A GIS-based model for the enhancement of rural landscapes. The case-study of Valdera - Tuscany (Italy)

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Abstract Complexity in planning and programming applied to rural landscape and territories was increased by the new approach of the European Landscape Convention and the growing awareness on the role of rural landscapes in providing Ecosystem Services. While the scientific debate is still going on, one of the main challenges is how to operationalize the new attitude and knowledge about the role played by landscape in general, and not only by historical and high valued landscapes. New instruments are needed to maintain and enhance everyday landscape taking into account that it is a living and evolving body. These instruments ask for multidisciplinary and transdisciplinary approaches based on a holistic knowledge system. GIS techniques allow taking into account both spatial distribution of elements/information and their physical relations, which are paramount for the analysis of interventions about landscape. This chapter illustrates as a case-study an attempt to provide, for a specific area located in Tuscany (Italy), an expedite model for identifying policy actions aiming to protect, maintain and manage rural territories. The model identifies a set of spatialized indicators, for which it is possible to compute a cardinal or ordinal value, to be used to individuate suitable actions. While the case-study analysis is necessarily bounded by rules stated by the Tuscan administration and by the context within it was developed, the philosophy underpinning the proposed methodology may well be extended to other territories and countries. Results show that it is possible to provide simplified operative tools able to increase the effectiveness and efficiency of territorial governance.

Keywords: landscape management, governance model, land managers, Tuscany

1. Introduction

Before European Landscape Convention (ELC), only landscapes of outstanding beauty or of historical and cultural interest were deemed important and usually protected by laws setting constraints to their change. The aim was to preserve their original features, sometimes through a process of 'museumification' (Magnaghi, 2005, p. 105) that made it increasingly difficult to maintain landscape as a living body, usually deriving from the interaction and coevolution of anthropic activities and geo-physical characteristics. Moreover, standard and constraint approaches are usually opposed by land managers and risk to be ineffective in preventing negative effects deriving from "not doing", e.g. in the case of agriculture, from land abandonment (Tempesta, 2014). ELC changed the above described approach stressing the need to care for "everyday" landscapes and to rule not only maintenance processes, but also management, creation and enhancement of landscapes. ELC stresses also the importance of landscape perception by local population (Council of Europe, 2000), thus promoting participative approaches in planning processes. This new attitude as regards landscape maintenance and management had a direct impact on planning.

Landscape can be considered as a sub-articulation of territory or, as Marson says (Marson, 2012), a different way to look at territory. The ELC defines landscape as follow: a zone or area as perceived by local people or visitors, whose visual features and character are the result of the action of natural and/or cultural (that is, human) factors (Council of Europe, 2000). In rural landscape farmers are key land managers, playing a very important role in landscape evolution. As a consequence, when planning for landscape sustainability (Wu, 2013), all the drivers influencing farmers' decisions, such as socio-economic drivers, regulative environment, geo-physical features etc., need to be taken into account together with the opinion of local population and other stakeholders (van Zanten et al., 2013).

Complexity of problems asks for new interdisciplinary and transdisciplinary approaches when dealing with landscape governance (Conrad, Christie, & Fazey, 2011; Scott, 2011).
In this paper, firstly we provide a theoretical model of governance, and secondly propose a set of measurable cardinal (or ordinal) indices on which to base actions for the landscape management of a case-study area located in Tuscany, a central region of Italy. While the regulative environment is specific to Tuscany, the authors believe that the proposed approach is suitable to a wide range of contexts.

2. A conceptual model for landscape and territorial governance

The ELC applies to the entire territory and concerns landscapes of outstanding beauty as well as everyday or even degraded landscapes (Council of Europe, 2000). Standard and constraint policies may be deemed as adequate for landscapes that either for their high value or critical situation need to be preserved or restored/reproduced. In other landscapes, management actions need to ensure an adequate provision of Ecosystem Services (ESs) without necessarily preserving the actual landscape structures or the historical actions that have contributed to their creation. According to Haines-Young (cited in Wu, 2013), "sustainability should be measured or assessed by the change processes active in the landscape - not by the state the landscape is in at any one time". In other words, the focus should shift from structures to the services they can produce and, consequently, from setting constraints to adopt old management actions to enforce rules able to reproduce positive structures and functions through new management actions (Magnaghi, 2005).
When dealing with policy and planning tools for landscape and territorial governance, the institutional framework cannot be overlooked. According to Grêt-Regamey et al (Grêt-Regamey, Sirén, Brunner, & Weibel, 2017), the successful implementation of tools requires a good understanding of decision-making processes to bridge gaps in the science-policy interface.
We have previously proposed a DSS for the governance of rural landscapes (M. Rovai, Andreoli, Gorelli, & Jussila, 2016) as a general model for guiding and helping to design policies and individuate proper actions according to the current features and dynamic evolution of different landscape ambits. Vice versa, this chapter is based on the authors experience when dealing with the decision makers' needs about a specific planning instrument, e.g. the drawing of the "structural plan" of Valdera[1], an administrative body born by the union of 7 municipalities among the 14 included in the "geographical" Valdera. This means that the model had to take into account general guidelines given by the Tuscan regional administration and zonation approaches, while providing a detailed knowledge framework at local level and giving suggestions for specific area-tailored actions. The knowledge base has been mostly provided as maps and tables that could be suitable for a participative approach.
The following part of the chapter is organized as follow.
In the methodology section we provide: a) information on the regulatory environment of Tuscany as regards territorial and landscape planning; b) the methodological approach and the description of the indicators chosen for the spatial knowledge framework on which guidelines and actions are based.
In the case-study section we provide: a) a short description of the area, b) some maps on the main indicators used, and c) an authors' proposal for management actions to be considered by decision-makers, based on values and criticalities characterizing each landscape unit.
In the concluding remarks we discuss the difficulties faced in the process and give insights on the potential of the adopted approach for steering planning and decision-making at local level.

3. Methodology

3.1 The planning regulatory environment of Tuscany

Since the beginning of the nineties, the territorialist approach (Magnaghi, 2005) has underpinned the regulation on territorial governance of the Tuscan Region.

[1] Valdera or Val d'Era is the plain created by Era River

As regards landscape, in 2009 the Tuscan Region decided to integrate its landscape plan in the "piano di indirizzo territoriale (PIT)" or guidance territorial plan (GTP) rather than ruling it by a specific plan. Territorial governance in Tuscany is currently regulated by Regional Law 65/2014 that states that the GTP is the instrument regulating territorial planning. All regional policies, sectoral plans and programmes having territorial impacts need to comply with GTP, as well as planning and urban planning tools. This decision makes the regulatory environment quite complex insofar as, as regards landscape, the Code for Cultural and Landscape Heritage states that regional landscape plans are super ordinate plans with contents which are compulsory prescriptive for local authorities. Vice versa, as regards planning, the Italian Constitution assigns to municipalities the responsibility not only for the drafting, but also for the approval of their territorial planning instruments, while the Region can make only specific recommendations, which do not have any binding value. This implies that the regional integrated territorial and landscape plan has a guidance role for physical planning while it gives compulsory prescriptions for the part of landscape plan (Marson, 2012).

The GTP distinguishes between the structural-statutory part of planning, defining the identifying features of places, namely their invariance and the rules for variations, and the strategic-operational part describing transformation projects (Magnaghi, 2005, note 1, p. 109).

The invariants that have been identified by the structural-statutory part of the current GTP are the following:

I) The hydro-geomorphological features of catchment basins and morpho-genetic systems;

II) The ecosystem features of landscapes;

III) The polycentric and network characteristic of settlement, urban and infrastructural systems

IV) The morphological and typological features of agri-environmental systems and rural landscapes.

In this chapter, we focus on rural landscapes, i.e. on the fourth invariant, and their morphotypes (deriving from their morphological ad typological features). The Landscape Plan of Tuscany has classified rural landscapes according to the Abacus of Rural Landscape Morphotypes. Rural morphotypes have been identified through the overlapping of several informative layers, i.e. anthropic characters such as settlements, size and characteristics of cultivated plots, soil typologies and land use, and hydro-geomorphologic characters, and define rural landscape typologies (Baldeschi, Brunori, Fastelli, Gisotti, & Rovai, 2017; Fastelli, Rovai, & Andreoli, 2018).

The regional landscape plan provides a map of morphotypes at a scale of 1:250.000 and, as a consequence, the map cannot be considered as a zoning of the rural territory, but as a broad identification of the areas within which a landscape type is prevalent on the others. Indeed, in a territorial context features characterizing morphotypes vary in intensity and boundaries are blurred. Consequently, the inclusion into a morphotype rather than into another is based on threshold values. For this reason, the classification of territory in morphotypes needs to be revised at the lower planning levels, when it is possible to have a detailed and exact description at a finer scale (Baldeschi et al., 2017). For each morphotype the Abacus describes bio-physical characteristics (elevation, acclivity, land cover, etc.), values, criticalities, gives information on its management and provides guidelines for policy actions.

As regards rural territories, the Landscape Plan gives a central importance both to agricultural enterprises and to non-professional entities in order to ensure the maintenance and reproduction of a landscape identity which is commonly shared, without penalizing the freedom in exercising economic activities or promoting an inefficient use of the resources. The individuation of morphotypes has been based on the awareness that changes in farms structures and management techniques are necessary to maintain an adequate income in a changed market and technological scenario. For this reason, for each morphotype it is important not only to perform a structural analysis, but also functional and management analyses able to highlight the degree of "viability" of that rural landscape. Rural landscape viability depends also on the typologies of farms which are operating in the area, and their attitude towards landscape invariants and environmental protection (Fastelli et al., 2018).

At municipality level, when drafting local planning instruments such as the structural plan (Piano Strutturale) and the operational plan (Piano Operativo) it is necessary to adequately define morphotype characteristics. In urban plans these characteristics influence rules and constraints that should be included. Vice versa, when dealing with policies for rural development or landscape maintenance and enhancement, morphotype characteristics can become targets to be reached through specific strategic projects, built through the involvement of local stakeholders.

3.2 The methodological approach

In this sub-section, firstly we provide a general model for landscape governance inspired by the ES cascade, and then we identify and develop a specific part of the model, i.e. the role of land managers in producing landscape, according to the specific aims of the case-study analysis.

The general model proposed in Fig. #.1 was inspired by the version of the cascade provided by the Barcelona case study (Potschin-Young et al., 2018, see fig. 4). In this case the cascade was transformed into a ring, thus solving the problem about the direction the cascade should be read. Indeed, while many authors start from structure and function to arrive at the benefits for human beings and their values, others suggest that the cascade should be read in the opposite direction, starting from the values of benefits in order to arrive to structures that are able to determine these benefits. This last option raises the question of policy instruments to be used in order to promote adequate structures. In both cases, ESs can be seen as on the boundary between the functions provided by structure and processes and the benefits that a function can represent for human beings, depending from their specific set of values. While in a strictly natural approach, policy action responses are mainly intended as a constraints aiming to limit anthropic pressure on biophysical structure and processes (Potschin-Young et al., 2018, see e.g. Fig. 1), when dealing with landscape management both in its natural and anthropic components, as in the case of landscapes, the approach can change and aim to increase the value of the territorial heritage, in its immaterial and material components, both natural and anthropic. In our general model, structure influence functions mostly as a consequence of choices operated by land managers. Vice versa, on the demand side, dwellers are the main stakeholders insofar as they decide the actual and potential uses of the territorial heritage; this by setting the values they attribute to ESs, highlighting the criticalities related to territorial depletion and contributing to setting policy goals.

Local decision makers have the role to translate land managers' and dwellers' needs and aspirations into planning, programming and design instruments. They should also ensure a horizontal and vertical coordination among all the instruments that have an impact on physical planning. Besides, local public authorities have new tasks in managing local resources, insofar as planning should not only profit from the flows of information coming from stakeholders involved in supply and demand of ESs (Potschin-Young et al., 2018, see fig. 4), but it should result from the joint working of all stakeholders (producers, dwellers and decision-makers) able to produce a shared vision of the territory and its development.

The described cycle is influenced by the general context. From a geographical point of view, landscape or local territory need to be seen in the framework of regional and global processes. At policy level, many interventions need to comply with rules and guidelines that are decided at international, national and regional levels, e.g. in the case of Rural Development Programmes (RDPs). Other policies that, at least in Italy, strongly affect planning are fiscal policies (Rusci, 2015). Last but not least, general economic situation, global market trends and innovation in technology are influencing the context inside which land managers and dwellers operate.

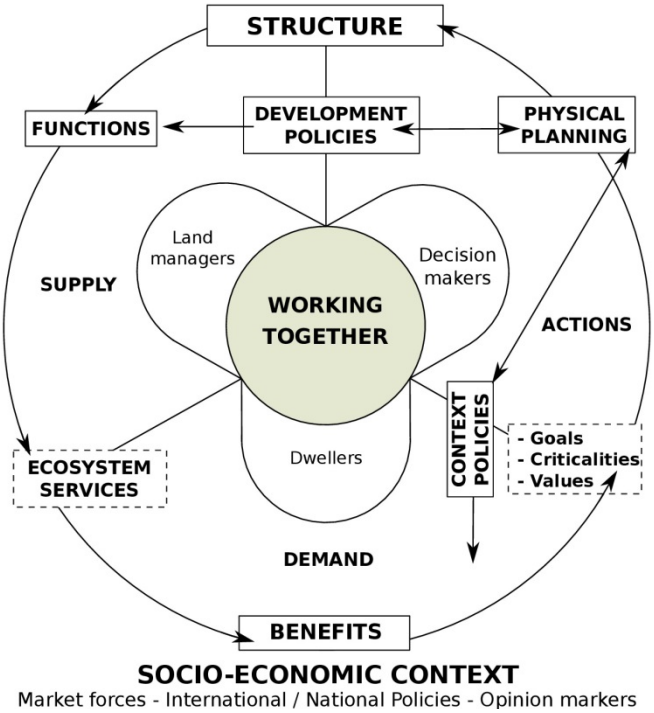

Fig. #.1. A general model for territorial and landscape governance inspired by the ES cascade.

GTP and landscape plan mainly refers to the identification of landscape criticalities, while the RDP mainly faces the needs of farmers. When planning mostly relates to rural landscape, as in the case of our case-study analysis, the physical planning and sectoral programming need to be coordinated and this implies that decision makers should work together with local stakeholders, mainly represented by farmers that in rural landscape are the key land managers. This cooperation should result in a shared vision for the local territory giving raise to landscape projects, promoted by private and public bodies.
While fig. #.1 provides a general and comprehensive model, when dealing with farmers as key land managers it would be useful to develop the supply sector and the relationships between land managers and policy actions. Fig. #.2 focuses on the above issues.

Fig. #.2 stresses and better details the influences between structure, management and functions. The underlying hypothesis in researches aiming to provide a knowledge base for planning and landscape projects is that landscape structure partly depends on the type of land management, insofar as long-term management actions can shape structure. In their turn, management options are influenced by structural features, which provide constraints and opportunity for specific management actions. Management in rural landscape is mainly related to agricultural activities. The relation between structure and management determines the functions landscape can fulfil, and consequently also ecosystem services, or disservices provided by landscape. Indeed, while it is difficult to attribute to nature negative functions, management choices of land managers may have both positive and negative effects on community well-being, even as a consequence of the same action (Zhang, Ricketts, Kremen, Carney, & Swinton, 2007).

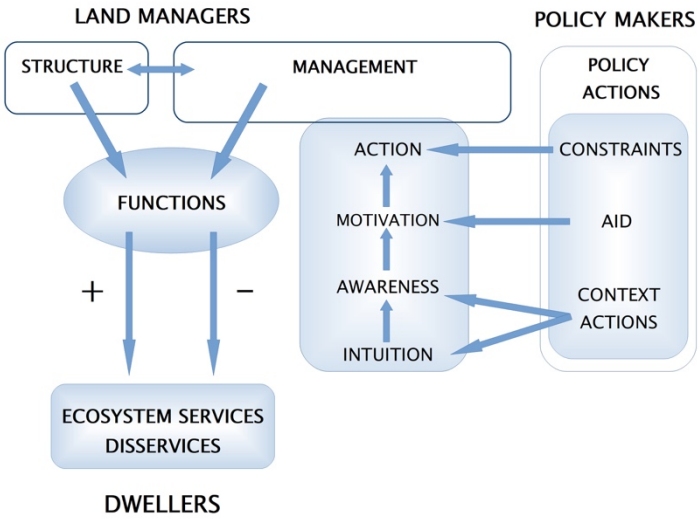

Fig. #.2. Focusing on the supply side of the general governance model, i.e. on structure, management and policy actions and their influence on ES provision

According to Brunori et al. (Brunori, Fastelli, & Rovai, 2013) land managers' behaviour is influenced by a cultural path that starting from the intuition of the impacts their decisions can have on landscape or environmental features, evolve in awareness, which in turn modifies motivations and eventually actions. Studies dealing with the adoption of agri-environmental schemes and their effects (see, e.g. Mills et al., 2017) have shown that in some cases the creation of motivation through a cultural change can bring about more durable effects than economic aid. From this point of view, while motivation may be modified by aid and actions constrained by rules, context policies are needed to promote intuition and awareness (Brunori et al., 2013).

A good knowledge of functions provided by a landscape as a result of structure and management may be the base for understanding the ESs landscape can provide. Among the wide range of ESs, for the case-study analysis the following have been selected:

• Productive services (related to the economic function);
- Agri-food production,
- Tourism and tourism-related services,
- Territorial marketing,

• Recreational-cultural services (related to the socio-cultural function);
- Maintenance and reproduction of the historical, cultural and identity heritage,
- Usability of nature, environment, and of the aesthetic values of landscape,

• Protective services (related to the ecological function);
- Maintenance and reproduction of water resources,
- Maintenance and reproduction of agri-ecosystem biodiversity,
- Maintenance and reproduction of landscape heterogeneity,
- Reduction of hydrogeological risk.

Morphotypes, according to their specific features, could be more suitable for fulfilling specific functions, while having an unsatisfactory performance for other functions, or fulfil a balanced mix of functions. A morphotype that is highly specialized in agricultural production, e.g., risks having an unsatisfactory performance as regards environmental functions. On the other hand, a morphotype characterized by land abandonment as a consequence of increasing farm economic difficulties may have a good environmental performance but be characterized by criticalities as regards aesthetic and

perceptive functions or historic and identity functions. These latter, in their turn, may negatively impact on functions related to tourism and tourism-related activities.
The "state of health" of morphotypes may be analysed through a set of spatial or spatialized indicators that describe morphotype structures and the way they are currently managed.
Tab. #.1 provides a list of structural and management indicators that can be computed by crossing the information of several databases provided by the Tuscan Region or other public bodies connected to the Tuscan administration (LaMMA, ARTEA). For a description of available data and the way different dataset can be integrated, see (Fastelli et al., 2018).
From the integrated analysis of the above listed indicators it is possible to derive useful information on the functions a morphotype is able to fulfil as a consequence of its state of health and the way land managers operate, and recommendations for policy actions. These recommendations, when integrated in a shared vision of territorial development, may help to implement specific landscape local projects. Few of the main indicators of management will be described and commented in the result section.

Table #.1. Spatial or spatialized indicators for morphotype analysis

A - Structural indicators	**B - Management indicators**
A-1. Physical features	***B-1. Evolutionary trends***
A-1.a Elevation	B-1.a Changes in land use
A-1.b Acclivity	B-1.b Agricultural land abandonment
A-1.c Geology	B-1.b Soil consumption
A-1.d Pedology	***B-2. Management aspects***
A-1.e Climate	B-2.a Resident population
A-2. Naturalistic and ecologic structure	B-2.b Share of agricultural working population
A-2.a Forest vegetation	B-2.c Land managed by professional and non-professional farmers
A-2.b Ecological assets (II invariant)	B-2.d Farm characteristics
A-2.c Fragmentation and heterogeneity	B-2.d.1 Farm typology
A-2.d Protected areas	B-2.d.2 Average Utilized Agricultural Area
A-3. Settlement pattern	B-2.d.3 Number of separated parcels
A-3.a Historic / recent buildings ratio	B-2.d.4 Main crops
A.3.b Presence buildings of particular historical or architectural interest	B-2.e Presence of "Agri-tourism" activities
A-3.c Rural settlements	B-2.f Land included in Denomination of origin
A-3.d Type of agrarian meshes	B-2.g Agricultural areas accessibility
A-4. Perception / visibility	

4. Case-study analysis: area description, preliminary results and discussion
This section describes some preliminary results of the experience gained by some of the authors during a research project requested by the administration of the Valdera Municipality Union (Tuscany).
The current period is characterized by the need for municipalities and municipality unions to issue new local planning instruments after the adoption, in 2015, of the territorial and landscape plan. In particular, the research group was asked to provide a knowledge framework for the structural plan (Piano Strutturale) and the operative plan (Piano Operativo) for the case-study area, with a specific focus on rural landscapes. A structural plan includes three parts: a knowledge framework, a statutory-structural part and a strategic-operational part; these two latter should be based on the knowledge framework. At present, only a few structural plans have been issued after that the integrated territorial and landscape plan entered into force. These local plans were mainly drawn by simply reutilizing the information utilized for the regional plan, refining at a more detailed scale morphotypes boundaries, but not providing a local specific knowledge framework on which to build tailored solutions. Besides,

according to the cultural attitude of local decision makers, there is the risk for the knowledge base to be considered only a formal rule it is necessary to comply with, without exploiting its potentialities in identifying local heritage and in building land-scape and territory management rules.

4.1 Case-study area description

The geographical area called "Valdera", takes its name from the Era River, which in this area merges with Arno, the main river of Tuscany. It is mainly represented by the inland part of the ambit 8 of the Landscape Plan of Tuscany, related to the plan between Pisa, Leghorn and Pontedera[2]. Valdera includes 14 municipalities[3], 7 of which belong to the Valdera Municipality Union[4]. The municipality union does not include the municipality of Ponsacco, although it is surrounded by the other municipalities belonging to the municipality union; for this reason, on maps there is a central area for which spatial information is not provided. Valdera includes municipalities with quite heterogeneous situations, as regards biophysical features, economic development, and population size and density (Orsini, 2013).

Environment and rural areas are considered as strengths for Valdera territory. Indeed, the environment still presents high quality and pristine characteristics inside which are located heterogeneous rural spaces, with highly prized characteristics. This results in a landscape with high aesthetic and perceptive value, which maintains and enhances the typical Tuscan landscape, with hilly area still unspoiled while development is mainly concentrated in flat areas and some valley floors. Hilly areas are mainly cultivated with olive groves and vineyards, whose renowned productions may ensure farm vitality. Hence, they need to be protected by containing urban expansion. In the location where rural areas have been already eroded by urban settlements, it is necessary to enhance the integration between rural space and space used for residential, productive and infrastructural uses.

At the same time, the agricultural sector is facing increasing difficulties, mostly in the more difficult areas and suffers for land abandonment that is bringing about higher risk of erosion, floods, forest fires, etc. Moreover, some of past choices about the localization / delocalization of productive activities and services are scarcely sustainable from an environmental point of view and, as a consequence, they can determine in time the depletion of stock of resources that are important for the social and economic development of these areas.

4.2 Preliminary results and discussion

The first step of the analysis was to define at local level, at a finer and more precise scale, the morphotypes characterizing the case-study area. While in the regional Abacus were included 23 general morphotypes, at local level where identified 27 morphotypes.

Fig. #.3 shows, in the left side, the distribution of rural morphotypes in the 7 municipalities of the Valdera Municipality Union. The white central part delimited in pink is the territory of the municipality of Ponsacco, which does not belong to the union, while other white parts refer to territories that are not classified as "rural".

The research has focused more on management than on structure and in particular on the causes of soil consumption. This can be caused both by land artificialization and land abandonment, but we have privileged the last phenomenon as being more important for rural landscapes. In the following paragraphs we describe three of the main indicators of management (B-1.b; B-2.c and B-2.d.2) included in tab. #.1.

Land abandonment, especially when not adequately controlled, is deemed as having more negative effects than farming insofar as it may cause a loss of benefits for human well-being in terms of productive, protective and recreational-cultural ESs (Cooper et al., 2009; García-Ruiz & Lana-Renault, 2011; Haddaway, Styles, & Pullin, 2013; Pelorosso, Della Chiesa, Tappeiner, Leone, &

[2] Only the municipality of Santa Maria a Monte is not included in ambit 8

[3] Bientina, Buti, Calcinaia, Capannoli, Casciana Terme-Lari, Palaia, Pontedera, Santa Maria a Monte, Ponsacco, Crespina, Terricciola, Peccioli, Chianni and Lajatico.

[4] Bientina, Buti, Calcinaia, Capannoli, Casciana Terme – Lari, Palaia, Pontedera.

Rocchini, 2011) that is higher than benefits deriving from renaturalization. Sometimes land abandonment is masked by processes of reforestation, both natural and artificial, which transforms previously cultivated land into woodland, with the loss of landscape of historical interest (Agnoletti, 2014). Fig. #.3, right side, shows the areas (in red) were reforestation processes affecting landscape in the period 1954-2016 were particularly strong. These processes mainly affect hill areas with the highest elevation, where cultivation is more difficult and less profitable. Territories with a high share of land cover accounted by woodland, bushes and natural or scarce cover are usually characterized by higher land abandonment, since woodland is not able to ensure an adequate income. More fertile lands are able to provide a higher per unit income and, as a consequence usually, in the case that a farmer close its enterprise, land is not abandoned but purchased by neighbouring farmers (M. Rovai et al., 2016).

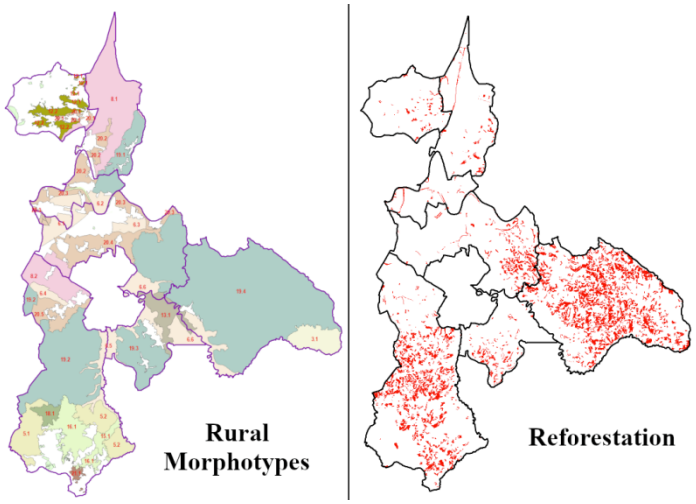

Fig. #.3. Left side: Map of rural morphotypes identified in the territory of the Valdera Municipality Union. Right side: Map of land interested by processes of natural and artificial reforestation during the period 1954-2016.

Indeed, several morphotypes with high share of woodlands and similar uses are also the ones that were most affected by phenomena of land abandonment from 1954 and 2016, thus confirming our previous hypothesis.

It is important to identify not only areas that are already abandoned, but also areas at risk of abandonment by analysing land managed by professional and non-professional farmers. A high presence of land managed by non-professional farmers can pose questions for the future dynamics of morphotypes, insofar as non-professional farms are usually vulnerable to change in the economic context (e.g. people choice to produce its own olive oil even if it costs very much more than the purchased oil), the cultural context (when parents die, children who have grown up outside an agricultural context, are not able to carry on cultivation), etc. Besides, land managed by hobby and style farmers is more dependent on its geographical location, in terms of closeness to settlements and accessibility. Although the decision to carry on agricultural production in these areas may seem irrational from a productive-economic point of view, their abandonment could have very negative impacts as regards hydro-geologic stability and risk of forest fires.

Non-professional farmers do not respond to economic incentives, usually as a consequence of their small size that makes the economic and bureaucratic effort for applying for aid non profitable. In this context, if these areas cannot be integrated in stronger farms, their survival may be ensured by different policy actions, e.g. promoting private or public services (e.g. pruning, harvesting, etc.) able to counteract the above mentioned issues of high costs (in the case of style-farmers) or loss of expertise (in the case of hobby farmers).

A spatialized analysis of the importance of professional farms vs non-professional ones is shown in fig. #.4, left side.

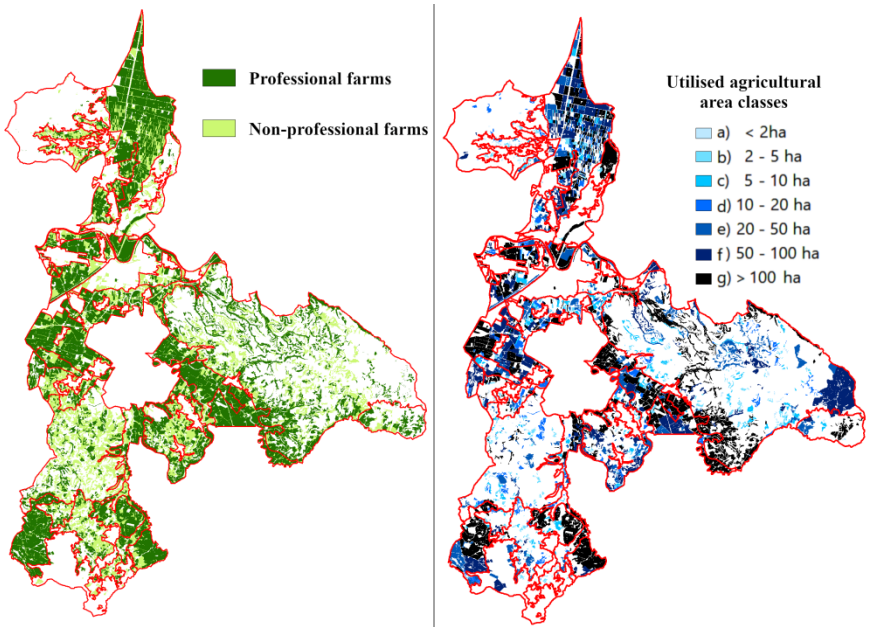

Fig. #.4. Left side. Land managed by professional (dark green) and non-professional (light green) farmers. Right side: Farm classification according to the class of Utilized Agricultural Areas.

Fig. #.5 shows the same themes zooming on two morphotypes, i.e. morphotypes 12.1 - "Terraced olive groves on the eastern side of Monte Pisano" and 8.1 - "Arable land on the reclaimed land of the former Bientina Lake". Top map shows that these two rural landscapes are quite different in terms of share managed by professional farms. Indeed, while in the "Arable land on the reclaimed land of the former Bientina Lake" there is a high presence of land managed by professional farmers, in the "Terraced olive groves on the eastern side of Monte Pisano" there is a prevalence of land managed by non-professional farmers.

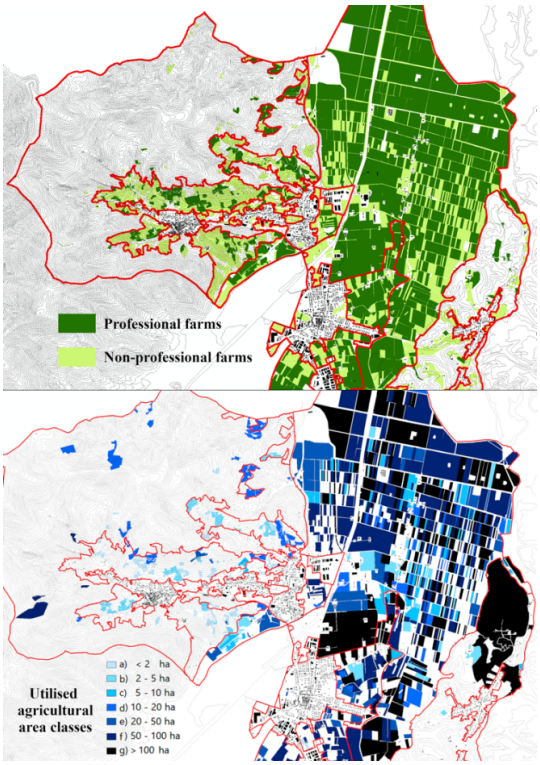

Fig. #.5. Morphotypes 12.1 - "Terraced olive groves on the eastern side of Monte Pisa-no" and 8.1 - "Arable land on the reclaimed land of the former Bientina Lake". Top map: Land managed by

professional (dark green) and non-professional (light green) farmers. Bottom map: Farm classification according to the class of Utilized Agricultural Areas.

Usually there is a quite strong relation between physical and economic size of farms, especially among farms with similar crop mixes. Hence, average size of farms may be considered as an important information related to farm viability and to the permanence of agricultural activities. Bottom map in fig. #.5 shows the spatial information about this characteristic, focusing on the same morphotypes shown in the top map. This analysis confirms the weakness of morphotype 12.1 (where about 46% of land is managed by farms with 5 ha. or less) in comparison to morphotype 8.1 where farms with average-large size are prevalent (about 73% is managed by farms whose size ranges from 50 to 500 ha.).

As stated above, in order to ensure the permanence of agricultural activities in areas that are neither suitable for self-consumption production nor close to settlements, it is necessary to promote professional farms that need to have an adequate size to be viable. In areas where small farms include fertile land, this viability and the absence of abandonment maybe ensured only through the transfer of land (rent or purchase) from small to larger and stronger farms. At the same time, the growth in farm size and modernization processes need not to totally destroy the typical signs characterizing farming in the Tuscan region, namely the agrarian meshes represented by the dense network of farm roads, field boundaries, hedges and tree lines.

The situation is more difficult to be faced in areas where land is characterized by low fertility, because in this case is more likely that the evolution will be towards abandonment. Consequently, it is necessary to ensure that this will not happen without a proper control, able to guarantee territorial stability.

Based on the variables described in tab. #.1 and of the above considerations, for each morphotype has been drawn a summary table that describes the main functions provided by each morphotype and the consequent guidelines and recommendations for policy actions. Policy actions do not have to relate necessarily to urban planning rules but may attain to sectoral policies (e.g. to Rural Development Programme - RDP) and can be at the base of a landscape strategic project.

The following tab. #.2 and #.3 describe functions and policy actions intended for the two morphotypes to whom we have made special reference, e.g. “Terraced olive groves on the eastern side of Monte Pisano” and “Arable land on the reclaimed land of the former Bientina Lake”.

Table #.2. A simplified framework for the analysis of morphotype “12.1 – Terraced olive groves on the eastern side of Monte Pisano” and recommendations for policy actions.

Function / Ecosystem Service	***Assessment: description***
**Productive services*	
-Agri-food production	High share of land cultivated for self-consumption or by hobby farmers
-Tourism and tourism-related services	High presence of on-farm tourism and Bed & Breakfast
-Territorial marketing	Landscape is seldom used as a leverage point for territorial enhancement
**Recreational-cultural services*	
-Maintenance and reproduction of historical, cultural and identity heritage	Strong identity of Monte Pisano and Tuscan landscapes
-Usability of nature, environment and of the aesthetic value of landscape	Widespread presence of roads and walking paths connecting the area with the neighbouring protected areas of Monte Pisano
**Protective services*	
-Maintenance and reproduction of water resources	Presence of hydraulic works that are paramount for managing surface water
-Maintenance and reproduction of agri-ecosystem biodiversity	Widespread presence of natural vegetation

-Maintenance and reproduction of landscape heterogeneity	Landscape specialized in olive groves, but that maintain a good level of heterogeneity thanks to the presence of ecological infrastructures
- Reduction of hydrogeological risk	Key role of terraces

Recommendations for policy actions

Policy actions need to guarantee the economic viability of productive processes insofar as they guarantee a mix of positive ecosystem services.

Policy actions should aim to promote innovative management processes, such as: a) collective services for the management of olive groves that are abandoned or at risk of abandonment, at least for the more critical phases of cultivation; b) involvement of public bodies – e.g. municipality, land reclamation consortium – in the maintenance and management of the hydraulic and minor road networks; c) aid to promote and maintain an adequate presence of farms in order to prevent abandonment phenomena and risks deriving from abandonment; d) promote facilities (e.g. storage buildings) with adequate security and aesthetic features, able to make easier carrying out productive activities; e) design regulations for common goods able to recognise the commitment of farmers in maintaining terraced olive groves and the consequent production of ecosystem services, and considering the provision of payments for ecosystem services (PES).

Table #.3. A simplified framework for the analysis of morphotype "8.1 – Arable land on the reclaimed land of the former Bientina Lake" and recommendations for policy actions

Function / Ecosystem Service	***Assessment description***
**Productive services*	
-Agri-food production	High share of farmland belonging to professional farms that cultivate cereals and industrial crops
-Tourism and tourism-related services	Absence of on-farm tourism and other tourism services
-Territorial marketing	Landscape is seldom used as a leverage point for territorial enhancement
**Recreational-cultural services*	
-Maintenance and reproduction of historical, cultural and identity heritage	Reclaimed land landscape with a strong identity in Tuscany. Hydraulic work and road networks well pre-served and widespread presence of farmhouses, although not so well maintained
-Usability of nature, environment and of the aesthetic value of landscape	Presence of wetlands to be maintained; widespread presence of roads and walking paths that easily allow area usability
**Protective services*	
-Maintenance and reproduction of water resources	Presence of hydraulic works that are paramount for managing surface water, since the area suffers for water stagnation
-Maintenance and reproduction of agri-ecosystem biodiversity	Widespread presence of wetlands, but low presence of ecological infrastructures
-Maintenance and reproduction of landscape heterogeneity	Landscape characterized by extensive crops, whose heterogeneity is ensured by crop diversification and fallow land (Common Agricultural Policy).
-Reduction of hydrogeological risk	Not significant, being a lowland

Recommendations for policy actions

This morphotype has a high naturalistic value but is vulnerable from the point of view of the maintenance and management of agricultural hydraulic works. It needs to be carefully preserved and enhanced.

Policy actions should aim to: a) connect this area with other territorial systems (Monte Pisano, Cerbaie) by organizing adequate ecological corridors; b) guarantee that agricultural hydraulic works are kept in good efficiency in order to ensure farmland production; c) promote the restoration of abandoned farmhouses, highlighting their cultural and identity specificity. Farmhouses may be valuable resources for developing environ-mental tourism activities; d) prevent the sprawl of settlements and soil consumption; e) improve actions for territorial enhancement and territorial marketing.

5. Conclusion

The experience gained during our research, aiming to lay down a knowledge framework for a structural plan, highlighted that in local urban planning interests are focused on land transformation, more than on rural morphotype management. Contrariwise, we believe that the role played by the rural landscape (and the territory) is as important as the role of infrastructures and residential and industrial settlements. Rural landscape role, in the coming decades, will tend to regain a new centrality, related to the organization of vital infrastructures able to provide local communities with ecosystem services directly affecting their well-being: food production, water and land management, carbon dioxide sequestration, creation and maintenance of landscape, culture and local identities, enjoyment of a balanced relationship between nature and individuals and communities (Di Iacovo, Rovai, & Orsini, 2010)(Rovai, Di Iacovo, & Orsini, 2010). Therefore, if we consider rural landscapes as living organisms that evolve in relation to management methods, any command and control approach will be doomed to be ineffective. For this reason, we considered the analysis of management by farmers as paramount. Through the management analysis we reconstructed the framework of functions / services performed by each landscape and its most probable short-medium term development. Integrating the supply side of functions with the community "demands" or "hopes" for the territory / landscape, consent to identify and develop specific policies and / or projects.

Unfortunately, in the current phase, territorial planning is still guided by strong economic interests linked to land transformation and there is a scarce concern about the rural territory, about which planning tends to introduce constraints and rules, without providing aid or promoting territorial development.

Due to the fundamental role played by rural territory in providing Ecosystem Services (ESs), the need arises for a closer coordination between planning and rural development tools, in order to promote effective landscape projects with the aim to strengthen the production of ESs. Landscape projects as local development tools need to be drawn and implemented through a shared vision between farmers, as key land managers, and other stakeholders. Moreover, landscape projects may stimulate farmers to act based on a greater awareness of the role they play in producing landscape and ESs and consequently bring about more durable positive effects.

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