View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Archivio della Ricerca - Università di Pisa

Bio-based and Applied Economics 6(1): 81-114, 2017
DOI: 10.13128/BAE-14625

Full Research Article

A spatial analysis of terrain features and farming styles in a disadvantaged area of Tuscany (Mugello): implications for the evaluation and the design of CAP payments

Laura Fastelli[1]*, Chiara Landi[2], Massimo Rovai[1], Maria Andreoli[1]

[1] Dept. Of Agricultural, Food and Agri-environmental Sciences, University of Pisa, Pisa, Italy
[2] Italian National Institute of Statistics, Rome, Italy

Date of submission: 2014 15th, June; accepted 2017 1st, March

Abstract. In recent times there has been a growing awareness of the role of agriculture in providing public goods and services, in particular in less favoured areas. However, since agriculture is an economic activity, its permanence implies that it should be able to generate a satisfactory income for farmers. Where this is not possible, due to natural constraints or adverse economic and market conditions, in order to maintain an adequate use of farmland it is necessary to provide public aid to farmers. In this framework, the design of proper interventions aimed to promote rural development in less favoured areas should be based on a deep knowledge at the farm and territorial level. As regards the territorial level, the RDP zoning [art. 11 Reg. Ce 1698/2005] developed by Member States on the base of the guidelines provided by the European Commission is very often not sufficient to adequately define the territorial characteristics of rural areas. The use of GIS techniques may help to handle this issue by providing a better and more detailed knowledge at the territorial level. Farm level is important insofar as aid effectiveness is usually strongly depending on the type of farm that is receiving it. Thus, a careful selection of beneficiaries could determine a more effective and efficient distribution of resources. This paper aims to provide a spatial analysis of natural constraints and types of farming style in Mugello area and to analyse their relations with CAP aid distribution. Both Single Payment Scheme (SPS) and Rural Development Programme (RDP) payments have been taken into account. The paper combines a GIS analysis of terrain features with the theoretical approach of farming styles. For this purpose, the study integrates several sources of data: the 2010 Italian Agriculture Census, the Tuscany Regional Agency for Payments in Agriculture (ARTEA) database, and land cover data from the database Corine Land Cover (CLC-06), as updated to 2007 by LAMMA (Laboratory for Environment Monitoring and Modelling). A geo-referenced database including socioeconomic attributes of farms, land use, and terrain characteristics has been generated in order to merge information at territorial and farm level. The results of this integrated analysis confirm that Mugello is a very heterogeneous area as regards terrain characteristics despite the fact that it is totally included in less favoured areas. On the other side, farm strategies and economic results seem to be related to entrepreneurial characteristics as much as to natu-

*Corresponding author: laura.fastelli@for.unipi.it

ISSN 2280-6180 (print)
ISSN 2280-6172 (online)

© Firenze University Press
www.fupress.com/bae

ral constraints. The analysis of Pillar I payments and RDP payments for farms located in this mountainous area shows a very complex situation where the strategies implemented by farmers of the strongest farming styles may successfully counteract natural constraints. Besides, in the Authors' opinion, the analyses performed highlight the importance of spatial analysis as a tool for evaluating how public resources are distributed on a territory, thus providing also useful information on the way this distribution could be improved, e.g. for ensuring a higher level of environmental services.

Keywords. Farming styles, integrated GIS database, multi-criteria analysis, disadvantaged rural areas, Common Agricultural Policies

JEL codes. Q12, Q15, Q18

1. Introduction

Since its beginning the Common Agricultural Policy (CAP) has been aiming at raising farmers' incomes. In time, CAP aims have changed showing an increasing interest in rural development, also as a tool for lowering disparities among different territories, and in maintaining the environment. In these last cases, farm viability and performances are seen more as a mean to promote both local development and Ecosystem Services provision, than as a goal in itself (Cooper *et al.*, 2006).

The Italian agricultural system is characterized by a wide range of farms, which differ in terms of socioeconomic (size, structure, labour, knowledge, networks, etc.) and farmed land (terrain) bio-physical characteristics. In order to design proper policies, decision makers need to understand and take into account this heterogeneity in the framework of the changing socioeconomic conditions of rural areas, both at farm and at territorial level. This heterogeneity is extended also to farmers strategies, as regards entrepreneurial attitudes, external operating environments and uses of available resources, that can be more deeply analysed through the theoretical approach of the style of farming (Van der Ploeg, 1990; 1994; 2000). According to the existing literature, farming style defines a specific way of combining together different resources, such as, land, labour, livestock, machines, networks, knowledge, etc., in order to achieve specific objectives. In other words, it is an entrepreneurial attitude that combines material and immaterial resources related to a specific rural context. This type of analysis allows understanding the causes of the coexistence of several types of farms, in terms of resources, investments and cultural heritage, within the same area or the same supply chain, and it helps investigating the complexity of agricultural systems, which are characterised by an increasing heterogeneity among farms (Van der Ploeg, 1994). Farming style analysis is often based on surveys of farms located in territories that have similar characteristics, thus highlighting the differences in farm strategies (Emtage & Herbohn, 2012; Schmitzberger *et al.*, 2005). According to Guillem *et al.* (2012), even at small geographical scale, diversified farm strategies related to personal attitudes and objectives of the farm operator, may coexist and lead to diversified development trajectories within the same area (Beaudeau *et al.*, 1996).

The farming style analysis represents a useful tool to assess the combination of goals, strategies, and related practices put in place by farmers to improve their economic performance. Furthermore, this analysis allows understanding the impacts of public policies on the territory and the effects of farms' activities on the provision of ecosystem services. Following this approach, public policies should be tailored to the specific needs of each farming style, consequently improving the effectiveness of public expenditure (Wilson, Harper, and Darling, 2013; van der Ploeg and Ventura, 2014; Guillem *et al.*, 2012). Guillem *et al.* (2012), through a social survey, define farming styles according to farmers' perceptions of the environment. Results show that farmers do not entirely follow their stated objectives, since external factors – such as input and output price signals and subsidy levels – have on their strategies a stronger influence than their stated opinions about environmental and social issues. From this point of view, a classification of farming styles based on characteristics and decisions taken by farmers could be more reliable than one built on the results of a social survey. This approach may help to design more effective policy instruments, which integrate ecological issues within the planning activity.

Nevertheless, due to its relation both with farms and territorial characteristics, farming styles' definition needs a huge amount of information, which prevents this kind of analysis being carried out at large scale. During the last few decades, researchers have created large databases able to provide good information also on specific small areas. These databases may reduce the time lag between research activities and policy makers' decisions (Joerin *et al.* 2001). However, this issue is very complex as many variables at territorial and farm level play a key role. Many questions arise, such as: which are the needs of a specific area at farm and aggregated levels? And which are the best tools to fulfil these needs, combining public objectives related to regional development, and private objectives, related to business development?

Geographical Information Systems (GIS) may help handle this issue by highlighting the specific needs of these areas in terms of policy supply (Budic, 1994). The current availability of data and their processing by GIS analysis make it possible to reach a more comprehensive knowledge of a specific territory, since socioeconomic information alone is not sufficient to explain the evolutionary trajectories of agriculture, due to their relationship with the physical characteristics of land (altitude, slope, etc.). Indeed, spatial analysis – by locating all the parcels composing the farms through a spatial representation – better supports the planning processes (Gonzales and Del Campo, 2012).

Many contributions on GIS analysis have been applied to land use evaluation (for a review see Malczewski, 2004). Several contributions try to estimate ex-ante the potential impact on farm structures and on ecosystem services provided by the territory brought about by agricultural policies in general or by specific measures, i.e. Rural Development Plan (RDP) environmental measures. Ex-ante evaluations are usually performed by means of Agent-Based Model (ABM), such as the contributions of Piorr *et al.* (2009), Brady *et al.* (2012), and Lobianco and Esposti (2010).

Another strand of the literature uses GIS to perform an ex-post evaluation of the CAP since it seems to reduce costs and increase the effectiveness of policy results (Matthews *et al.*, 2013). Matthews *et al.* (2013) use a spatial analysis framework to assess the effects of Single Farm Payments (SFP) on farm income in several areas of Scotland, integrating biophysical and socioeconomic data. Their results show that the shift to area-based payments leads to a redistribution within sub-sectors; from intensive to more extensive systems. Yang *et al.* (2014) investigating the implementation of agri-environmental measures in Scotland argue that spatial models are more suitable to achieve an effective policy if compared to non-spatial regression models. Besides, they note that, although results show a significant positive relationship between Sites of Special Scientific Interest (SSSI)[1] and agri-environmental payments, the current incentives system is not able to improve the provision of ecosystem services in the 'wider countryside', since only a low share of Scottish farmers accede to this kind of payments. Finally, other contributions (Spaziante *et al.*, 2009; 2012; Adisa, 2012) use GIS to evaluate the effectiveness of agri-environmental payments by analysing the spatial distribution of these measures (for a review see Gonzales and Del Campo, 2012). Results show that the territorial allocation of several environmental measures among farmers could be greatly improved. According to the authors, the spatial analysis provides useful inputs to policy makers especially when dealing with RDPs, which involve a wide range of objectives, stakeholders, environmental effects and beneficiaries. The research presented in this paper follows the latter strand of the literature.

Although the introduction of the analysis at farm level in this kind of evaluation is usually based on the data of FADN[2] accountancy (see, e.g., Piorr *et al.*, 2009) and it is mainly based on structural features and type of output mix, the authors deemed more important to take into account farm strategies, in order to be able to evaluate the influence of human capital on the possible evolution of the area.

In this framework, this paper provides a GIS analysis of Single Payment Scheme (SPS) and Rural Development Programme (RDP) payments spatial distribution in Mugello area (Tuscany), with the aim of providing some insights on the spatial correlation between terrain features and farming styles and between farming styles and amount of aid received. In particular, these analyses should allow verifying if aid is more related to territorial features or to the type of farming style to which the receivers belong to.

Mugello is a mountain area located the North-East of Tuscany, Italy, where farming is characterised by the presence of dairy cattle and other livestock, that experienced a 20% decline in the number of farms over the last ten years, associated to a 12% loss of Utilised Agricultural Area (UAA) (ISTAT, 2010). Indeed, as regards mountain and other disadvantaged areas, Cooper *et al.* (2006) state that in these areas farms and farming systems are generally subject to natural handicaps, which act as a constraint on more intensive practices. In turn these handicaps exert an impact on the viability of the farm business and its relative competitiveness. As such, these farms are potentially under the greatest threat from the decline and cessation of management, with a consequent risk of loss of environmental values. The previous data of farms and UAA decrease seems to confirm that this risk is present in Mugello. On the other hand, more than for its economic impact, farms and farming systems disappearance and land abandonment are important from an environmental viewpoint, insofar as the environmental and related public goods that are of value in the countryside stem from appropriate land management, and in particular, agricultural management over large areas. Continued agricultural management contributes most to the countryside where it supports the maintenance of valued open landscapes, semi-natural habitats and biodiversity; it assists in the control of forest fires; or contribute to good soil and water management (Cooper *et al.*, 2006: p. 13).

---

[1] The Sites of Special Scientific Interest (SSSI) are designated sites prioritized by the Scottish policy.
[2] The Farm Accountancy Data Network (FADN) is an instrument for evaluating the income of agricultural holdings and the impacts of the Common Agricultural Policy.

For this study, a geo-referenced database was created, integrating 2010 agricultural census data, public payments database and land use data, in order to understand the interactions among socioeconomic aspects, land use, terrain characteristics and agricultural policies. Different entrepreneurial models or farming styles were identified through a Multi-criteria analysis, which used quantitative and qualitative information at farm level. Statistical and spatial data were processed in order to provide a deeper knowledge on the consistency of distribution of CAP payments aimed at supporting farms located in disadvantaged areas.

The paper is structured as follows: the following section 2 presents the methodology; section 3 presents the case study, firstly giving a description of the main features of the area, and then describing data and results of the analyses; section 4 presents concluding remarks on the main results of this work.

2. Methodology

In order to analyse the distribution of SPS and RDP payments in Mugello area and its correlation with farming styles and territorial features, several sources of data were integrated. Land use data from Corine Land Cover (CLC-06) and LAMMA 2007 (Laboratory for Environment Monitoring and Modelling) databases were merged with the 2010 Census of Agriculture (in the following referred to as "Census") and the 2012 Tuscany Agency for Payments in Agriculture (ARTEA) databases. The 2010 Census provides a wide range of information regarding socioeconomic aspects of farms, and the ARTEA database provides information on the public payments received by farms both under Pillars 1 and 2.

In the first step, both territorial and cadastral[3] data were used in order to focus on the main differences among the agricultural resources existing inside Mugello and to check their correlation with the zones defined by the Tuscany RDP. Then Census and ARTEA data were processed in order to define different farming styles/attitudes. Finally, all the databases were merged to analyse the territorial structure of each RDP zone. All spatial analysis were carried-out using open-source GIS software (QGIS. 2.2) and its statistical and geomorphologic analyses plug-ins[4].

As previously stated, the first analysis focuses on territorial characteristics of rural areas according to land use, and it is carried out through statistical processing of land cover data (LAMMA, 2010). A geo-referenced database has been created integrating the cadastral database, the ARTEA database and Census data, in order to be able to allocate each plot of land to the farm that is farming it, to know the socioeconomic features of farms to which plots were allocated and to reconstruct the spatial area to which CAP payments were distributed.

Then, these data have been clipped with the CLC data and terrain features data. In particular, altitude (extracted from a digital elevation model) and slope (calculated as the average slope angle for each cadastral parcel in percent, based on first order derivative estimation) were determined for each cadastral parcel. The choice of altitude and slope

[3] Cadastral data refer to the Italian inventory of agricultural land (Catasto Terreni), where the elementary unit is a parcel of land belonging to the same Municipality, holder, category of agricultural utilization and class of productivity, that is not divided by roads, rivers, railways, etc.

[4] More information of QGIS project and on the QGIS software can be found on the QGIS project website, at the address http://qgis.osgeo.org/en/site/about/index.html (last consulted 05.05.2016).

as has been made on the base of the rules for defining less favoured areas, among which Mugello is included. Indeed, "there are three categories classified as LFA. Each category covers a specific cluster of natural or specific handicaps in Europe in which the continuation of agricultural land use is threatened". The first class is that of Mountain areas, which "are characterised as those areas handicapped by a short growing season because of a high altitude, or by steep slopes, or by a combination of the two at a lower altitude" (Jones *et al.* 2012). Although the new rules proposed by Jones *et al*. (2012) for assessing natural constraints favour the length of growing season as a constraint related to both temperature and altitude, within such a small area as Mugello, altitude is highly correlated to temperature, and consequently it is a good proxy of the length of growing season.

Thanks to the merging and geo-referentiation of data from different sources, it was possible to obtain a sample, which covers a Total Agricultural Area (TAA) of 52,849 ha, 94% of which (49,966 ha) was geo-referenced. This final geo-referenced sample, which allows to represent each farm according to its terrain features (such as altitude, slope and land cover) and socioeconomic characteristics, is composed by 821 farms, representing 56% of farms and 81% of the TAA surveyed by ISTAT in 2010 (Table 1).

Table 1. Mugello - Coverage of the farms sample compared to universe provided by 2010 Agricultural Census.

	Sample	Universe	% Sample/ Universe
Farms (*Number*)	821	1462	56%
Utilised Agricultural Area (UAA) (ha)	23,476	27,290	86%
Total Agricultural Area (TAA) (ha)	49,966	61,865	81%

Source: own elaboration on 2010 Census of agriculture data

The geo-referenced sample of Mugello farms presents stronger structural characteristics than the universe in terms of UAA, TAA and Standard Output per farm (Table 2) and this is very likely due to the fact that it includes only farms which have received public payments through ARTEA; consequently the sample represents the *core* of the Mugello agricultural system. This explains the differences between sample and universe in terms of farm acreage, which are confirmed by ANOVA results (see row t-*test* in Table 2*)*.

Then the farms operating in Mugello area were classified in order to identify different farming styles or entrepreneurial models/attitudes using quantitative and qualitative information provided by the 2010 Census. Following the approach proposed by Rocchi and Landi (2013) and Rocchi *et al.* (2014), we define entrepreneurial attitudes according to the level of *entrepreneurial dynamism* and of *multifunctional diversification*. The *entrepreneurial dynamism* is related to the farm operator attitude towards the business external environment, i.e. his/her capacity to properly react to external changes, and it was measured using several variables as proxies, i.e. the use of bookkeeping, the use of Information and Communication Technology (ICT), the use of subcontracting, on-farm presence of the farm operator, type of integration with output markets and the attendance of the farm operator to professional

Table 2. Mugello - Comparison between the geo-referenced sample and the universe.

	Farm Utilized Agricultural Area (ha)		Farm Total Agricultural Area (ha)		Farm Standard Output (€)	
	Sample	Universe	Sample	Universe	Sample	Universe
MIN	0	0	0.24	0	0	0
1ST QUART	4.87	2.38	8.12	4	5,870	3,397
MEDIAN	11.05	5.82	22	11.36	17,370	9,348
MEAN	28.34	18.67	64.37	42.32	47,750	31,690
3RD QUART	30	16.59	56	35.58	42,000	23,600
MAX	775.75	775.75	6,453	6,453	3,073,000	3,073,000
t- test	4.5831***	2.1743**	2.8027***			

Source: own elaboration on 2010 census data. (*** significance at 0.01; ** significance at 0.05, * significance at 0.1).

courses (Table 3). The *multifunctional diversification,* related to non-agricultural activities, i.e. the so called "other, or secondary, gainful activities" and the production of high quality products (Table 3), is another very important feature of farmers since it highlights the attempt to diversify farm income by pursuing new business activities, as promoted by the EU.

The *multifunctional diversification* and *entrepreneurial dynamism* levels were measured through a Multi-criteria Analysis (MCA) methodology (Dean and Nishry, 1965). The MCA encompassed the following stages: a) definition of variables and attributes; b) definition of a scale from 1 to 10 for each attribute (Table 3) and attribution of scores to each farm for every attribute; c) pairwise comparison to assign relative weights to the variables; d) determination of the matrix of weighted scores for both *multifunctional diversification* and *entrepreneurial dynamism* indices; and e) definition of farming styles. In order to weigh the variables used for computing the two indices, we applied a pairwise comparison among the selected variables (Table 4), where the value 1 was given when the variable on the row was deemed more important than the variable on the column, 0.5 if they had the same importance and 0 when the variable on the row was deemed less important than the one on the column. From the matrix of the weights resulting from the pairwise comparison it was possible to obtain a vector of the variables' weights, that has been normalised by making its sum equal to 1. The results obtained are presented in Tables 4 and 5, which show the weights assigned to the variables used to compute *entrepreneurial dynamism* and *multifunctional diversification* indices, respectively. The most important variables, i.e. those with higher weights, are the percentage of income coming from non-agricultural activities (*multifunctional diversification)* and the importance of forms of integration with output markets on total production (*entrepreneurial dynamism)*. The values of both *multifunctional diversification* and *entrepreneurial dynamism* indices are obtained, for each farm, as a weighed sum of the scores obtained on all variables composing the indices.

When representing the *entrepreneurial dynamism* and the *multifunctional diversification* on the two axes of a Cartesian plane, where the threshold value (axes origin) is represented by the average value of the resulting scores, four main farming styles are defined

Table 3. Variables (and rules for their score assignment) composing the «*multifunctional diversification*» and the «*entrepreneurial dynamism* » Indices.

Multifunctional diversification Index		Entrepreneurial dynamism Index	
Cultivation practices (Total score 0-10 as a sum of the four single scores)	Presence (**2.5**)/absence (**0**) of: - hedgerows - grass and cover crops - crop rotation - conservative tillage	Bookkeeping (presence and type)	**0** - no bookkeeping **5** - bookkeeping only for VAT accounting purposes **10** - bookkeeping for ordinary accounting regime
High quality products (share of farm acreage dedicated to high quality products)	**0** - None **2.5** - < 1/3 **5** - 1/3 - 2/3 **10** - > 2/3	Information Communication Technology (uses for types)	**0** - no ICT use **2** - only for administrative purposes **4** - only for crops and livestock management **6** - both for administration and for crops and livestock management **8** - Use of Internet **10** - Use of Internet and e-commerce
Non-agricultural activities (number)	**0** - no non-agricultural activities **3.33** - 1 activity **6.66** - 2 activities **10** - > 2 activities	Attendance to professional courses	**0** - no **10** - yes
Share of farm income deriving from non -agricultural activities	**0** – none **5** - < 30% **10** - >30%	Subcontracting (Surface expressed as percentage of UAA.)	**0** - > 75 % **5** - 25- 75 % **10** - < 25 %
		Presence of the entrepreneur (in terms of on farm and off farm working days)	**0** - farm operator not working on farm **2.5** - < 100 working days on farm **5** - 100- 180 working days on farm **7.5** - >180 total working days; off-farm days > on- farm days **10** - >180 total working days; off-farm days < on- farm days
		Forms of integration with output markets (share of sold standard output)	**0** - Only self-consumption **3.33** - < 1/3 of sold standard output **6.66** - 1/3 - 2/3 of sold standard output **10** - >2/3 of sold standard output

Note: variables' scores in bold.

(Figure 1). Since the *multifunctional diversification* is mainly related to non agricultural activities, the farms beyond the average value have at least one non-agricultural activity representing a consistent share of total income.

Table 4. Weight matrix related to *entrepreneurial dynamism.*

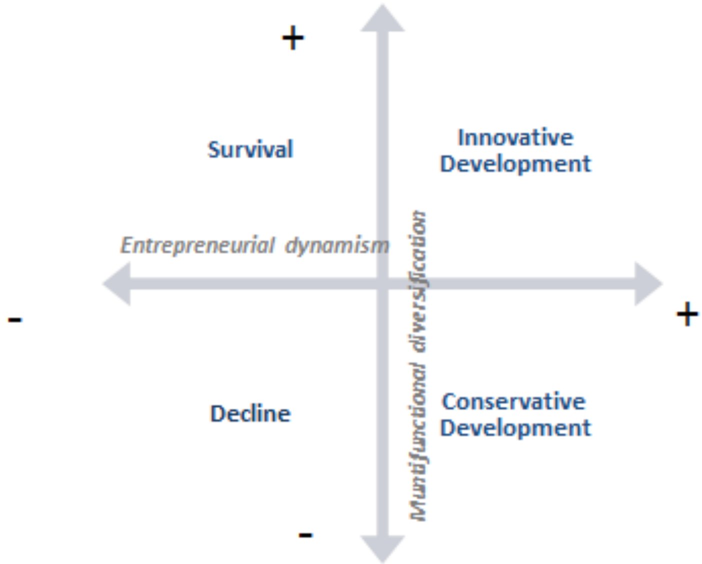
	Book-keeping	ICT	Courses	Subcon-tracting	Entrepre-neur labour	Integration with output markets	Control number	Weight vector
Bookkeeping	x	0	1	0	0	0	1	0.100
ICT	1	x	1	0	0	0	1	0.150
Courses	0	0	x	0	0	0	1	0.050
Subcontracting	1	1	1	x	1	0.5	1	0.225
Entrepreneur labour	1	1	1	0	x	0	1	0.200
Integration with output markets	1	1	1	0.5	1	x	1	0.275

Table 5. Weight matrix related to *multifunctional diversification.*

	Cultivation practices	High quality products	Number of non-agricultural activities	Output from non-agricultural activities (%)	Control number	Weight vector
Cultivation practices	x	0	0	0	1	0.100
High quality products	1	x	0	0	1	0.200
Number of non agricultural activities	1	1	x	0	1	0.300
Output from non-agricultural activities (%)	1	1	1	x	1	0.400

The farming styles stemming from the previous classification are: i) *Decline*, ii) *Survival*, iii) *Conservative Development*, and iv) *Innovative Development* (Figure 1). The *Decline* farming style includes farms without non-agricultural activities and with a low degree of *entrepreneurial dynamism*. The *Survival* farming style includes farms with a low degree of *entrepreneurial dynamism* but where entrepreneurs adopt strategies aimed to increase farm income through on-farm diversification (Bartolini *et al.* 2013). The last two types include farms with higher *entrepreneurial dynamism*. The difference between these two last farming styles stems from the productive choices of the farm operator: strengthening the agricultural production improving economies of scale and technological investments with a more traditional approach (*Conservative Development*); or farm diversification due to the introduction of activities that increase the added value of products and the provision of ecosystem services (*Innovative Development*), with a more innovative approach and a positive spill-over on the society for the provision of public services.

Figure 1. The definition of farming styles according to the level of *multifunctional diversification, and entrepreneurial dynamism.*



3. The case study: description of the area, data and results

In the following paragraphs, after describing the case study-area, firstly we describe in details the data used in this analysis, and then we provide an analysis of the statistical significance (ANOVA and t-test) of the results for Mugello area of the farming styles described in the previous chapter against several socioeconomic indicators, including the access to public payments. Once verified the validity of the farming styles from a statistical point of view, they were correlated with RDP zoning. As regards public payments, especially those relating to RDP measures 211 and 212 (i.e. mountainous and other disadvantaged areas), the analyses of their spatial distribution aimed at highlighting their correlation with farming styles and the level of natural handicap constraints, measured by terrain features.

3.1 Mugello: Location, main features and importance of CAP aid for the permanence of agricultural activities

Mugello, one of the historical regions of Tuscany, is located northeast of Florence, and it includes 9 municipalities[5], which belong to two different sub-zones, Upper [6] Mugello in the North, where mountain areas are associated to high altitude and declivity of land,

[5] Barberino di Mugello, Borgo San Lorenzo, Dicomano, Firenzuola, Marradi, Palazzuolo sul Senio, San Piero a Sieve, Scarperia, and Vicchio.
[6] Firenzuola, Marradi, and Palazzuolo sul Senio.

and Lower[7] Mugello in the South, where the land is more suitable to agricultural activities. According to Tuscany RDP zoning, Mugello includes three different zones: *Intermediate rural areas in transition* (C1); *Declining intermediate rural areas* (C2) *and Rural areas with development problems* (D). Zones C1 and C2 derive from the splitting of the class of Intermediate Rural Areas described by the National Rural Development Plan, since in Tuscany this zone would have accounted for more than 60% of the regional territory. The splitting has been made mainly on the basis of the incidence of workers employed in agriculture (whose high value characterises C2 zone) and of the total forestry area (including also the part not belonging to farms). Mugello area has traditionally been specialised in agricultural activities and animal husbandry, especially dairy cattle and beef cattle rearing. In particular, in Upper Mugello, forestry and pastoral activities are very important. Farmers mainly use the forestry for firewood and chestnut cultivation, which are both rapidly growing due to the current policies.

In Mugello the relationships between geomorphologic features and anthropogenic organisation are very important. Indeed, several differences between the northern and the southern part exist at geological and at hydro-graphic network level. This, in turn, has strongly affected the types of settlement, their locations, and the farm structures. Upper Mugello is characterised by steeper terrains with worse accessibility conditions, associated to increasing depopulation and abandonment of previously cultivated fields, pastures and woods. The reduction of agroforestry practices has triggered massive processes of renaturalisation and expansion of natural vegetation. This massive renaturalisation of Mugello is often bordering with abandonment and, coming after an agricultural exploitation of the land, it has broken the old balance of this territory, bringing about hydrologic and erosive problems resulting in very negative effects. The southern side is characterised by gentle reliefs, where the forest cover is not continuous, and large areas of agricultural fields alternate to grasslands and pastures (LAMMA, 2010). As regards environmental quality, a recent contribution of Bartolini and Brunori (2014) shows that in 2010 the situation in Mugello was quite good as regards the High Nature Value (HNV) index and had been improving during the previous ten years.

A spatial description of the distribution of field types in Mugello area can be found in Piorr *et al.* (2009, fig. 3). Recent analyses by Piorr *et al.* (2009) and Uthes *et al.* (2011) show that a change of CAP aid in Mugello, especially in the case of abolishing direct payment, could bring about severe consequences in the area, such as a dramatic abandonment of mountain grassland field types, a relevant change in the share of uncultivated land on the total arable and changes in land use intensity. Piorr *et al.* (2009) provide an estimate of the impact of these changes on water erosion. Nevertheless, according to this study, the main changes would be related to a loss of landscape diversity and biodiversity. Uthes *et al.* (2011) in a simulation of the effects of abolishing direct payments, stress the importance for farm survival of a highly diversified sector with agro-tourism opportunities and good marketing and sales structures, variables that in our analysis have been included in the computation of the *multifunctional diversification* index. Nevertheless, according to Uthes *et al.* (2011), although agriculture survival could not be at stake, in the case of change of policy patterns, there will be severe impacts on some variables, e.g. on the share accounted by grassland, due to shifting of the traditional grazing-based activity of livestock rearing to

[7] Barberino di Mugello, Borgo San Lorenzo, Dicomano, San Piero a Sieve, Scarperia, and Vicchio

more intensive indoor systems. These changes could bring about both environmental problems (due to intensification) and social problems (due to the disappearance of many small farms and a reduction of labour requirement caused by land abandonment).

3.2 Land use, natural constraints and RDP zoning of Mugello

In order to better understand the natural resources of Mugello area, we have analysed the data of the distribution of Corine Land Cover as updated by Lamma (Table 6). In this case the total agro-forestry area includes also land that is not belonging to any farm.

The area of Mugello is 113,122.65 ha, 95.3% of which (107,838.37 ha, Table 6) are accounted by agroforestry land uses (LAMMA, 2010). Forestry (CLC classes 311, 312, 313, 322 and 323) and pasture and natural grassland (CLC classes 231 and 321) prevail in D zone (zone which represents 50.20% and 64.87% of the total area, respectively, for these land uses). In terms of share of each RDP zone, forest uses range from the 63.74% of C1 zone to the 74.49% of D zone, thus representing the main use of land in all the territory (70.91% on average in the whole Mugello area). Furthermore, the data show an almost equal distribution of the total arable land (CLC class 211) among the three RDP zones, although in terms of incidence on the total area of the RDP zones, arable land is decreasing from C1 (where it accounts for 28.26%) to D zone (where it accounts for 14.27%), with an inverse correlation with the share of forest land. Arable land accounts on average for 19.21% of the total Mugello areas, being the second most important land use after forest. On the map, the arable land is mainly represented by the horizontal belt in clearer colours that is located in the southern part of C1 and C2 zones. This arable land is mainly located in the class with the lowest altitude (Figure 3). Contrariwise, permanent crops (CLC classes 221, 222 and 223) are distributed unevenly, with a prevailing presence in the C2 zone (which accounts for 64.34% of the total), although their share on the total area of each zone is quite small, ranging from the 3.72% of the C2 zone to the 0.45% of D zone. Figure 2 presents the detailed distribution of CLC classes in Mugello area, while the corresponding detailed data can be found in Table A.1 in appendix.

As already highlighted in the methodological chapter, according to the 2010 Agricultural Census, the sample used in the present analysis covers a TAA of 52,849 ha and over 94% of this area has been geo-referenced trough the Q-GIS software (QGIS Development Team 2012). Land use is often related to terrain features, such as altitude and slope, which were assessed through terrain analysis (plug-in Q-GIS[5]). The data were analysed choosing cultivated cadastral parcels as the elementary reference unit. This choice results in analysing units with a variable size, while most of the analyses has been done by using larger regular square grid units. In the author's opinion, the advantages in using a unit that is homogeneous (see note 2) from the point of view of agricultural features and utilisation; and which allows performing spatial analysis of the real structural and socio-economic features of each farm, overcome the disadvantages in working with units that are not regular in shape and size. Due to parcels homogeneity, their size distribution was deemed as not important, since it is mostly depending on the administrative history of the parcel.

After analysing land uses in Mugello areas, we deemed important to analyse the main terrain features, since they are related to the level of natural constraints that not only influence the possible land uses, but also the costs and the incomes of those uses. The

Table 6. Distribution of Corine land cover (CLC) classes in Mugello RDP zones. C1: Intermediate rural areas in transition; C2: Declining intermediate rural areas; D: Rural areas with development problems.

6.1 – Absolute values

Group number	Description of groups of CLC classes	Groups of CLC classes (LAMMA, 2010)	Surface (hectares) by RDP zones			
			C1	C2	D	Mugello
1	Arable land	211	6,457.01	6,910.09	7,353.23	20,720.33
2	Permanent cultivation	221+222+223	456.49	1,244.18	233.15	1,933.82
3	Pastures and natural grassland	231+321	187.13	333.27	960.81	1,481.21
4	Agriculture land mixed with natural land	241+242+243	410.79	559.00	510.83	1,480.62
5	Forest	311+312+313+322+323	14,565.90	23,514.31	38,385.74	76,465. 95
6	Sparsely vegetated area	333+324	774.38	891.63	4,090.45	5,756.46
	Total	TOTAL	22,851.70	33,452.48	51,534.21	107.838,37

6.2 – Relative values

Group number	Description of groups of CLC classes	Row distribution (%)				Column distribution (%)			
		C1	C2	D	Mugello	C1	C2	D	Mugello
1	Arable land	31.16	33.35	35.49	100.00	28.26	20.66	14.27	19.21
2	Permanent cultivation	23.61	64.34	12.06	100.00	2.00	3.72	0.45	1.79
3	Pastures and natural grassland	12.63	22.50	64.87	100.00	0.82	1.00	1.86	1.37
4	Agriculture land mixed with natural land	27.74	37.75	34.50	100.00	1.80	1.67	0.99	1.37
5	Forest	19.05	31.18	49.51	100.00	63.74	70.29	74.49	70.91
6	Sparsely vegetated area	13.45	15.49	71.06	100.00	3.39	2.67	7.94	5.34
	Total agro-forestry	21.19	31.02	47.79	100.00	100.00	100.00	100.00	100.00

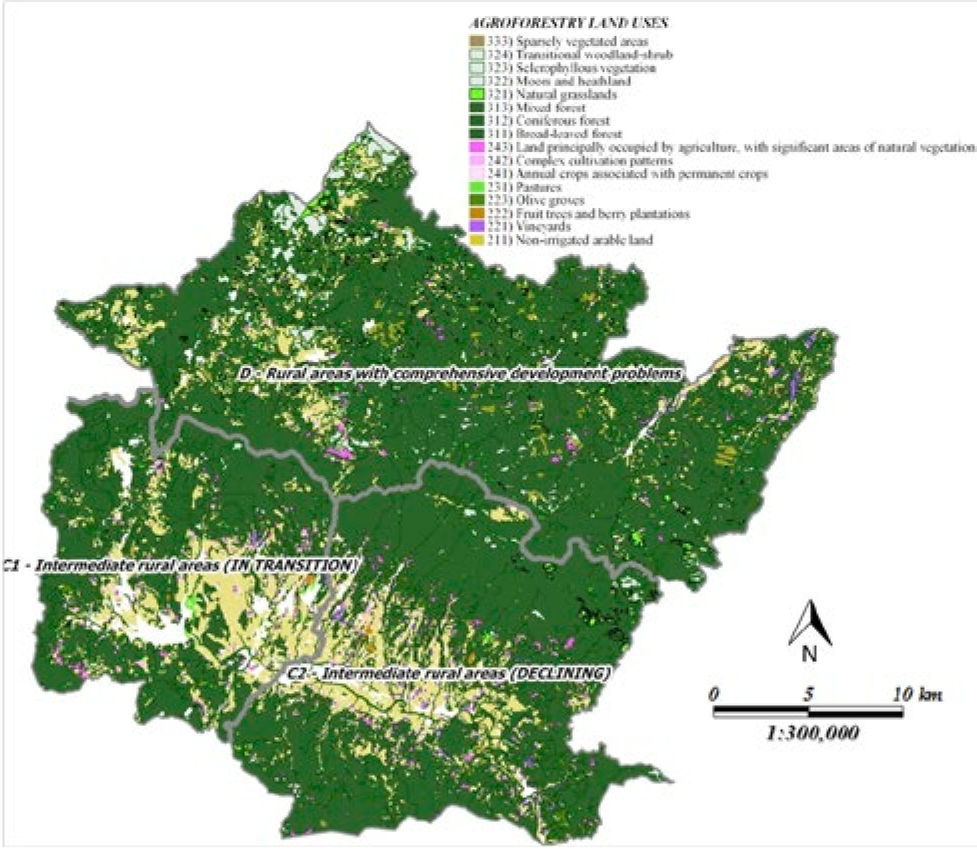
Source: own elaboration on Corine Land Cover as updated by Lamma (2010).

following maps and Tables (Figures 3, 4, 5 and Tables 7, 8, 9) present the characterisation of the geo-referenced farms operating in the Mugello area in terms of terrain features. As already stated above, differently from Piorr *et al.* (2009)[8] the land characteristics have been attributed to the farm's parcels as resulting from the ARTEA database (ARTEA 2012) and not to a regular grid and this, in our opinion, consent to obtain results that are more adherent to real farm management, since regular grids do not allow reconstructing the land that is under management by each farm.

The following Table 7 analyses the correlations between the distribution of farm land by classes of average altitude and the three RDP zones into which Mugello total area is

[8] Piorr *et al.* (2009) defined the standard size of the fields (1 ha).

Figure 2. Land use in Mugello.



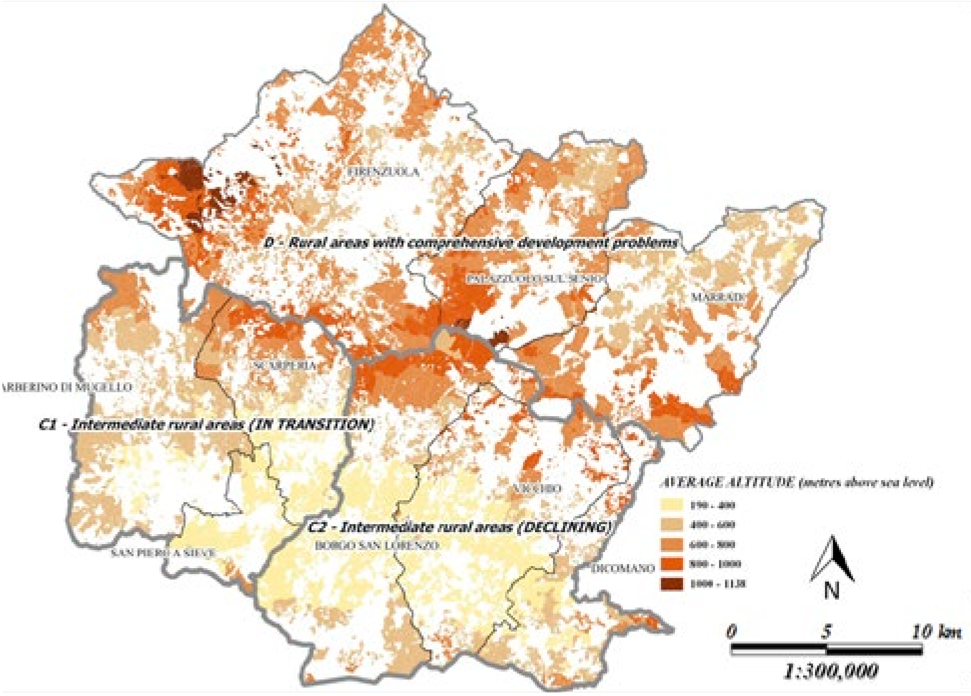
Source: own elaboration on Corine Land Cover as updated by Lamma (2010).

classified. This could help understanding with greater detail how much the variable altitude has influenced the RDP zoning[9]. Besides, it allows verifying, if between C1 and C2 areas there are differences in altitude since the splitting of Intermediate Rural Areas has not been influenced by this variable. Table 7 has been organised in three sections; the first part gives the share accounted by each class coming from the crossing of altitude classes and RDP zones, while the second and third parts describe how each RDP zone is distributed among altitude classes (row distribution) and how each altitude class is distributed among RDP zones (column distribution), respectively.

As one can see from Table 7, land below 400 m a.m.s.l. is mainly located in C2 zone, which accounts for 74.81% of the total of this "lowland", while lands in the class 400-600 m and in the classes above 600 m are mainly located in C1 zone (where it accounts

[9] The National Rural Development Plan (NDP) provided a zoning based on demographic density, altimetry features and share of agricultural surface on total.

Figure 3. Average altitude of farmland areas in Mugello (m a.m.s.l.).



Source: own elaboration on Digital Terrain Model of Tuscany Region.

for 56.87%) and D zone (where it accounts for 72.13%), respectively. Usually, when analysing altitude as a factor constituting a natural constraint for agricultural activities, the altitude of 600 m is considered as the one able to limit agricultural activity when taken alone, while in combination with a relatively high slope also a lower altitude could be considered as a limiting factor (Cooper *et al.*, 2006). When analysing data by RDP zone (see third section of Table 7), it emerges that C2 zone accounts for almost 75% of the total land located under 400 m, although it presents also a not negligible share of land in the 800-1000 m class, while D zone represents the prevalent share both of the class 600-800 m (75,92% of which is located in this zone) and of the class 800-1000 m (52,92%). The 0,36% of total Mugello area that is located above 1000 m is entirely located in D zone. The previous analysis (Table 6) shows a D-C2-C1 hierarchy of "favourable" land uses. However, as regards altitude features, there is an inversion in the hierarchy between C1 (intermediate rural areas in transition) and C2 zone (intermediate rural areas in decline) as this latter presents better features.

Table 8 presents the distribution of farmland area by slope classes and RDP zones. While the first part of the table presents the share accounted by each class obtained by crossing slope classes and RDP zones, the following parts present, respectively, the row and column distributions, namely the share that slope classes account inside each RDP

Table 7. Mugello - Distribution of farmland areas in RDP zones according to the class of altitude (meters above medium sea level).

RDP ZONE	Distribution of farmland area in the sample (%) by ALTITUDE CLASSES and REGIONAL DEVELOPMENT PROGRAMME (RDP) ZONES				
	< 400 m a.m.s.l.	400-600 m a.m.s.l.	600-800 m a.m.s.l.	800-1000 m a.m.s.l.	> 1000 m a.m.s.l.
C1	7.40	14.85	3.30	0.56	0.00
C2	22.87	8.23	3.91	2.34	0.00
D	0.30	9.88	22.73	3.26	0.36

RDP ZONE	Distribution of farmland area in the sample (%) by ALTITUDE CLASSES inside each REGIONAL DEVELOPMENT PROGRAMME (RDP) ZONE					
	< 400 m a.m.s.l.	400-600 m a.m.s.l.	600-800 m a.m.s.l.	800-1000 m a.m.s.l.	> 1000 m a.m.s.l.	Total Area
C1	28.34	56.87	12.64	2.14	0.00	100.00
C2	61.23	22.03	10.47	6.27	0.00	100.00
D	0.82	27.05	62.22	8.92	0.99	100.00

RDP ZONE	Distribution of farmland area in the sample (%) by REGIONAL DEVELOPMENT PROGRAMME (RDP) ZONE inside each ALTITUDE CLASS				
	< 400 m a.m.s.l.	400-600 m a.m.s.l.	600-800 m a.m.s.l.	800-1000 m a.m.s.l.	> 1000 m a.m.s.l.
C1	24.21	45.05	11.02	9.09	0.00
C2	74.81	24.97	13.06	37.99	0.00
D	0.98	29.98	75.92	52.92	100.00
Total Area	100.00	100.00	100.00	100.00	100.00

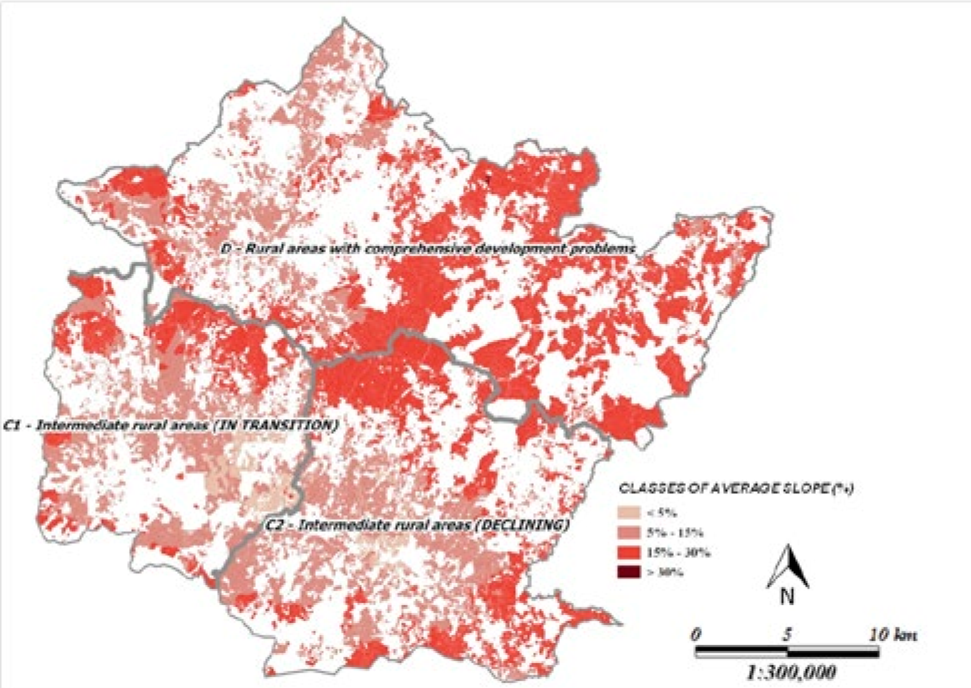
Source: own elaboration on Digital Terrain Model of Tuscany Region and RDP regional DB.

zone (row distribution) and the share that RDP zones account inside each slope class (column distribution).

According to the new proposed rules for the delimitation of areas with natural constraints (Böttcher *et al.*, 2009), slope becomes a limiting factor alone when it is above 15%; thus the attention should focus on the class related to the highest slope (15-30%) while the previous class should be given attention only when associated to high altitude. As it is apparent from Table 8, in Mugello the areas with a slope higher than 15% are about 39% (13.58% accounted by C2 zone and 25.62% by D zone). In D zone the class with the highest slope accounts for 55.56%. Since D zone is also characterized by the highest altitude classes, the agricultural activities of this RDP zone suffer from severe natural constraints. As regards the situation of C1 and C2 zones, C2 is characterised by a higher share of farmland included in the highest slope class compared to that of C1 zone (36.4% in C2, 26.32% in C1). Thus, while C1 zone has worse features than C2 as regards altitude, it has better features as regards slope.

The previous figures and tables highlight a great difference in terms of terrain characteristics among the three RDP zones. The land above 600 m a.m.s.l. is concentrated in

Figure 4. Farmland areas in Mugello according to classes of average slope.



Source: own elaboration on Digital Terrain Model of Tuscany Region

zone D (26,35% of Mugello total farmland area), with lower values in zones C1 (3.86%) and C2 (6.25%). Similarly, land in the slope class higher than 15% located in zone D accounts for a share of 25.62% of Mugello total area, whilst in zones C2 and C1 this value decreases to 13.58% and 6.91%, respectively. In summary, coherently with expectations, areas with development problems show the worst operating conditions. These results, together with average values for altitude and slope by RDP zone, have been validated through ANOVA, which shows statistically significant differences among RDP zones (Table 9).

Table 8. Mugello - Distribution of farmland surfaces (%) in RDP zones according to the slope classes.

RDP Zone	SLOPE CLASSES (Share %)			ROW DISTRIBUTION (%)			COLUMN DISTRIBUTION (%)		
	< 5%	5-15%	15-30%	< 5%	5-15%	15-30%	< 5%	5-15%	15-30%
C1	1.81	17.53	6.91	6.9	66.78	26.32	58.39	34.51	14.99
C2	1.26	22.47	13.58	3.38	60.23	36.40	40.65	44.24	29.45
D	0.03	10.79	25.62	0.08	29.61	70.31	0.97	21.24	55.56

Source: own elaboration on Digital Terrain Model of Tuscany Region and RDP regional DB

Table 9. Mugello - Average altitude (m a.m.s.l.) and slope (%) of Mugello RDP zones and statistical significance of distribution

Variables	RDP zones			ANOVA F value
	C1	C2	D	
Altitude	458.63	440.17	642.34	152.51***
Slope	11.09	14.04	18.53	156.84***

Source: own elaboration on Digital Terrain Model of Tuscany Region and RDP regional DB (*** significance at 0.01; ** significance at 0.05, * significance at 0.1).

3.3 Farming style analysis and spatial distribution

The farming styles representing different entrepreneurial attitudes of farmers in Mugello were analysed according to the statistical significance of the main socioeconomic characteristics and factors of productivity. The *Decline* group, with 379 holdings, includes the majority of farms, whilst the *Survival* group includes only 52 farms. The *Conservative Development* and *Innovative Development* groups include respectively 193 and 197 holdings. Table 10, with ANOVA[10] results, shows that differences in structures among the four farming styles are statistically significant. Farms included in the *Decline* style have lower acreage, economic dimension and annual working units[11] (AWU), presenting an average size of 16.29 hectares, an average standard output (SO) equal to 18,150 € per year and 1.09 AWU per year. On the contrary, the highest values characterize farms included in the *Innovative development* group, with an average size of 52.22 ha and an average standard output equal to 103,000 € (Table 10). *Survival* and *Conservative Development* groups show similar values, even though the latter group shows slightly higher values (27.90 ha against 25.71 ha of average size; 49,430 € against 43,670 € of annual standard output).

In the first two rows of Table 10 the total Farm UAA, Farm SO and Farm AWU accounted by each farming style and the relative share accounted by each farming style on the total of the above mentioned variables are reported. As regards UAA, the *Innovative Development* style accounts for the major share (44.4%) of the total UAA followed by the *Decline* and *Conservative Development* styles which account respectively for 26.6% and 23.2% of the UAA, while *Survival* style accounts for a very limited share (5.8%). The importance of *Innovative Development* style is still higher in terms of standard output (52.1%). As regards SO, *Conservative Development* represents a higher share than *Decline*, while for UAA it was the opposite. When analysing the Annual Working Unit, the situation is more balanced with shares, for the three more important styles, varying from the 36.4% of *Innovative Development* to the 26.3% of *Conservative Development* style, while *Survival* accounts for 7.7%. In summary, results show that over 52% of farms and 32% of UAA are included in the *Decline* or *Survival* styles, which are the groups closer to exit in the long run.

[10] Three different ANOVA were run on the sample of 821 farms. The dependent variable was respectively the UAA, SO and AWU, whilst the independent variable was the categorical variable showing the style to which each farm belongs.

[11] The annual working unit (AWU) is a measure introduced by the European Union to design the work of a full time equivalent worker and it is calculated as the number of working days divided by 225.

Table 10. Mugello - UAA (hectares), standard output (euro) and AWU according to farming styles

	Farm UAA (ha)				Farm SO (€)				Farm AWU			
	Decline	Survival	Conservative Development	Innovative development	Decline	Survival	Conservative Development	Innovative development	Decline	Survival	Conservative Development	Innovative development
Total	6173,9	1336,9	5384,7	10287,3	6,878,850	2,270,840	9,539,990	20,291,000	413,1	108,2	366,7	508,3
% on total	26.6	5.8	23.2	44.4	17.6	5.8	24.5	52.1	29.6	7.7	26.3	36.4
MIN	0.24	0.32	0.66	1.00	0	0	0	1165	0	0	0.08	0.10
1ST Quart	3.01	6.53	7.40	14.30	2,856	7,149	12,690	25,320	0.40	0.71	0.92	1.50
MEDIAN	6.03	13.56	15.10	27.36	7,215	16,010	25,880	41,770	0.73	1.26	1.62	2.06
MEAN	16.29	25.71	27.90	52.22	18,150	43,670	49,430	103,000	1.09	2.08	1.90	2.58
3RD Quart	13.00	25.32	32.25	61.00	17,920	37,680	55,230	93,090	1.62	2.67	2.68	3.20
MAX	468.20	215.30	169.10	775.7	573,500	361,400	107,2000	3073,000	6.48	13.30	12.89	9.73
ANALYSIS OF VARIANCE (ANOVA)												
	DF	Sum sq	Mean sq	F value	DF	Sum sq	Mean sq	F value	DF	Sum sq	Mean sq	F value
Model	1	1.5339e+09	1.5339e+09	61.73***	1	8.8036e+11	8.8036e+11	46.38***	1	286.18	286.18	139.82***
Residuals	819	2.0351e+10	24848184		819	1.5543e+13	1.8978e+10		819	1676.32		

Source: own elaboration on 2010 census data. (*** significance at 0.01; ** significance at 0.05, * significance at 0.1).

Table 11 and Figure 5 show the intensity on the use of factors among different farm styles according to the criteria of farm's efficiency (Iacoponi, 1994): land productivity, labour productivity and intensity of labour use on the land. According to the ANOVA, differences among farming styles in terms of land productivity, intensity of labour use for land unit and age of the household members working in the farms are statistically significant, while differences in labour productivity among farming styles are not. Farms included in the *Innovative* and *Conservative development* styles show the highest levels of land and labour productivity associated to a lower average age of family workers. This may be due to a higher land productivity associated to a less intensive use of labour. Hence, the productivity should be related to capital intensive and labour saving (dairy cattle, mechanisation) factors. Similarly, the added value of the production may increase the productivity. Conversely *Decline* and *Survival* styles register lower values. In particular, farms included in the *Survival* style showed higher land productivity than those of *Decline* style, but an inefficient use of the labour per hectare (it presents the highest value among the four styles), which negatively affects total labour productivity. This may be due to the high share of manual labour used by these farms on high added value production (i.e. specialty foods). Figure 5 illustrates the economic performance of the four farming styles in terms of index numbers, showing that the highest efficiency belongs to the farms included in the *Innovative development* whilst the lowest performance to farms included in the *Decline* style.

Table 12 illustrates the distribution of the four farming styles according to the RDP zones. Farms included in the *Decline* style represent respectively 42.24% and 45.70% of the total farms located in C2 and D areas, i.e. the areas deserving more attention from policy makers, due to their development problems, and which accounts for about 73.5% of the Mugello sample TAA. Hence, without a proper policy support these areas are deemed to lose a very high share of active farms. In terms of TAA the situation is quite different since, although farms included in *Decline* style represent 49.70% of the TAA in C2 area, in D area they represent only 2.53%, due to a higher incidence of farms belonging to *Conservative and Innovative Development* styles.

In order to assess the existing relationships between the amount of public payments received by farms and the farming styles, access to public payments has been investigated (Table 13). The most likely hypothesis was that "stronger" farming styles may have a significantly higher level of access to public payments. In this last case the enforcement of a specific policy able to prevent the exit of weaker farms could be required, if their survival is considered to be important due to social or environmental targets. However, knowing the relations among farming styles and aid distribution could help to improve policy design, e.g. by introducing rules able to promote beneficiaries who have specific characteristics and attitude towards farming.

The ANOVA (Table 13) shows that the difference in average payments stemming from pillar 1 and 2 among the styles is statistically significant, and confirms the above hypothesis, i.e. that the "strongest" farming styles are the ones which capture the majority of aid in Mugello area. According to the ARTEA database (2012), between 2007 and 2012, 144 farms operating in the Mugello area received RDP payments stemming from axis 1, 92 farms received payments from axis 2 and only 16 farms received payments from axis 3.

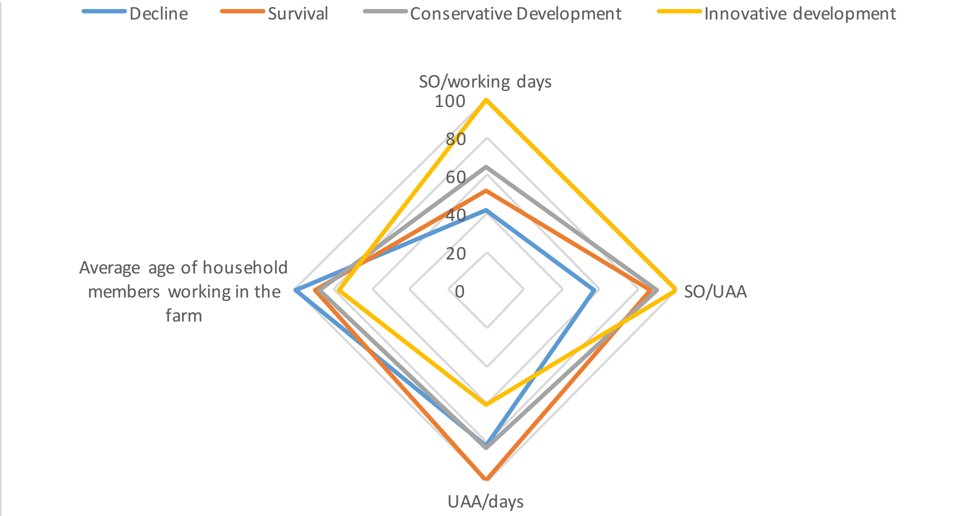
Farms included in the *Decline* style (N = 379) are the less dynamic, since they receive the lowest amount of RDP payments (pillar 2). The majority of the aid stems from pub-

Table 11. Mugello - Land and labour productivity according to farming styles.

	Decline	Survival	Conservative Development	Innovative development	ANALYSIS OF VARIANCE (ANOVA)				
						DF	Sum sq	Mean sq	F value
SO/AWU	16,406	20,858	26,081	40,474	Model	1	2.5044e+09	2.5044e+09	0.033
					Residuals	818	6.1318e+13	7.4870+10	
SO/UAA	1,114	1,672	1,771	1,978	Model	1	27722	27722	5.1045*
					Residuals	818	4442508	5430.9	
AWU/UAA	0.07	0.08	0.07	0.04	Model	1	0.0002	2.6685e-04	11.04***
					Residuals	818	0.019	2.4156e-05	
Average age of household members working in the farm	61	55	53	47	Model	1	22017	22017	150.52***
					Residuals	786	114966	146.3	

Source: own elaboration on 2010 census data. (*** significance at 0.01; ** significance at 0.05, * significance at 0.1).

Figure 5. Mugello - Land and labour productivity indices according to farming styles.



Source: own elaboration 2010 census data.

Table 12. Mugello - Farming styles distribution by Tuscany RDP zones. Farms Number and Hectares of TAA.

RDP ZONE		Decline	Survival	Conservative development	Innovative development	Total
C1) Intermediate rural areas in transition	n°	74	5	24	33	136
	% n	54.41%	3.68%	17.65%	24,26%	100
	Ha	3,748.72	662.45	2,276.73	6,543.78	13,231.68
	% Ha	28.33%	5.01%	17.21%	49.46%	100
C2) Intermediate declining rural areas	n°	98	22	52	60	232
	% n	42.24%	9.48%	22.41%	25.86%	100
	Ha	9,337.38	919.54	2,547.87	5,981.21	18,786.00
	% Ha	49.70%	4.89%	13.56%	31.84%	100
D) Rural areas with development problems	n°	207	25	117	104	453
	% n	45.70%	5.52%	25.83%	22.96%	100
	Ha	453.23	515.85	7,897.72	9,082.44	17,949.24
	% Ha	2.53%	2.87%	44.00%	50.60%	100
TOTAL	n°	379	52	193	197	821
	% n	46.16%	6.33%	23.51%	24.00%	100
	Ha	13,539.33	2,097.84	12,722.32	21,607.43	49,966.92
	% Ha	27.10	4.20	25.46	43.24	100

Source: own elaboration on cadastral data (2011), ARTEA data (2012), and census data (2010).

Table 13. Mugello - First Pillar (SPS) and RDP payments according to the farming style.

	Decline			Survival			Conservative Development			Innovative Development		
SPS Average annual payment per farm (Pillar 1)	2,716			3,678			5,708			8,559		
RDP Axis	1	2	3	1	2	3	1	2	3	1	2	3
Share of farms (%)	5	4	0.5	11	8	0	17	9	0.5	35	24	7
RDP payments per year, 000 €	227.3	15.7	27.9	82.2	9.5	0	156.3	77.4	1.5	393.7	207.9	157.3
Annual average RDP payments per farm €	596	41	73	1,521	184	0	810	401	8	1,960	1,034	783

ANOVA

		Degrees of freedom	Sum Sq	Mean Sq	F value
SPS Average annual payment per farm (Pillar 1)	Farm style	1	4.5132e+09	4513228387	22.916***
	Residuals	819	1.6130e+11	196947987	
Total RDP payments per year (all axes)	Farm style	1	1.5148e+11	1.5148e+11	20.399***
	Residuals	819	6.0817e+12	7.4258e+09	
		Fischer exact test	Pearson chi^2		
Share of farms		0.00	135.8344		

Source: own elaboration on ARTEA data (2007-2012) and census data (2010). (*** significance at 0.01; ** significance at 0.05, * significance at 0.1).

lic payments under pillar 1, highlighting how farms included in the *Decline* style try to maintain the status quo, which grants them a sufficient amount of money to survive in the short run. The lower access to the RDP payments of farms included in the *Decline* style could be due to higher barriers in accessing payments. Indeed, they could require higher investments, entrepreneurial attitudes, innovations. Farming styles intercepting the majority of public payments stemming from pillar 1 are the *Innovative Development* and *Conservative Development* styles, with an average payment[12] respectively equal to 8,559 and 5,708 €/year over the period 2007-2012, that in the first style is probably related also to the larger size in terms of UAA. Furthermore, farms included in the *Innovative Development* style show the highest level of access to RDP payments both in terms of average payment, with an average amount of 1,960, 1,034 and 783 € per year, respectively, from axes 1, 2 and 3, and in terms of share of farms intercepting payments, with 35%, 24% and 7%, respectively, for the axes 1, 2 and 3 of RDP. More than 30% of the farms included in the *Innovative development* style received payments stemming from axes 2 and 3, which are respectively related to agri-environmental schemes and diversification, and represent one

[12] The average payment is calculated as the ratio between total payments per year over the period 2007-2012 for each farming style and the number of farms included in that style. This index allows assessing the access of farms to public payments according to the farming style.

of the main development strategies to increase farm income. Finally, the *Survival* style (N = 52) shows the second highest payment (1,521 € per year) after the *Innovative development* style for RDP axis 1 and also a SPS Average annual payment that is higher than that of the *Decline* style. A further analysis is needed to assess whether the farming styles affect or are affected by the access to public payments, which represents an important aspect within the CAP reform.

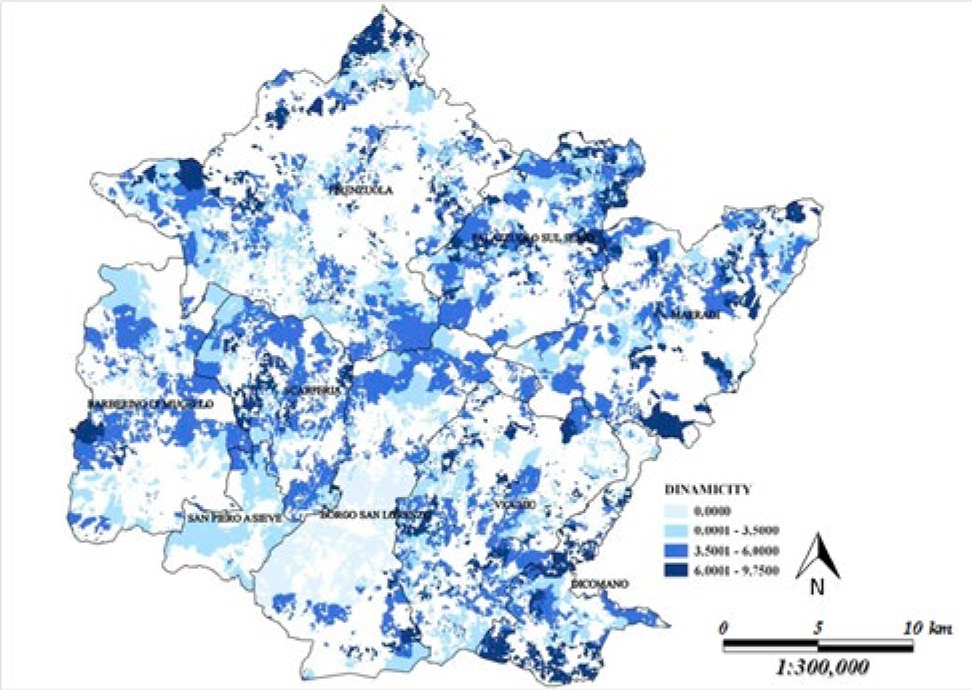
When considering the distribution of RDP resources among styles, due to the high differences in the number of farms belonging to each style, the situation is slightly different insofar as farms belonging to the *Decline* style, although having the lower amount of RDP payments per farm, are able to capture about 20% of the total RDP aid, while more than 55% goes to the farms belonging to *Innovative Development*.

After the analysis of the main features of the farming styles and their relation with the ability to intercept public aid, it is important to analyse their spatial distribution, that could be confronted with the land use analysis and the spatial analyses of altitude and slope presented above, which give a picture of the kind of resources and constraints that farms have to face in their activity. Thus, in the following part, we provide both the maps of the two indices by which farming styles have been individuated, i.e. *entrepreneurial dynamism* and *multifunctional diversification*, and the map giving the spatial distribution of farmland belonging to the four farming styles.

Figure 6 shows the spatial distribution of the *entrepreneurial dynamism* among farmers. The highest levels of *entrepreneurial dynamism* are located in zones C2 and C1 (especially the municipalities of Dicomano and Scarperia); however, even some areas of zone D in the Upper Mugello are characterised by a high *entrepreneurial dynamism* level such as the north part of Firenzuola and Palazzuolo sul Senio. Surprisingly, the municipality of Borgo San Lorenzo, albeit located in zone C2 and characterised by areas with more favourable conditions for crops, shows the lowest level of *entrepreneurial dynamism*, probably due to better chances of employment in other sectors. Farming strategies, in this case, do not aim to produce income, but they could be interpreted as "hobby-styles" or as strategies for the maintenance of real estate assets, i.e. land and buildings, that could increase their value, due to the proximity to residential or industrial areas.

As shown by Figure 7, the majority of farms operating in Mugello present low levels of *multifunctional diversification* if compared to the *entrepreneurial dynamism* map. However, the Upper Mugello seems to be more oriented to multifunctionality; this could be likely due, from the one hand, to the more severe cropping conditions that makes it necessary to have an innovative approach and look for alternative sources of farm income, and from the other hand, to the lower level of economic development that makes it difficult to find employment in other sectors. In terms of number of farms, Firenzuola municipality presents a relatively high level of *multifunctional diversification* since over 50% of farms can be considered as multifunctional. The same result holds in Palazzuolo sul Senio. Indeed, the agricultural activity in this area requires a high level of labour intensity and presents a lower land productivity if compared to Lower Mugello. Farmers who operate in these municipalities and have few opportunities to work outside agriculture without moving out from the area, tend to adopt diversification strategies made possible by the high quality level of local natural, environmental and landscape resources, when agricultural production is not able to ensure an adequate income.

Figure 6. Map of *entrepreneurial dynamism* in Mugello.

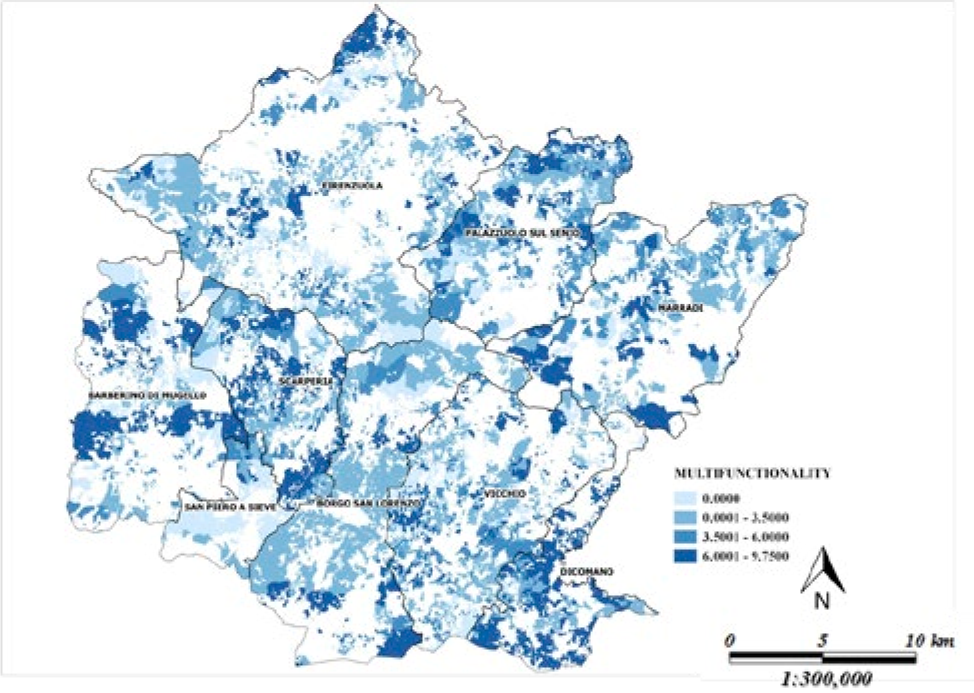


Source: own elaboration on cadastral data (2011), ARTEA data (2012), and census data (2010).

These results highlight the importance of human capital, since there are farms that, due to the ability of the entrepreneur, are economically profitable despite the scarce fertility and suitability to an intensive use of their farmland. Thus, although resource marginality could be one of the drivers of agricultural and farm marginality, this factor can be counterbalanced by good entrepreneurial skills; indeed statistical analysis shows no significant correlation between farming styles and terrain features. This result highlights the importance of the human factor, which is often not considered at farm level analysis, where structural and productive mix features are usually privileged.

Figure 8 illustrates the spatial distribution of the four farming styles. Most *Innovative development* style farms are located in the municipalities of Dicomano and Scarperia in Lower Mugello (the part of Mugello with less development problems). Many *Decline* style farms are located in the municipality of Borgo San Lorenzo (and S. Piero a Sieve), the part of Lower Mugello that is more suitable for agricultural activities. This might be due to the higher off-farm opportunities of employment offered by these municipalities. i.e. employment in local SMEs and in the public sector which allows to maintain /continue farming activities. In this framework, the survival of weak farms might be due to a strong presence of retirees or professionals who carry on farming, e.g. as style of life. In this case, as previously stated, farming is carried out either as a hobby and a way to produce food for the family, or as a strategy based on the expectation of an increase in periurban land values.

Figure 7. Map of *multifunctional diversification* in Mugello.



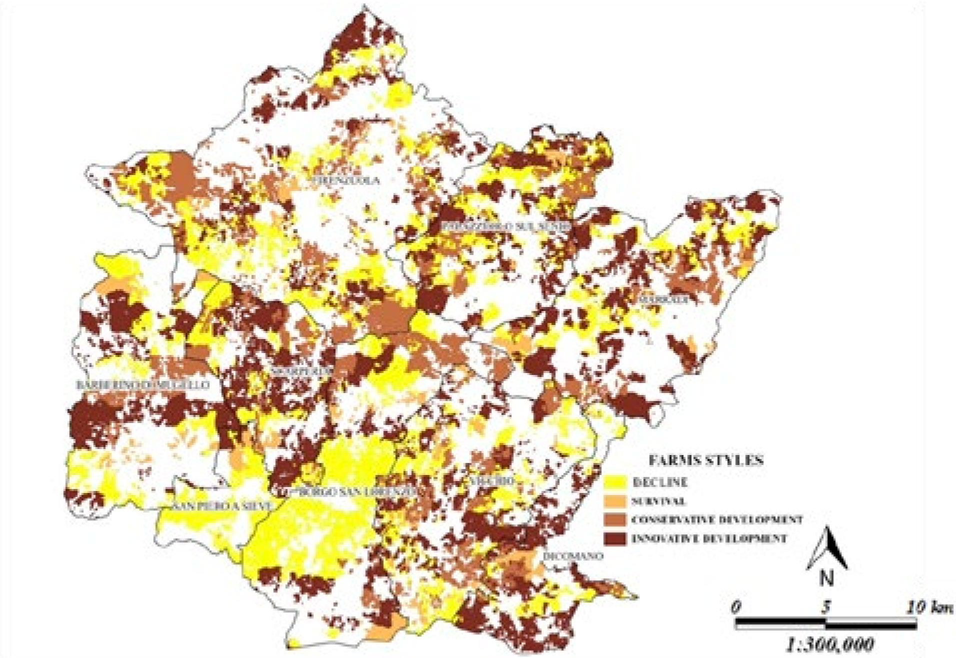
Source: own elaboration on cadastral data (2011), ARTEA data (2012), and census data (2010).

In summary, the analysis of the spatial distribution of farming styles seems to highlight a poor correlation with the terrain and land use features of the territory. Indeed, it seems that this correlation is sometimes opposite to the one that could have been hypothesized, namely that where the territorial features are more favourable to agricultural activities, other factors – such as labour and land markets for non agricultural activities – have higher importance in influencing farming activity. Viceversa, where territorial features are less suitable for agricultural uses, farmers seems to be more motivated and capable of innovation with the aim to improve their farming activity and to make it more sound from an economic viewpoint. This aim is pursued by farm diversification, intensification or by the research of economies of scale and scope, in many cases through the use of public aid, both belonging to pillar 1 and 2.

At the end of this chapter we consider useful to provide a spatial analysis of the distribution of CAP aid. In this framework, since all Mugello is classified as Less Favoured Area (LFA) and since Cooper *et al.* (2006), in their evaluation of the LFA measure in the 25 member states of the European Union, raised some doubts on the way the measure had been implemented in Tuscany, we have decided to focus on RDP axis 2 measures related to LFA, i.e. measure 211 (mountain areas) and 212 (other disadvantaged areas).

We, thus, analysed the spatial distributions of farms receiving payments under measures 211 and 212, in order to test the effectiveness of RDP payments in giving help to the

Figure 8. The farming styles distribution in Mugello.

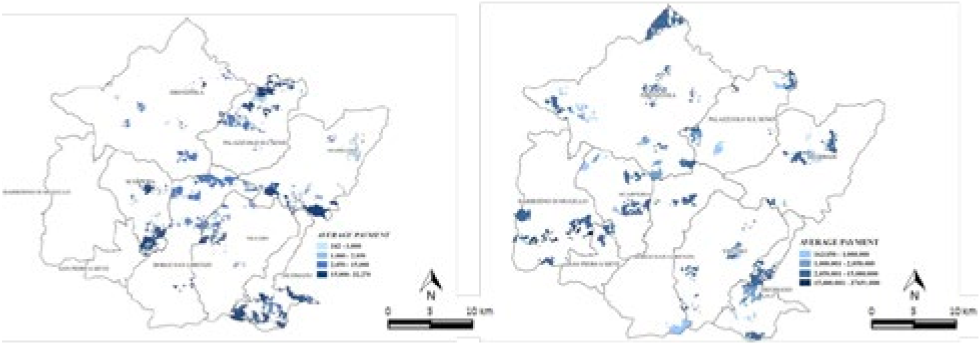


Source: own elaboration on cadastral data (2011), ARTEA data (2012), and census data (2010).

areas with the highest natural constraints. Given that the entire territory of Mugello is classified as a mountainous area, it should be only eligible for the measure 211. Nevertheless, some farms in Mugello have received payments under measure 212 since these payments are not granted on the basis of cadastral parcels location but just considering the location of the farm center. Since farmers cannot apply to both payments for the same parcel, but they have to choose which measure they prefer, for farms that have their center outside Mugello, but manage land inside Mugello it could be more profitable to apply for compensation under measure 212. In this way they get aid for all their farmland while, if applying under measure 211, they would be able to obtain aid only for the land located in Mugello.

Figure 9 shows the spatial distribution of public payments given to farms located in mountainous areas with natural disadvantages (measure 211, left) and the spatial distribution of public payments given to farms located in other areas with natural disadvantages (measure 212, right). As result, we observed that 51 out of 821 farms received the payments related to measure 211 for a total amount of 676,037 € over the period 2009-2012, while 55 farms received the payments related to the measure 212, with a total amount of 713,796 € over the period 2009-2012. This spatial analysis shows that many farms located in Lower Mugello, where the terrain is less steep and the soils more suitable for cropping, received these types of payments. Conversely many areas located in Upper Mugello did

Figure 9. Average payment (euro) related to areas with development problems (measure 211, left, and 212, right), in Mugello.



Source: own elaboration on ARTEA RDP regional DB

not receive any kind of payment related to natural disadvantages. Consequently we note a lack of coherence in the use of the measures 211 and 212, which should have helped farms located in area with higher natural disadvantages, since these payments are distributed without taking into account the characteristics of farm parcels.

When analysing the farm styles that were more able to capture this kind of aid, the results highlight the problem of the access to these public payments, which affects especially farms of the *Decline* style. Over the period 2007-2012, only 2% of the farms included in this style received the payments, whilst 11% of the *Conservative Development* farm style group received the payments. This could be due to the combination of limited resources to be distributed and the priority given to professional farmers that led to provide aid almost exclusively to the strongest farming styles. The decision makers chose to limit aid to livestock farms with a minimum acreage and to privilege professional farmers with the aim to concentrate resources on the farms representing the backbone of Mugello agriculture. Decision makers were afraid that, otherwise, these farms would disappear or intensify their production by shifting to indoor systems (Uthes *et al.*, 2011), since both abandonment and intensification would bring about negative effects on ES provision or on socio-economic situation of Mugello. However, a spatial distribution that is neither linked to the areas with higher natural constraints nor to beneficiaries with weaker features at farm level could increase the risk of land abandonment. This may imply a stronger limit to the development of rural areas, which are often characterized by part-time farmers, non-professional farmers, life-stylers farmers, which, however, play an important role for agri-environmental protection and the maintenance of rural culture and traditions. The present Tuscany RDP, which has just started, does not bring an improvement on the side of a better targeting to areas with higher natural constraints insofar as, differently from other Regions (e.g. the bordering Umbria Region), it does not provide any graduation of the intensity of payment related to the classes of altitude and slope.

4. Conclusions

This paper presents a spatial analysis of the farm styles, terrain features and CAP payment distribution in Mugello area. The analysis was carried out by utilizing and integrating data at farm and territorial level, which included information on farm and family structures, public payments and terrain characteristics. The resulting database includes data of 821 agricultural holdings operating in the area, whose cadastral parcels were georeferenced to localise the land managed by each farm. Then, through a Multi-criteria analysis, four different farm styles were defined according to their *entrepreneurial dynamism* and *multifunctional diversification* level, i.e. *Decline, Survival, Conservative and Innovative Development*, with the aim to include farm strategies in our analysis. Indeed, many ex-post and ex-ante evaluations of CAP aid take into account the farm level only by considering structural or crop mix features. However, personal attitude and farming styles may heavily influence the capacity to intercept public aid and to build viable farms, especially when only poor agricultural resources are available. The main strength of this contribution is the intertwining between farms and territorial data, which allows to localise all the parcels of every farm included in the sample and to characterize them in terms of altitude and slope, being aware of the constraints that those features have for the agricultural activity. This contribution shows the potential of GIS, as it allows performing a deeper analysis on the area at the farm and territorial level and to single out the areas (and farms) that are at risk of abandonment. Policy makers should use this approach to design, monitor and assess the impact of local agricultural policies, which, in order to be effective, should be able to fit the needs of specific rural sub-areas and farm styles. Besides, the spatial analysis could be extended from an ex-post to an ex-ante evaluation, e.g. providing maps of potential aid distribution under different hypotheses about eligibility or priority (based on farm acreage, professional status of the farmer, etc.) or about a graduation of aid intensity based on the level of natural handicap (e.g. as it happens in Umbria Region for aid given to areas with natural constraints).

Results show a significant heterogeneity within Mugello area, with the coexistence of different farming styles also in areas with similar terrain features. These results are particularly important since they point out that biophysical marginality is only one of the components of farm marginality and that entrepreneurial skills could allow farm viability and profitability also in the case that terrain features and land uses are not favourable. From this point of view, the importance given to farms belonging to the weakest farming styles, especially in the most unfavourable areas, aims to highlight situations where natural and human capitals concur to bring about negative effects. In particular, almost 50% of farms and 1/3 of the total agricultural area included in the sample belong to farms that seem to be close to the exit (*Decline* and *Survival* styles). This may negatively impact the socioeconomic, environmental and landscape conditions of Mugello area in the following years, due to the effects of agricultural activity abandonment and the relocation of residents in more accessible and favourable areas.

As regards the evaluation of CAP design, especially in the case of RDP measures, the analyses aiming to relate RDP zones with land use and terrain features show that their delimitation was consistent with the aim to individuate areas of increasing marginality levels. Results show that C1 zone is the best as regards the share of highest profitability land use (e.g. arable land) while D zone has the worst ones (with high presence of forestry and natural grassland). As regards terrain features, while D zone has the worst characteristics as regards altitude and slope, C2 seem to be slightly better for altitude, but has worst characteristics as regards slope than C1 area. Nevertheless, significant levels of heterogeneity within each RDP zone may be individuated.

While it could be hypothesized a correlation between natural resources endowment and farming styles, results, as above mentioned, show that this is not the case in Mugello area. Furthermore results show that very often public aid, even if targeted to areas with natural constraints, do not show any significant relation with the level of natural constraints arising from terrain features or with the kind of farming style, even if RDP zoning is consistent with an increasing level of natural constraints. Thus, if policies aimed to avoid land abandonment by aiding areas characterized by less favourable terrain features and weaker farming styles, results show that they have failed to meet these targets.

The decision to perform an analysis for Less Favoured Areas that, while integrating terrain and farm characteristics, keep these two levels as separate stems from the awareness that policies related to natural constraints areas currently focus on area delimitations based only on bio-physical characteristics, while the promotion of farming typologies or farming styles can be introduced by Regions and Member States when deciding rules regarding beneficiaries and priority criteria. Thus, delimitations could be valid for a longer term (since bio-physical features do not change so fast in time), while changes in the socioeconomic situation (that can change also in a short time period) can be counteracted by adapting eligibility and priority criteria.

As regards the access to public payments stemming from pillars 1 and 2, we note that the highest amount of aid goes to farms included in the *Conservative* and *Innovative development* styles, which represent farms with the highest level of *entrepreneurial attitudes*. A further (diachronic) analysis could explain whether this capacity to intercept financial opportunities provided by CAP is the cause or the effect of the resulting high levels of payments, and if the design of policies has directly or indirectly favoured areas, types of productions, types of farmers, in a way that is consistent with the goal of supporting agriculture, especially in disadvantaged areas. Another reason that might explain the results in term of distribution of public resources among farming styles could be the "technocratic" approach of Tuscany Region, which aims at capturing and spending the maximum amount of European financial resources more than at targeting the promotion of self-empowerment and improvement of weaker areas and farms as, e.g., in the case of Leader approach (Arrighetti, 2016). Results show deficiencies in the access to public payments by weaker farms and territories. Farms included in the *Decline* group face the highest barriers when they try to enter into the system of public aid. Hence, new activities such as information practices or more adequate rules regarding farms and farmers eligibility and priority for these payments should be put in place to address this issue. Although focusing mainly on professional farmers has its rationale, this could drive out of the system "lifestyle" farmers (Mantino, 1990), who may well contribute to the landscape maintenance (Lobley and Potter 2004) and, from a territorial point a view, could hinder a more homogeneous rural development. In these cases, proper policies should be addressed also to this type of farmers.

Finally, focusing on the RDP measures specifically intended for areas with natural disadvantages, we raise some doubt on the effectiveness of their design, since in

Mugello there is apparently no correlation among distribution of aid and intensity of natural constraints. This result confirms the need to use more efficient evaluation tools, like GIS, to support a proper agricultural policy. From this point of view, our ex-post analysis should stimulate proper ex-ante analyses able to better define territories and farmers eligibility.

References

Arrighetti, S. (2016). Le Politiche di Sviluppo Rurale fra Retorica e Pratica: Una "Lettura" di Leader in Chiave di Innovazione Sociale. PhD dissertation, Department of Agriculture, Food and Environment, University of Pisa. Available online: https://etd.adm.unipi.it/theses/available/etd-02192016-221826/.

Ballas, D., Clarke, G.P. and Wiemers, E. (2005). Building a Dynamic Spatial Microsimulation Model for Ireland. *Population, Space and Place* 11: 157-172.

Bartolini F., Andreoli M. and Brunori G. (2014). Explaining Determinants of the On-Farm Diversification: Empirical Evidence from Tuscany Region. *Bio-based and Applied Economics* 3(2): 137-157.

Bartolini, F. and Brunori, G. (2014). Understanding Linkages Between Common Agricultural Policy and High Nature Value (HNV) Farmland Provision: An Empirical Analysis in Tuscany Region. *Agricultural and Food Economics* 1(2): 1-21.

Beaudeau, F., van der Ploeg, J.D., Boileau, B., Seegers, H. and Noordhuizen, J.P.T.M. (1996). Relationships Between Culling Criteria in dairy Herds and Farmers' Management Styles. *Preventive Veterinary Medicine* 25(3-4): 327-342.

Böttcher, K., Eliasson, Å., Jones, R., Le Bas, C., Nachtergaele, F., Pistocchi, A., Ramos F., Rossiter D., Terres J.-M., Van Orshoven J. and Van Velthuizen, H. (2009). Guidelines for Application of Common Criteria to Identify Agricultural Areas with Natural Handicaps. Luxembourg: European Commission Joint Research Centre Institute for Environment and Sustainability.

Brady, M., Sahrbacher, C., Kellermann, K. and Happe, K. (2012). An Agent-Based Approach to Modeling Impacts of Agricultural Policy on Land Use, Biodiversity and Ecosystem Services. *Landscape Ecology* 27(9): 1363-1381.

Budic, Z.D. (1994). Effectiveness of Geographic Information Systems in Local Planning. *Journal of the American Planning Association* 60(2): 244-263.

Cooper, T., Baldock, D., Rayment, M., Kuhmonen, T., Terluin, I., Swales, V., Poux, X., Zakeossian, D. and Farmer, M. (2006). An Evaluation of the less Favoured Area Measure in the 25 Member States of the European Union. Institute for European Environmental Policy for DG Agriculture. London.

Council of the European Communities (1975). Council Directive (EC) No *75/268*/EEC of 28 April 1975 on Mountain and Hill Farming and Farming in Certain Less-Favoured Areas. Official Journal L 128: 0033 - 0067. Available online: http://data.europa.eu/eli/dir/1975/271/oj.

Council of the European Communities (2005). Council Regulation (EC) No 1698/2005 of 20 September 2005 on Support for Rural Development by the European Agricultural Fund for Rural Development (EAFRD). Official Journal L 277: 1-40. Available online: http://data.europa.eu/eli/reg/2005/1698/oj.

Dean, B.V. and Nishry, M.J. (1965). Scoring and Profitability Models for Evaluating and Selecting Engineering Projects. *Operations Research* 13(4): 550-569.

Emtage, N. and Herbohn, J. (2012). Implications of Landholders' Management Goals, Use of Information and Trust of Others for the Adoption of Recommended Practices in the Wet Tropics Region of Australia. *Landscape and Urban Planning* 107(4): 351-360.

Emtage, N.E. and Herbohn, J.L. (2012). Assessing Rural Landholders Diversity in the Wet Tropics Region of Queensland Australia in Relation to Natural Resource Management Programs: A Market Segmentation Approach. *Agricultural Systems* 110: 107-118.

Gonzales Del Campo, A. (2012). GIS in Environmental Assessment: A Review of Current Issue and Future Needs. *Journal of Environmental Assessment Policy and Management* 14(1): 7-30.

Guillem, E.E., Barnes, A.P., Rounsevell, M.D.A. and Renwick, A. (2012). Refining Perception-Based Farmer Typologies with the Analysis of Past Census Data. *Journal of Environmental Management* 110: 226-235.

Iacoponi, L. and Romiti, R. (1994). Economia e Politica Agraria. Bologna: Edizioni Agricole.

ISTAT (2010). 6th Agricultural Census. Roma. Available online: http://censimentoagricoltura.istat.it/

Joerin, F., Thériault, M. and Musy, A. (2001). Using GIS and Outranking Multicriteria Analysis for land-Use Suitability Assessment. *International Journal of Geographical Information Science* 15(2): 153-174.

Jones, R., Le-Bas, C., Nachtergaele, F., Rossiter, D., Van, J., Orshoven, R. S. and Van Velthuizen, H. (2012). Updated Common Bio-Physical Criteria to Define Natural Constraints for Agriculture in Europe. JRC Scientific and Technical Report, European Commission Joint Research Centre Institute for Environment and Sustainability -IES. Luxemburg. Available online: http://members.iif.hu/tot3700/abstr/JVO-JMTTT2012.pdf

LAMMA Regione Toscana (2010). Uso e Copertura del Suolo della Regione Toscana. Available online: http://www.lamma.rete.toscana.it.

Lobianco, A. and Esposti, R. (2010). The Regional Multi-Agent Simulator (RegMAS): An Open-Source Spatially Explicit Model to Assess the Impact of Agricultural Policies. *Computers and Electronics in Agriculture* 72(1): 14-26.

Lobley, M. and Potter, C. (2004). Agricultural Change and Restructuring: Recent survey of agricultural households in England. *Journal of Rural Studies* 20 (4): 499-510.

Malczewski, J. (2004). GIS-Based Land-Use Suitability Analysis: A Critical Overview. *Progress in Planning* 62(2): 1-65.

Mantino, F. (1990). Azienda e Famiglia: Funzione Obiettivo, Allocazione del Reddito e Strategie Economiche. In De Benedictis, M. (ed), Trasformazioni Agrarie e Pluriattività in Italia, Bologna: INEA-Il Mulino, 33-82.

Matthews, K.B., Buchan, K., Miller, D.G. and Towers, W. (2013). Reforming the CAP-With area-Based Payments, Who Wins and Who Loses?. *Land Use Policy* 31: 209-222.

Piorr, A., Ungaro, F., Ciancaglini, A., Happe, K., Sahrbacher, A., Sattler, C., Uthes S. and Zander, P. (2009). Integrated Assessment of Future Cap Policies: Land Use Changes,

Spatial Patterns and Targeting. *Environmental Science and Policy* 12(8): 1122-1136.
QGIS Development Team (2012). QGIS Geographic Information System. Open Source Geospatial Foundation Project. Available online: http://qgis.osgeo.org.
Regione Toscana (2012). Rural Development Programme of Tuscany Region 2007/13. Available online: http://www.regione.toscana.it/documents/15878/0/psr_9.pdf/65a6bd93-3f3d-4ff1-a414-287daa06f2ae
Rocchi, B., Stefani, G., Landi, C., Greco, M., Fusco, D., Giordano, P. and Moretti, V. (2014). A Multi Item Scale to Assess Entrepreneurship Level in the Italian Agriculture. Conference of European Statistics Stakeholders. Rome (unpublished paper).
Rocchi, B. and Landi, C. (2013). Livelli di Imprenditorialità nell'Agricoltura Toscana. *Agriregionieuropa* 9(34): 1-11.
Schmitzberger, I., Wrbka, T., Steurer, B., Aschenbrenner, G., Peterseil, J. and Zechmeister, H. G. (2005). How Farming Styles Influence Biodiversity Maintenance in Austrian Agricultural Landscapes. *Agriculture, Ecosystems and Environment* 108(3): 274-290.
Spaziante, A. and Murano, C. (2009). Rural Development Programmes and Strategic Environmental Assessment: Towards a Sustainable Rural Territory. *International Journal of Agricultural Resources, Governance and Ecology* 8(2-4): 205-222.
Spaziante, A., Rega, C. and Carbone, M. (2012). Spatial Analysis of Agri-Environmental measures for the SEA of Rural Development Programmes. *Italian Journal of Rural Regional Science* 12(2): 93-116.
Topcu, Y. (2012). Rural Development-Contemporary Issue and Practices. In Adisa R.S. (ed) The Integrated Marketing Approach as a Rural Development Tool, Croatia: InTech-Open Access Publisher, 257-282.
Tuscany Regional Agency for Payments in Agriculture (2012). Tuscan Farms Database ARTEA. Firenze.
Uthes, S., Piorr, A., Zander, P., Bieńkowski, J., Ungaro, F., Dalgaard, T., ... & Sahrbacher, A. (2011). Regional impacts of abolishing direct payments: An integrated analysis in four European regions. Agricultural Systems, 104(2), 110-121.
Van der Ploeg, J.D. (1990). Lo Sviluppo Tecnologico in Agricoltura, il Caso della Zootecnia. Bologna: il Mulino.
Van der Ploeg, J.D. (1994). Styles of Farming: An Introductory Note on Concepts and Methodology. In Van der Ploeg, J.D. and Long, A. (eds.), Born from Within. Practice and Perspectives of Endogenous Rural Development, Assen: Van Gorcum, 7-31.
Van der Ploeg, J.D. (2000). Revitalising Agriculture: Farming Economically as Starting Ground for Rural Development. *Sociologia Ruralis* 40(4): 497-511.
Van der Ploeg, J. D. and Ventura, F. (2014). Heterogeneity Reconsidered. *Current Opinion in Environmental Sustainability* 8: 23-28.
Wilson, P., Harper, N. and Darling, R. (2013). Explaining Variation in Farm and Farm Business Performance in Respect to Farmer Behavioural Segmentation Analysis: Implications for Land Use Policies. *Land Use Policy* 30(1): 147-156.
Yang, A.L., Rounsevell, M.D.A., Wilson, R.M. and Haggett, C. (2014). Spatial Analysis of agri-Environmental Policy Uptake and Expenditure in Scotland. *Journal of Environmental Management* 133: 104-115.

Appendix

Table A.1 Distribution of Corine land cover (CLC) classes in Mugello RDP zones. C1: Intermediate rural areas in transition; C2: Declining intermediate rural areas; D: Rural areas with development problems.

CLC classes (LAMMA, 2010)	C1 (ha)	C2 (ha)	D (ha)	TOT CLC (ha)
211 Non-irrigated arable land	6,457.01	6,910.09	7,353.23	20,720.33
221 Vineyards	137.67	364.30	127.69	629.66
222 Fruit trees and berry plantations	66.88	156.37	85.88	309.13
223 Olive groves	251.94	723.51	19.58	995.03
231 Pastures	167.43	121.59	133.23	422.24
241 Annual crops associated with permanent crops	64.93	70.85	33.41	169.18
242 Complex cultivation patterns	136.62	149.86	14.40	300.88
243 Land principally occupied by agriculture, with significant areas of natural vegetation	209.24	338.29	463.02	1,010.55
311 Broad-leaved forest	13,140.08	23,430.36	36,699.66	73,270.10
312 Coniferous forest	967.51	7.25	1154.85	2,129.61
313 Mixed forest	437.92	35.25	436.94	910.11
321 Natural grasslands	19.70	211.68	827.58	1,058.96
322 Moors and heathland	20.39	41.45	88.29	150.13
323 Sclerophyllous vegetation	0.00	0.00	6.00	6.00
324 Transitional woodland-shrub	774.38	880.08	3,815.24	5,469.70
333 Sparsely vegetated areas	0.00	11.55	275.21	286.76
TOT Area	22,851.69	33,452.47	51,534.21	107,838.37

Source: own elaboration on land uses data (LAMMA, 2010).