools proper of social sciences (participative methods), territorial planning and environmental evaluation - and to cope with different time and spatial scales.
- Highlight the importance of a real and direct involvement of social actors to bring about structural and long-term changes, thus making more effective the public expenditure.
- Allows to single out and locate sub-regions where critical evolutions as regards the management of agricultural land, and consequently landscape modifications, may take place.

Such results provide a fundamental, scientifically robust and flexible tool able to support public decision-makers for territorial planning interventions in an area. Indeed the model, when implemented, has to be adapted according to the specific features of an area, data availability, etc. This flexibility is a favourable characteristics insofar as “the efficacy of the rules that safeguard the maintenance of the characteristic elements of the landscape is strictly linked to the diversity and typicality of the landscape where they are applied and (…) the evaluation may only be conducted at local level” (Agnoletti et al., 2011).

The case-study of Castiglione d'Orcia Municipality represents a first simplified approach, since an extension to areas with different characteristics - especially in a process of integration of territorial planning and tools promoting the economic development - would ask for a more comprehensive analysis of environmental variables and for the definition of territorial ambits inside and not outside the model. Nevertheless, we think that it allows the readers to appreciate the potential usefulness of this tool in designing effective landscape policies at local level and in matching the policy-makers need for new tools, methods and guidance material (Conrad et al., 2011a). In recent literature there are many studies on landscape, but what is still missing is an effort to coordinate and organize all this knowledge in a way that could make it useful in terms of policy application.

Although the "scientific analysis" is a first and important step, nevertheless it is not sufficient, by itself, to guarantee the transfer into appropriate operative actions aiming to improve landscape ecosystem services. Besides, while new guidelines in landscape policies ask for a new approach from researchers able to fill the gap in the field of more modern and holistic approaches to the landscape, it seems that operative policies have difficulties in abandoning the old approach linked to the preservation of areas just for their aesthetical and natural characteristics without taking into account the need to integrate landscape and landscape policies in a broader context and to coordinate them. In this framework, we think that in order to promote the governance of a sustainable rural landscape it would be necessary:

- To create a proper data-base about environmental and socio-economic information at least at Regional level, able to provide detailed information at different geographic scales and times. In this framework every effort should be made to make the data/information easily and freely available for both administrative and research purposes.

- To promote participation, using also the tools of information technology, and properly integrate it in decision making processes.
- To make planning and programming processes continuous and more flexible. Too often the “ad hoc” concertation requires too much time, so that when a plan or a programme is implemented it is already “too old”; this problem is worsened by the fact that these tools have often a very long life time-span.
- To overcome the lack of coordination between different policy tools. Indeed, what is still missing in the Italian context is an operative policy approach able to integrate and coordinate instances coming from stakeholders, agricultural (or other sectoral) policies and territorial and landscape governance. Consequently efforts should be directed towards innovative policies and governance instruments, such as collective voluntary actions, integrated project, etc., which are needed for any adequate implementation of sustainable landscape and rural development policies.

As regards this last issue, although the measures on landscape are still less important than in the previous RDP, Tuscany Region has included in the RDP 2014-2020 a measure relating Integrated Territorial Projects, whose implementation was permitted by the National Development Plan already in the previous RDPs. The Integrated Projects make it possible to coordinate the actions of many private and public subjects operating on the same territory according to a shared strategy and consequently could constitute a first attempt to pursue the above mentioned coordination.

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