A Spatial Analysis to evaluate the Farm's structure and the Geography of Rural Areas: The case study of Mugello Area

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

[1] Department of Agriculture, Food and Environment (DISAAA), University of Pisa, Italy
[2] Department of Energy, System, Territory and Construction Engineering (DESTEC), University of Pisa, Italy

chiara.landi@for.unipi.it
laura.fastelli@for.unipi.it

Paper prepared for presentation at the 3rd AIEAA Conference
"Feeding the Planet and Greening Agriculture: Challenges and opportunities for the bio-economy"

25-27 June, 2014
Alghero, Italy

Summary

In order to promote rural development public agricultural policies need to constantly adapt to the continuous change of socio-economic conditions of rural areas, related to both farm and territorial dynamics. Hence beyond the zoning provided by the European Commission and developed by Member States [art. 11 Reg. Ce 1698/2005], policy makers should take into account geography, farms characteristics and farmers attitude to acquire a deeper knowledge of these rural areas. This paper aims at supporting the design of proper agricultural policies focusing on the case-study of Mugello territory, a rural area located in the North of Tuscany, which includes both: intermediate rural areas and areas with development problems. This purpose is firstly pursued by generating a geo-referenced database able to develop a deeper analysis on the existing interactions between socio - economic attributes of farms, land use and agricultural policies. The study combined several sources of data: the 2010 Italian Agriculture Census, the Tuscany Regional Agency for Payments in Agriculture (ARTEA) database, and cover land data from the database Corine Land Cover (CLC-06), as updated to 2007 by LaMMA (Laboratory for Environment Monitoring and Modeling). The resulting sample is composed by 821 farms operating in the Mugello area which are split in four different farm styles according to their level of multifunctionality and enterpreunership capacity. Results show that Mugello territory is characterized by an internal differentiation, that determines the prevalence of different farm structure according to the sub-areas characteristics. Especially analyzing the distribution of payments related to area with development problems we note that there are still margins of improvement.

Keywords: Rural development, Farm and Territorial Data, Rural Development Program, Spatial Analysis
JEL Classification codes: Q12, Q18

A Spatial Analysis to evaluate the Farm's structure and the Geography of Rural Areas: The case study of Mugello Area

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

1 Department of Agriculture, Food and Environment (DISAAA), University of Pisa, Italy
2 Department of Energy, System, Territory and Construction Engineering (DESTEC), University of Pisa, Italy

1. INTRODUCTION

In order to promote rural development public policies constantly need to be adapted to the changing socio-economic conditions of rural areas at both levels: individual and territorial level. During the last few decades researchers have created large databases able to provide deeper information on these areas. These databases may reduce the time period between the research activities and policy makers' decisions (Joerin et al. 2001). However this issue is very complex as many variables at both territorial and farm level play a key role. Actually many question arise: Which are the needs of a specific area at the individual and at the aggregated level? and which are the best tools to fulfill these needs combining public (regional development) and private (business development) objectives?

The Geographical Information System (GIS) may help handle the issue highlighting the specific needs of these areas in terms of policy supply (Budic 1994). Hence the current availability of data processed by GIS analysis improves the knowledge level of a selected territory. Actually socio-economic information are not sufficient to explain the evolutionary trajectories of agriculture in a specific area due to their relationship with the physical characteristics of land (altitude, slope, etc.). A spatial analysis instead allows to detect all the parcels composing the farms, knowing exactly where every farm's cadastral parcel is located.

The majority of contributions using the GIS analysis are applied to the soil use evaluation (for a review see Malczewski 2004). Conversely this paper use the GIS analysis to provide some insights on the effective territorial policies to be put in place in the Mugello area, evaluating farms characteristics, the geography of the different zones and the public policy, in terms of public payments, operating in this area. At present, to our knowledge few contributions (Spaziante et al. 2009, 2012, Adisa 2012) taking into account the public payments and GIS analysis exist. Spaziante et al. (2012) evaluate the agri-environmental schemes stemming from the rural development plan through a GIS analysis. Results show that the spatial distribution of the several environmental measures is not best - performing. Whilst these authors focus on a specific issue this study, integrating the 2010 agricultural census data to the public payments database, aims at providing an overall picture of the area from a socio-economic and environmental point of view at the farm and territorial level. Actually we add to the distribution of a specific measure related to areas with natural disadvantages, the spatial distribution of an entrepreneurship index which is split in farm's entrepreneurship capacity and multifunctionality.

This paper aims at supporting the design of a proper agricultural policy in the Mugello area. This region, located in the North-west of Tuscany, includes 9 municipality and its territory is characterized by hill and mountain altitudes. According to the Rural development Program (RDP) this area includes three different zones: intermediate rural areas in transition, declining intermediate rural areas and rural areas with

development problems. Further it is characterized by two different zones: the north part (Upper Mugello), where mountain areas are associated to high altitude and declivity, and the south part (Lower Mugello), where the soil allow several crops. The farming system is characterized by dairy and cattle livestock which experienced a decline in the number of farms, estimated to be 20% over the last ten years, associated to a loss of utilized agricultural area (UAA) equal to 12%. This territory has always been specialized in agricultural activities and animal husbandry (especially dairy cattle and beef cattle rearing). Especially in the Upper Mugello the silvopastoral activity is very important. Farmers mainly use the forest for the production of firewood and the chestnut cultivation which is rapidly growing due to the policies of valorisation.

In order to understand the specific characteristics of this area at the farm and the territorial level this paper firstly generates a geo-referenced database containing different data to understand the interactions among socio- economic aspects, land use and agricultural policies. Then, statistical and spatial data are processed to provide a deeper knowledge on the impact of policies on farms survival and on the rural landscape of Mugello i.e. information needed for the implementation of adequate and area-specific rural development policies. This analysis, showing the exiting interactions between the selected data related to farms and territorial variables allowed to define four different farm' styles: *Regression*, *Innovative Survival*, *Conservative Development* and *Innovative Development* which represent different farm structures according the multifunctionality and dinamicity level.

The paper is structured as follow: in section 2 the methodology is presented. Section 3 shows the data focusing on the description of farms and territorial data. Section 4 presents the main results of the empirical analysis. Finally the last section synthesizes the main achievements of this contribution

2. METHODOLOGY

This contribution relies on two different type of data: territorial data and farm data. First, the spatial data are analyzed considering the different RDP zones; then these data are clipped according to the available cadastral particles of farms. All territorial and farm data included in the census (related to households; farm structures, etc..), are selected through the join to the ARTEA database (public payments for the farms).
Then in order to localize the farms operating in the Mugello area we select only those particles simultaneously available in ARTEA and in the cadastral databases. The spatial analysis developed below is conducted through the use of open-source GIS software (v. QGIS. 2.2) and its statistical and geomorphological analysis plug-ins.

In order to classify different types of farms operating in the Mugello area we split the entrepreneurship index proposed by Rocchi and Landi (2013) in two different concepts: the «*multifunctional diversification*» and the «*entrepreneurship capacity*» or dinamicity. While the farming *multifunctionality* is related to the non-agricultural activities and the production of high quality products, the *entrepreneurship capacity* is measured by the farm operator's attitudes to investments using as proxy several variables such as the presence of the accounting, the Information Technology services (ICT), the outsorcing, the presence of the entrepreneur (in terms of time dedicated to farm, type of occupation etc.) operating in the farm, the number of sale channels and the attendance of the farm operator to professional courses (see table 1).

Table 1. Variables composing the «*multifunctional diversification*» and the «*entrepreneurship capacity*»

Multifunctionality		Dinamicity	
Cultivation practices	2.5 - hedges and rows 2.5 - grassing 2.5 - alternation 2.5 - conservative processing	Accounting	0 - no accounting 5 - not ordinary accounting 10 - ordinary accounting
High quality products	0 - No high quality ha 2.5 - < 1/3 high quality ha 5 - 1/3 - 2/3 high quality ha 10 - > 2/3 high quality ha	Information Technology services	0 - no ITS 2 - only administrative services 4 - only other services 6 - administrative services and other services 8 - Internet 10 - Internet and e- commerce
Number of non agricultural activities	0 - 0 activity 3.33 - 1 activity 6.66 - 2 activity 10 - > 2 activity	Courses	0 - No 10 - yes
Share of rents stemming from non agricultural activities	0 - 0 5 - < 30% 10 - >30%	Outsorcing	0- > 0.75 hectares 5- 0.25- 0.75 hectares 10 - < 0.25 hectares
		Presence of the entrepreneur	0 - farm operator not employed 2.5 - employed with < 100 days working in 5 - employed with 100- 180 days working in 7.5 - employed with >180 days working in and off - farm time > on - farm time 10 - employed with >180 days working in and off - farm time < on - farm time
		Sales channel	0- 0 3.33- < 1/3 standard output 6.66- 1/3 - 2/3 standard output 10- >2/3 standard output

Source: own elaboration

Differently from the original *entrepreneurship index*, the definition of the value of *multifunctionality* and *dinamicity* is made with a Multicriteria Analysis that consists of the following stages: a) definition of variables and attributes; b) assigning scores to the attributes in a scale from 1 to 10 points (see table 1) related to each farm; c) pairwise comparison to assign weights to the variables; d) determination of the matrix of weighted points for the two indices (*multifunctionality* and *dynamicity*) e) definition of the farm styles. In order to give a different weight to every variable composing the two indices, we apply a pairwise comparison among the selected variables (see table 2) where the value 1 is given when the variable on the row is more important than the corresponding value on the column, 0.5 if they have the same importance otherwise 0 is assigned. As result two matrices related to *multifunctionality* and *dinamicity* showing the weight assigned to each variable are obtained. The most important variables are represented by percentage of revenues stemming from non agricultural activities and the sales channels. Adding the resulting weighted score of the different variables we obtained the scores related to *multifunctionality* and *dinamicity*.

Table 2. Weight matrix related to *Multifunctionality*.

	Accounting	ICT	Courses	Subcontracting	Entrepreneur	Sales channel	Control number	weight
Accounting	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	1	1	1	0	x	0	1	0.200
Sales channel	1	1	1	0,5	1	x	1	0.275

Source: own elaboration

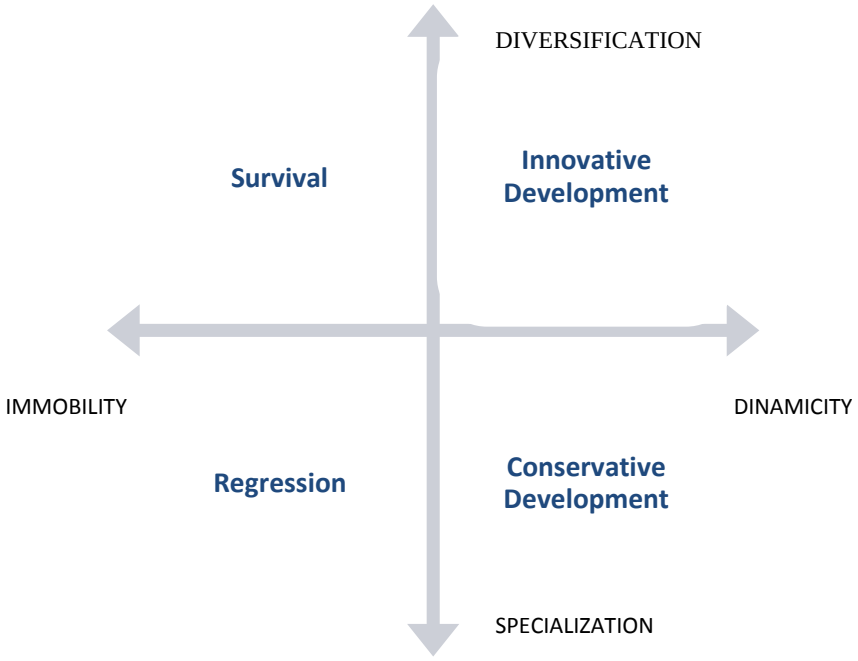
Table 3. Weight matrix related to *dinamicity*

	Cultivation practices	High quality products	Number of non agricultural activities	Share of rents stemming from non agricultural activities	Control number	weight
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
Share of rents stemming from non agricultural activities	1	1	1	x	1	0.400

Source: own elaboration

Splitting the *entrepreneurship index* in two different score of *multifunctionality* and *dinamicity* we defined four different farms' styles. The threshold value is represented by the average value of the resulting scores. Actually, on the *multifunctionality* side, beyond the average value we collect farms with at least one no-agricultural activity representing a consistent share of total rents. The different farms styles stemming from the previous classification are: *Regression*, *Innovative Survival*, *Conservative Development* and *Innovative Development* (see figure 1). The *Regression* includes farms without non-agricultural activities and with a low degree of *entrepreneurship capacity*. The *Survival* includes farms with a low degree of *entrepreneurship capacity* but where entrepreneurs adopt strategies aimed to increase different activities beyond the agricultural production. The last two types of agricultural holdings include farms with higher entrepreneurship capacity. The difference between these two farm structures stems from the production focus of the farm operator: strengthening the agricultural production improving economies of scale and technological investments (*Conservative Development*) and the farm diversification with the introduction of activities that increase the added value of products and the provision of rural services (*Innovative Development*).

Figure 1. Farms' styles.



Source: own elaboration

3. DATA

This study combines data from the 2010 Census of Agriculture, the Tuscany Agency for Payments in Agriculture (ARTEA) database, the land use soil data from Corine Land Cover (CLC-06) and LAMMA 2007 (Laboratory for Environment Monitoring and Modeling) database. While the 2010 Census provide a wide range of information related to the farm and the family such as the farm size, the standard output, the age and the education of the farm operator, the ARTEA database provides the information on the public payments stemming from pillars 1 and 2 received by each farm. Finally cover land provides information at the territorial level since it represents the soil use of the areas.

Once the data have been matched and georeferenced trough the Q-GIS software, the resulting sample, composed by 821 farms operating in the Mugello area, allows to represent the different farms structures in the Mugello according to the their socio-economic (the farm structure data and the entrepreneurship index) and geographic feature (such as the altitude, the slope and the type of soil).

3.1 Territorial data

The relationships between geomorphological factors and anthropogenic organization, have particular significance here. In fact, between north and south part there are various differences both at geological and at hydrographic network level, and this has strongly influenced the locations, types of settlement and management structures of the agricultural system.

The Upper Mugello, is characterized by worse accessibility conditions, associated to a processes of depopulation and abandonment of cultivated fields, pastures and woods. The Reduction of agroforestry practices has triggered massive processes of naturalization and expansion of natural vegetation. The southern side is characterized by gentle reliefs, and is represented by an interruption of forest cover, with larger areas of closed fields in which alternate forage the grazing practices.

The elaborations performed with the available spatial data allowed to analyze the territorial structure of each RDP zones.

The first analysis focuses on territorial articulation in rural areas according to land use, carried out through statistical processing of land cover LAMMA 2010 and geo-referenced representation of land use distribution. We observe that in the Mugello area, the territorial surface is equal to 113,122.65 Ha, of which 95.3% (107,838.37 Ha) is covered by agroforestry land uses.

Table 4. Type of soil according to RDP zones

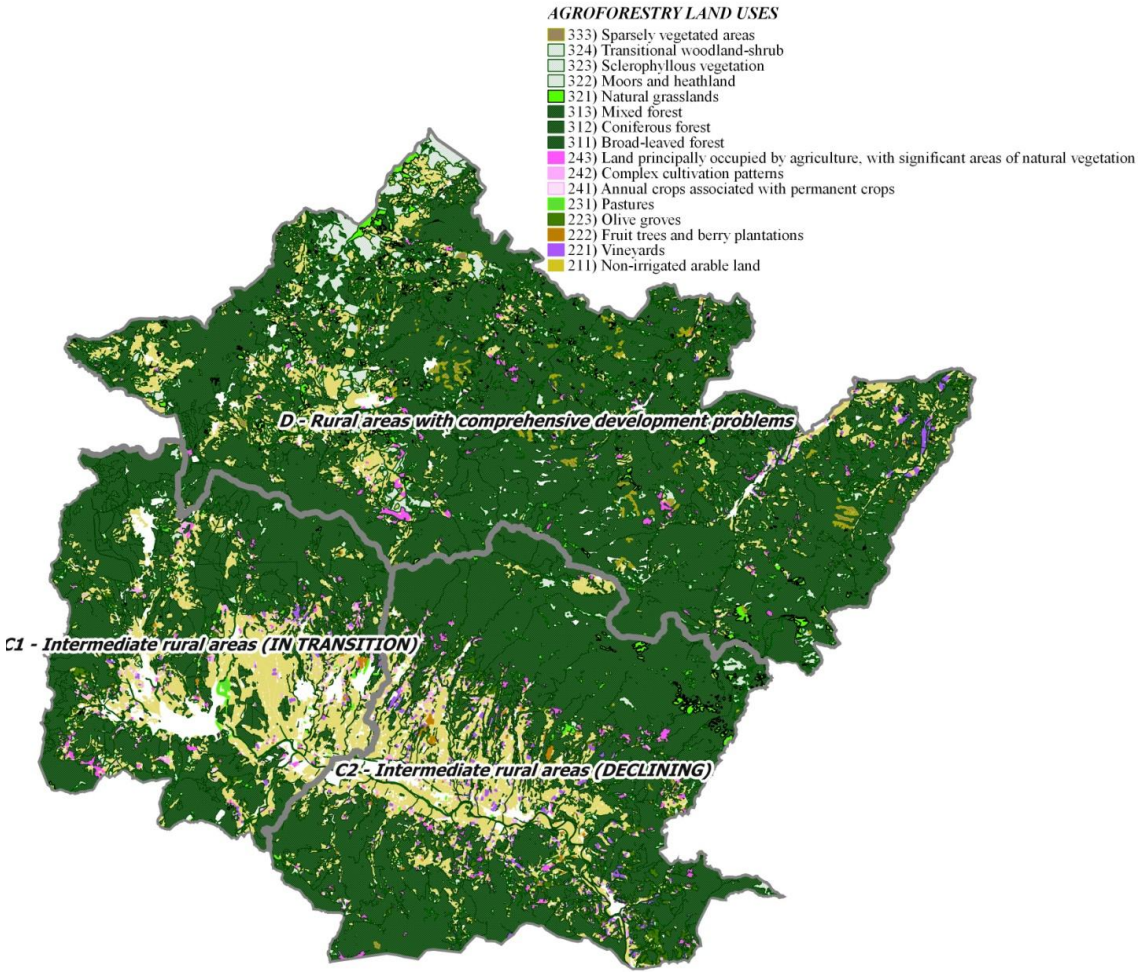
CLC classes (Land Use 2010)	C1 (Ha)	C1 % TOT CLC	C2 (Ha)	C2 % TOT CLC	D (Ha)	D % TOT CLC	TOT CLC (Ha)	TOT CLC % TOT Area
211 Non-irrigated arable land	6,457.01	*31.16%*	6,910.09	*33.35%*	7,353.23	*35.49%*	20,720.33	*19.21%*
221 Vineyards	137.67	*21.86%*	364.30	*57.86%*	127.69	*20.28%*	629.66	*0.58%*
222 Fruit trees and berry plantations	66.88	*21.63%*	156.37	*50.58%*	85.88	*27.78%*	309.13	*0.29%*
223 Olive groves	251.94	*25.32%*	723.51	*72.71%*	19.58	*1.97%*	995.03	*0.92%*
231 Pastures	167.43	*39.65%*	121.59	*28.80%*	133.23	*31.55%*	422.24	*0.39%*
241 Annual crops associated with permanent crops	64.93	*38.38%*	70.85	*41.88%*	33.41	*19.75%*	169.18	*0.16%*
242 Complex cultivation patterns	136.62	*45.41%*	149.86	*49.81%*	14.40	*4.79%*	300.88	*0.28%*

243 Land principally occupied by agriculture, with significant areas of natural vegetation	209.24	*20.71%*	338.29	*33.48%*	463.02	*45.82%*	1,010.55	*0.94%*
311 Broad-leaved forest	13,140.08	*17.93%*	23,430.36	*31.98%*	36,699.66	*50.09%*	73,270.10	*67.94%*
312 Coniferous forest	967.51	*45.43%*	7.25	*0.34%*	115.486	*54.23%*	2,129.61	*1.97%*
313 Mixed forest	437.92	*48.12%*	35.25	*3.87%*	436.94	*48.01%*	910.11	*0.84%*
321 Natural grasslands	19.70	*1.86%*	211.68	*19.99%*	827.58	*78.15%*	1,058.96	*0.98%*
322 Moors and heathland	20.39	*13.58%*	41.45	*27.61%*	88.29	*58.81%*	150.13	*0.14%*
323 Sclerophyllous vegetation	0.00	*0.00%*	0.00	*0.00%*	6.00	*100.00%*	6.00	*0.01%*
324 Transitional woodland-shrub	774.38	*14.16%*	880.08	*16.09%*	3,815.24	*69.75%*	5,469.70	*5.07%*
333 Sparsely vegetated areas	0.00	*0.00%*	11.55	*4.03%*	275.21	*95.97%*	286.76	*0.27%*
TOT Area	22,851.69	*21.19%*	33,452.47	*31.02%*	51,534.21	*47.79%*	107,838.37	*100.00%*

Source: own elaboration

The results, firstly highlight how the forestry cover (CLC classes: 311, 312, 313) is prevalent (over 70% of the Mugello) especially in D zone. Further the outcomes reveal an equal distribution of "arable land" (CLC classe 211) and "pasture" (CLC classe 231) between the three RDP zones. Contrariwise the permanent crops are distributed asymmetrically, with an evidently prevailing presence in the C2 zone.

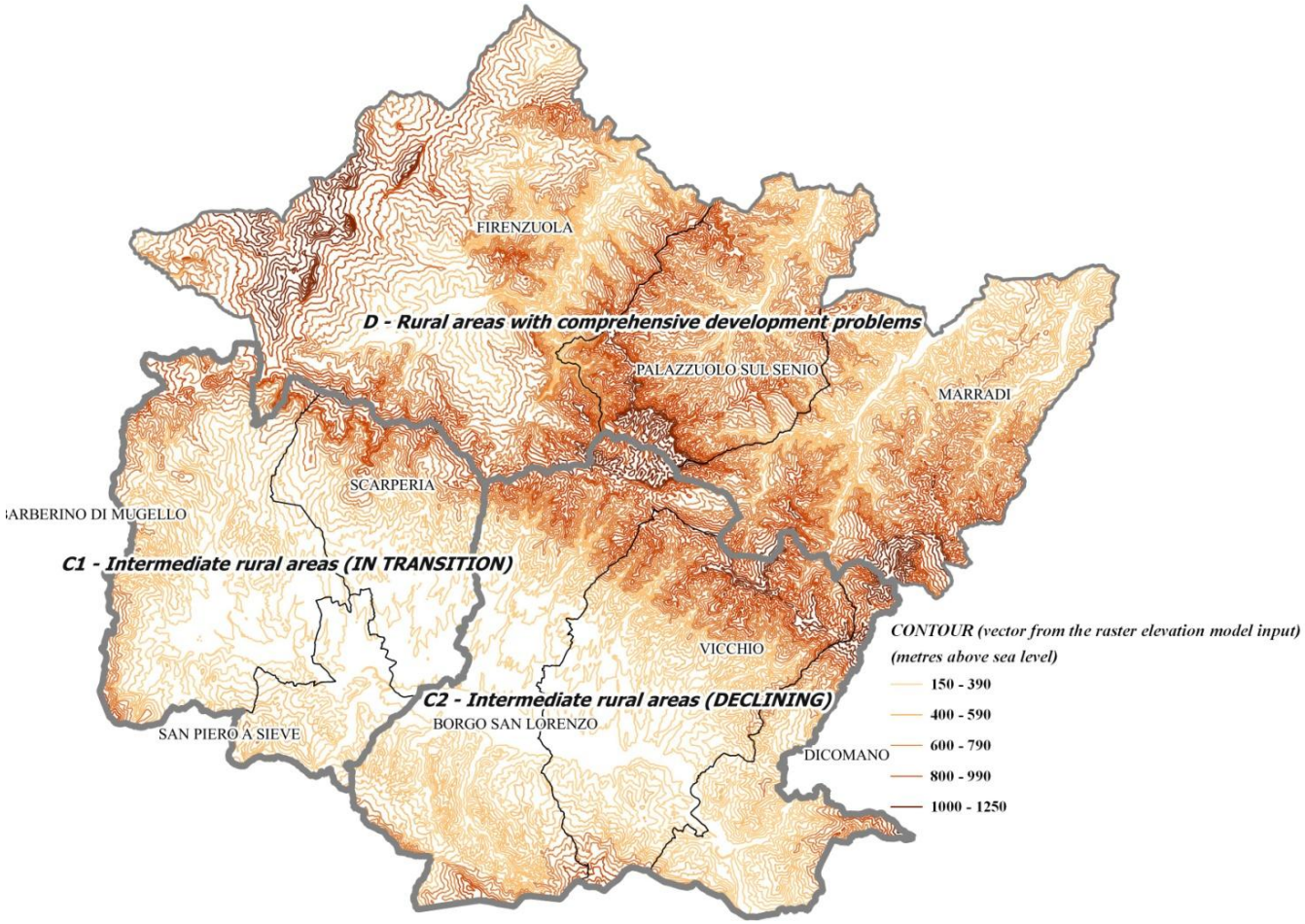
Figure 2. Land Use in Mugello



Source: own elaboration

According the 2010 census the resulting sample covers a total area of 52,849 (SAT) hectares and over 94% of this area has been georeferenced trough the Q-GIS software. After observing the land cover we have analyzed, through terrain analysis (plug-in Qgis), other territorial aspects as: altitude (extracted from digital elevation model data); slope (calculated as average slope angle for each cadastral particle in percent, based on first order derivative estimation); exposition (calculated starting with 0 for north direction counter clockwise).

Figure 3. Contour map of Mugello



Source: own elaboration

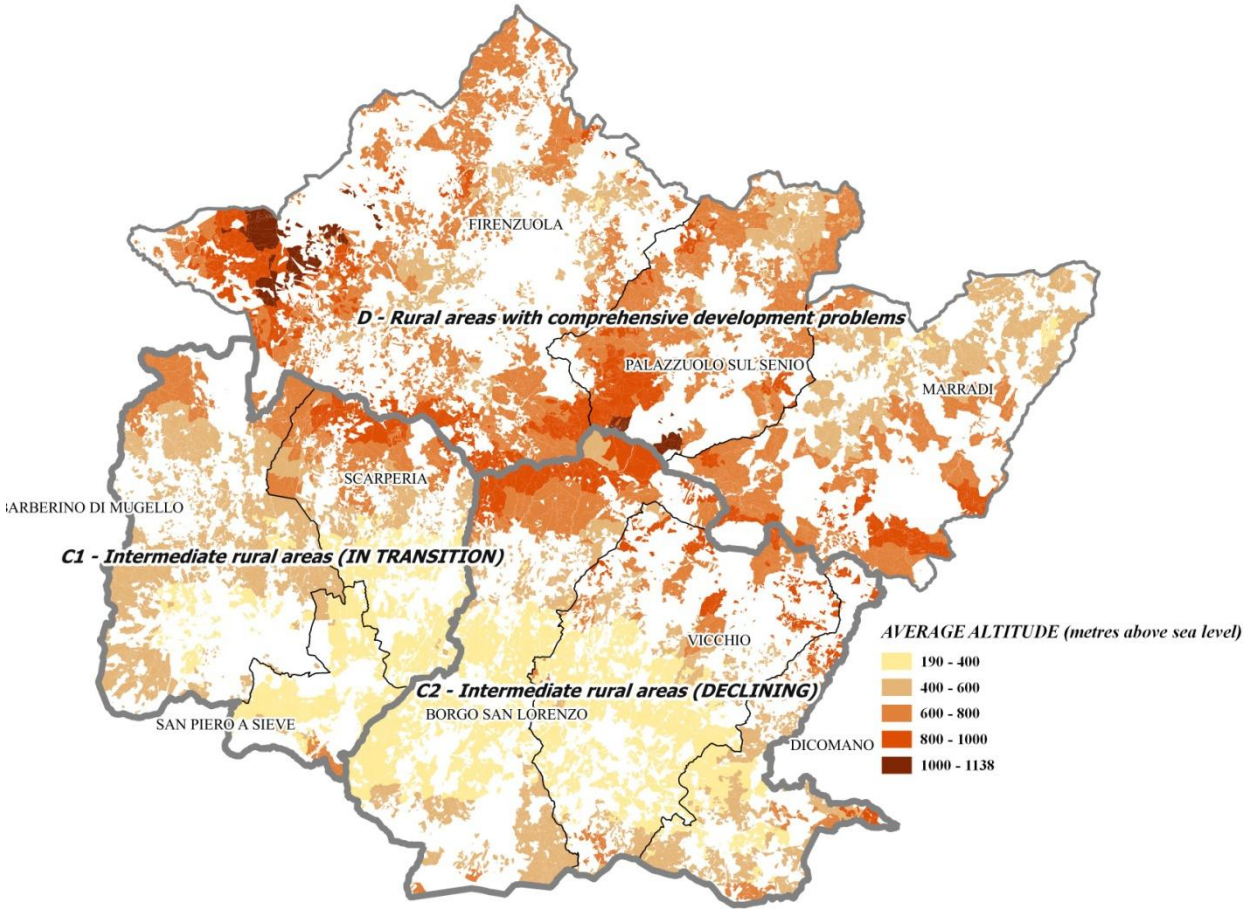
The following maps and tables (figure 4,5,6 and tables 5,6) represent the different characterization of the georeferenced surface conducted by farms operating in the Mugello area, and show that a real spatial pattern able to make a zoning certain spatial features on small-scale does not exist. Hence, in order to be able to identify significant territorial constants, a more detailed analysis provided by a large scale is necessary.

Table 5. RDP zones according to average altitude slope and exposition

DRP ZONE	AVERAGE ALTITUDE	AVERAGE SLOPE	AVERAGE EXSPOSITION
C1	445 MASL	12%	southeast
C2	490 MASL	16%	southwest
D	678 MASL	19%	southwest

Source: own elaboration

Figure 4. Average altitude of farm surface in Mugello



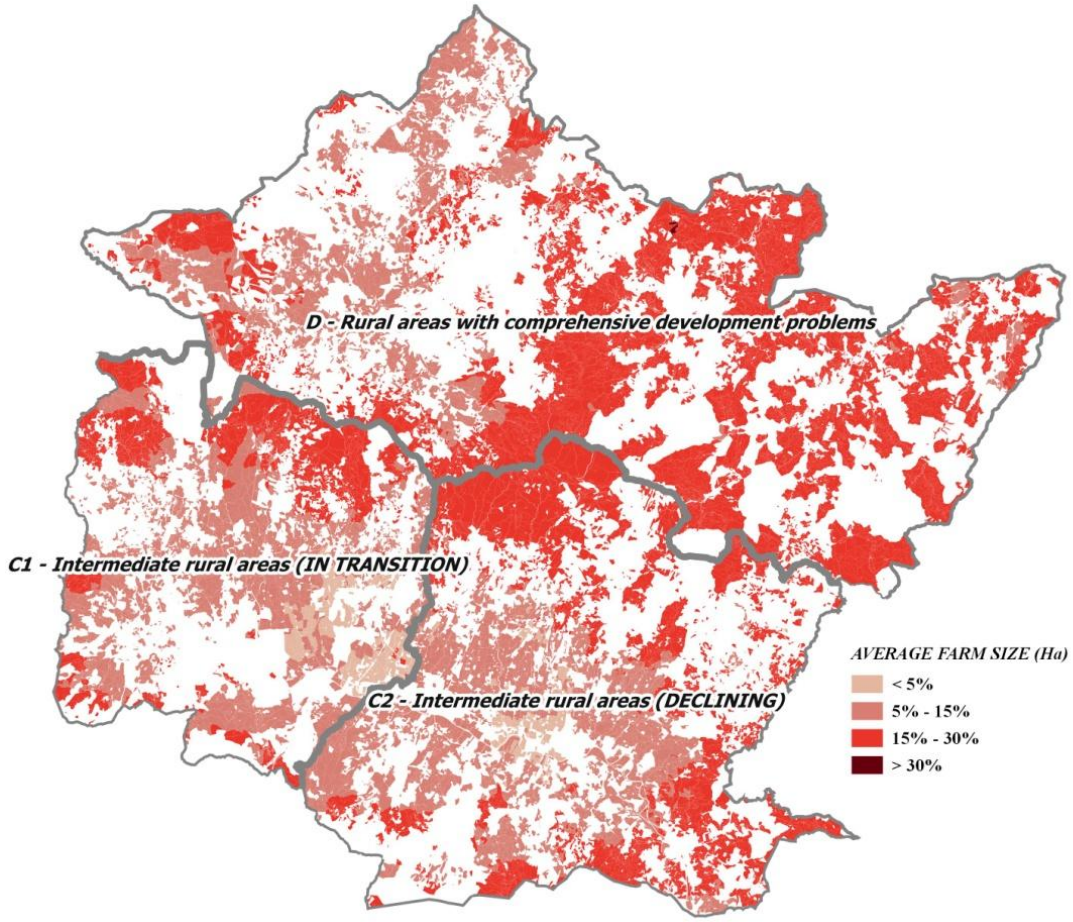
Source: own elaboration

Table 6. DRP zones according to the altitude

DRP ZONE	ALTITUDE (FREQUENCY %)				
	< 400	400-600	600-800	800-1000	> 1000
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

Source: own elaboration

Figure 5. Average slope of farm surface in Mugello



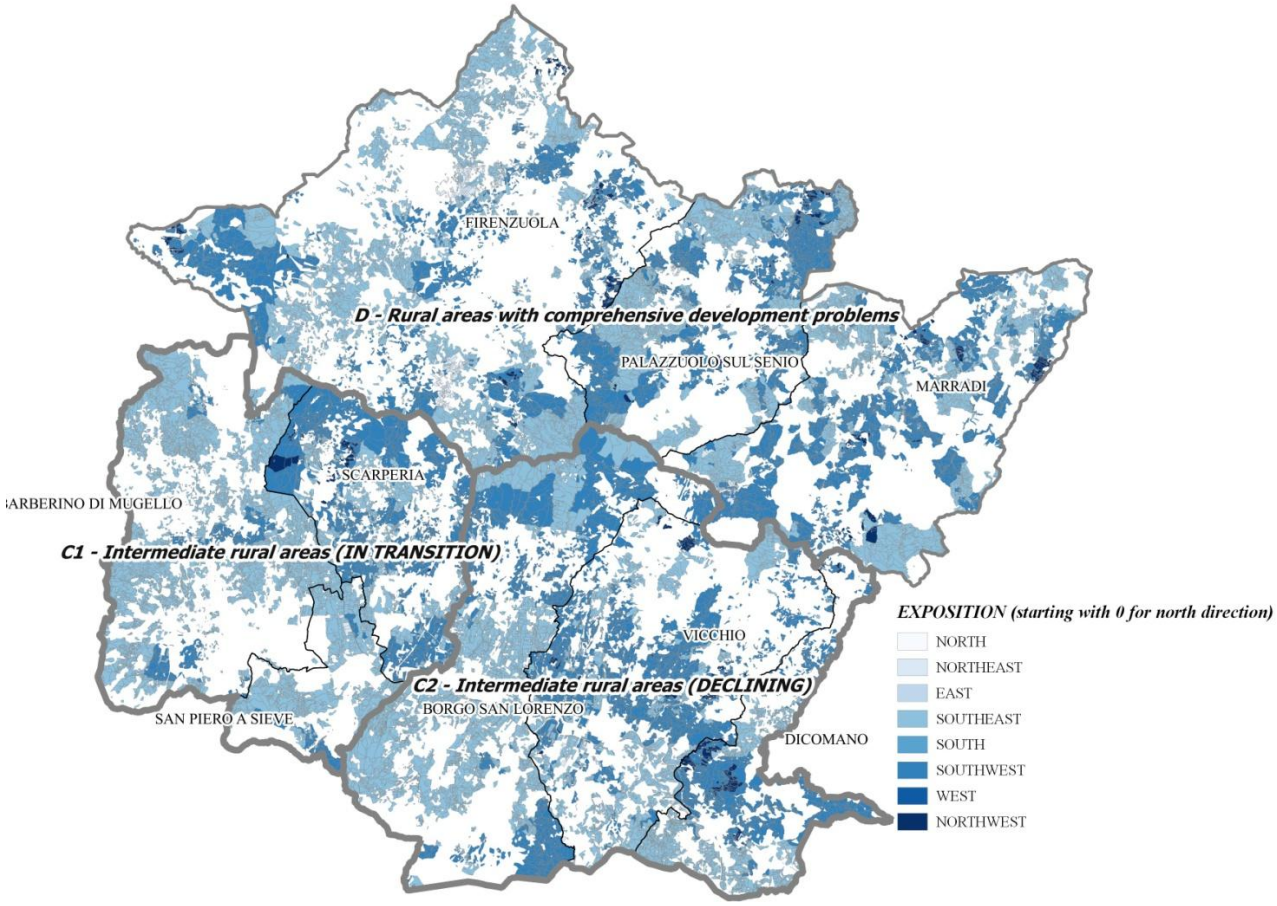
Source: own elaboration

Table 7. DRP zones according to the slope

DRP ZONE	SLOPE (FREQUENCY %)			
	< 5	5 - 15	15 - 30	> 30
C1	1.81	17.53	6.91	0.00
C2	1.26	22.47	13.58	0.00
D	0.03	10.79	25.62	0.00

Source: own elaboration

Figure 6. Average exposition of farm surface in Mugello



Source: own elaboration

According to the previous figures and tables we note a deep difference among the natural resources according to the RDP zones. Especially areas with development problems show several difficulties since over 70% of farms are located at altitudes higher than 600 metres and 25% of UAA show slopes higher than 25%. The territorial resources of the remaining two areas are similar, however C1 areas show slightly higher altitudes (from 400 to 600 metres) if compared to C2 ones.

3.2 Farms data

The sample is composed by the 821 georeferenced farms covering 49,966 ha which represent 56% of the farms and 81% of the total agricultural area (SAT) surveyed by ISTAT in 2010 (see table 8).

Table 8. Coverage of the sample compared to 2010 census

	sample	Mugello	%
Farms	821	1462	56,2%
UAA	23,476	27,290	86%
Total area	49,966	61,865	81%

Source: own elaboration on Census data

Comparing the selected sample to the universe of farms operating in the Mugello area we can observe that larger farms are more likely to be included in the selected sample since it stems from the merging between the universe and the farms receiving public payments (see table 9).

Table 9. Comparison between the selected sample and the universe

	UAA hectares		Total hectares		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	5870	3397
MEDIAN	11.05	5.82	22	11.36	17370	9348
MEAN	28.34	18.67	64.37	42.32	47750	31690
3RD QUART	30	16.59	56	35.58	42000	23600
MAX	775.75	775.75	6453	6453	3073000	3073000

Source: own elaboration on 2010 census data

The selected sample has been split in the above described four different styles according to their *multifunctionality* and *entrepreneurship capacity*. *Regression* includes the majority of farms with 379 farms, whilst the *Innovative survival* includes only 52 farms. The *Conservative Development* and *Innovative Development* instead include respectively 193 and 197 agricultural holdings. Table 10 shows the differences in structures among the four styles. Farms included in the *Regression* style have lower size, economic dimension and number of working days with an average size of 16.29 hectares, an average standard output (SO) equal to 18,150 euro and average working days equal to 246. Conversely the higher values belong to farms included in the *Innovative development* with an average size of 52.22 hectare and an average standard output equal to 103,000 euro (see table 10). Whilst *Innovative Survival* and *Conservative Development* show similar values even if the latter style shows slightly higher values.

Table 10. UAA hectares, standard output and working days according to the farm style

	Regression			Innovative Survival			Conservative Development			Innovative development		
	UAA	SO	days	UAA	SO	days	UAA	SO	days	UAA	SO	days
MIN	0.24	0	2	0.32	0	20	0.66	0	1	1	1165	24
1ST QUART	3.01	2,856	90	6.53	7,149	166	7.40	12,690	208	14.30	25,320	350
MEDIAN	6.03	7215	165	13.56	16,010	300	15.10	25,880	365	27.36	41,770	465
MEAN	**16.29**	**18,150**	**246**	**25.71**	**43,670**	**473**	**27.90**	**49,430**	**426**	**52.22**	**103,000**	**577**
3RD QUART	13.00	17,920	365	25.32	37,680	600	32.25	55,230	600	61.00	93,090	730
MAX	468.20	573,500	1460	215.30	361,400	3000	169.10	107,2000	2900	775.7	3073,000	2,190

Source: own elaboration on 2010 census data

According to the 2010 census data the UAA covered by the selected sample is 23,476 hectares. The *Innovative Development* represent 44% of the UAA area followed by farms included in the *Regression* and *Conservative Development* with respectively 26% and 22% of the UAA area. Table 11 and figure 7 show the intensity on the use of factors among different farm styles. Farms included in the *Innovative development* show the highest levels of land and labour productivity associated to a lower average age. Furthermore we note that farms included in the *Innovative survival* are less efficient than those included in the *Regression.*

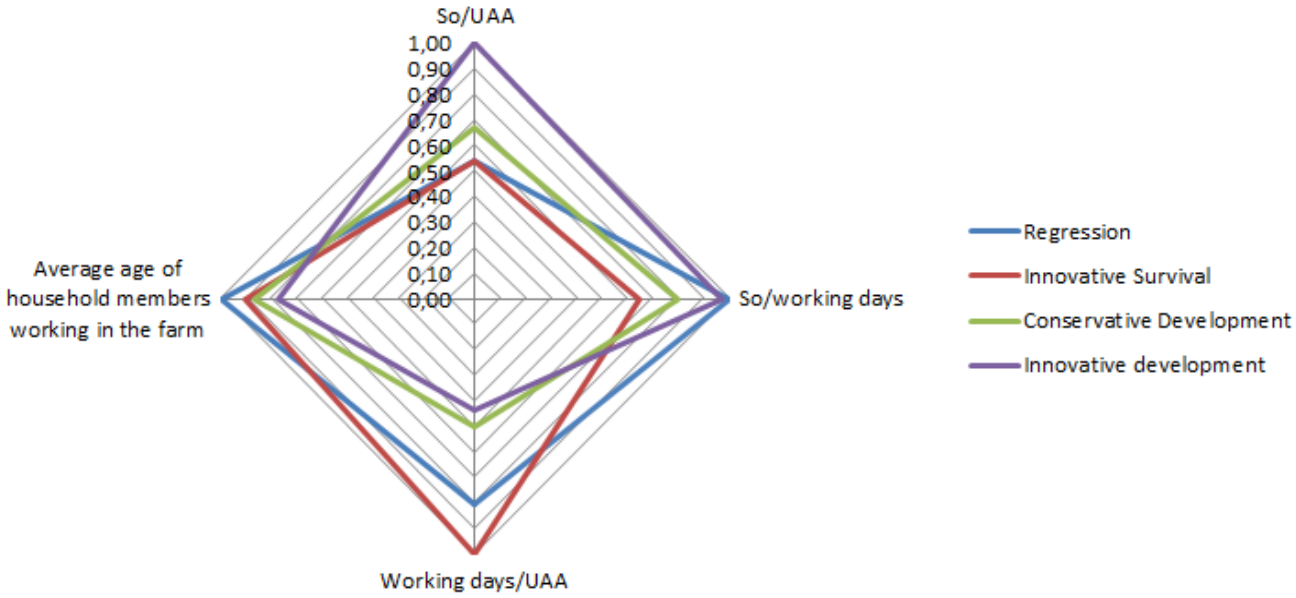
This may be due to the inefficient strategies put in place by these farms from an economic point of view, however they still are important in terms of social relationship among farmers.

Table 11. Land and labour productivity according to the farm's style

	Regression	Innovative Survival	Conservative Development	Innovative development
SO/UAA	1,769	1,781	2,209	3,309
SO/working days	268	174	214	260
days/UAA	0.61	0.76	0.38	0.33
Average age of household members working in the farm	61	55	53	47

Source: own elaboration on 2010 census data

Figure 7. Land and labour productivity index according to the farm's style



Source: own elaboration

The selected farms are all included in three areas defined by the Rural Development Plan: *rural areas in transition*, *declining rural areas* and *rural areas with development problems*. Table 12 illustrates the distribution of the four farm styles according to the RDP zone where it is represented the total geo-referenced area which is equal to 94% of total area stemming from the 2010 census. Over 50% of farms included in each style are located in area with development problems. Whilst Intermediate rural areas in transition include the minority of farms.

Table 12. The distribution of different farm styles according to different areas.

RDP ZONE		REGRESSION	SURVIVAL	CONSERVATIVE DEVELOPMENT	INNOVATIVE DEVELOPMENT	TOT
C1) Intermediate rural areas in transition	n°	74	5	24	33	137
	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 rural areas declining	n°	98	22	52	60	230
	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 comprehensive development problems	n°	207	25	117	104	454
	Ha	4,895.31	717.69	5,222,79	7,531.83	18,367.62
	% Ha	42.03	3.92	27.07	26.99	100
TOT	n°	379	52	193	197	821
	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, ARTEA data, Census data

According to the ARTEA database, 144 farms operating in the Mugello area received RDP payment stemming from axis 1, 92 farms received payments from the axis 2 and only 16 farms received payment from axis 3 over the period 2007-2012. Table 13 shows how the RDP payments are distributed among the four farm's styles. The average payment is measured as the ratio between total payments over the period 2007-2012 and the number of farms included in the farm style. This index allows to assess the access of farms to public payments according to the farm style. The data show that farms included in the *Innovative Development* show the highest level of access to RDP payments in terms of average payment with an average amount of 1960, 1034 and 783 euro respectively from the axes 1, 2 and 3. Furthermore farms included in this style show the highest share of farms detecting payments from the axes 1, 2 and 3 of the RDP (35%, 24% and 7%). Actually over 30% of farms included in the *Innovative development* received payments stemming from axes 2 and 3 which are related to diversification and agri-environmental schemes as they represent one of the main strategies of this style. Conversely just few farms included in the *Regression* are able to capture RDP payments. These results highlight a different level of access to public payments according to the farms style. Actually it seems that farms included in the *Regression* perceive higher barrier to receive payments, whilst the agricultural holdings included in *Conservative and Innovative Development* are eased acceding to the public payments. This representation allows to validate the proposed classification of agricultural holdings operating in the Mugello area.

Table 13. Axes of the RDP (euro) according to the farm style

	Regression			Innovative Survival			Conservative Development			Innovative Development		
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%
Total payments per year	227,340	15,691	27,900	82,170	9,527	0	156,276	77,436	1,501	393,659	207,894	157,332
Average payments	596	41	73	1,521	184	0	810	401	8	1,960	1,034	783

Source: own elaboration on ARTEA data, Census data

Table 14 shows a deeper analysis on the distribution of public payments stemming from the pillar 1. Again the farms styles detecting the majority of public payments stemming from pillar 1 are the *Conservative* and *Innovative Development*, with an average value respectively of 5,708 and 8,409 euro over the period 2007-2012. The payments per hectare are higher for the *Innovative Development*, whilst the share of public payment on the standard output is lower, implying that these type of farms are less dependent from the EU. Finally we note that farms included in the Regression collect the lowest amount of public payments. However when the payments are standardized by the number of working days and by the standard output this style shows the highest values. These results imply that 25% of their revenues stem from payments of pillar 1, and similarly the share of payments on the working days is so high to grant a consistent farm's profitability.

Table 14. The average amount of public payments received (euro) according to the farm style

	Regression	Innovative Survival	Conservative Development	Innovative Development
	Payments - pillar 1			
Average Payment	2,212	3,624	5,708	8,410
Total payments per year	1031,567	195,752	1101,721	1690,515
Payment/UAA	0.3	1.22	2.6	1.3
Payment/SO	0.25	0.10	0.32	0.085
Payment/w. days	117	10.1	57.19	19.2

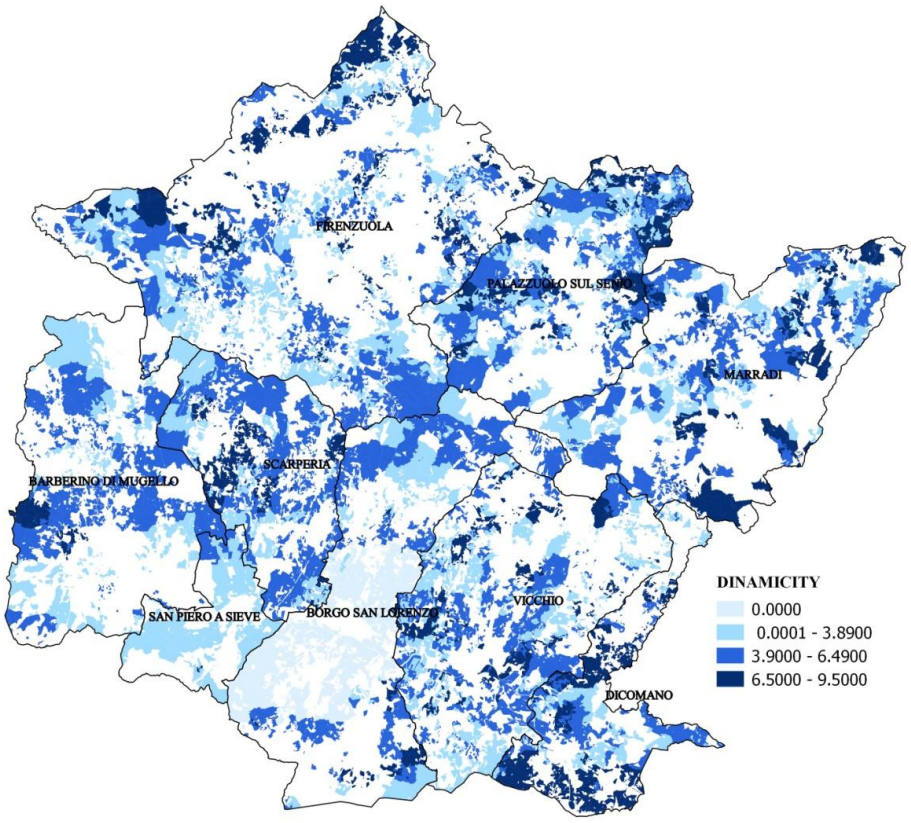
Source: own elaboration on ARTEA database

4. RESULTS

This analysis shows that the Mugello area is characterized by a deep internal differentiation at the farm and at the territorial level. Applying the multicriteria methodology on farm data we defined four different farm styles: *Regression, Survival*, *Conservative Development* and *Innovative Development* related to the farms operating in the Mugello area. Every style is different from the others not only in terms of farm and family structure but also in terms of the amount of public payments stemming from both: pillar 1 and 2. Actually farms included in the *Innovative Development* represent larger farms with a high land productivity whilst farms included in the *Regression* style seem to be close to exit since they have lower size, lower economic dimension and receive a consistently lower amount of payments from the European Union. However we need to note that this result is due also to the type of farm operator since according to the European commission only entrepreneurs are eligible to receive public payments.

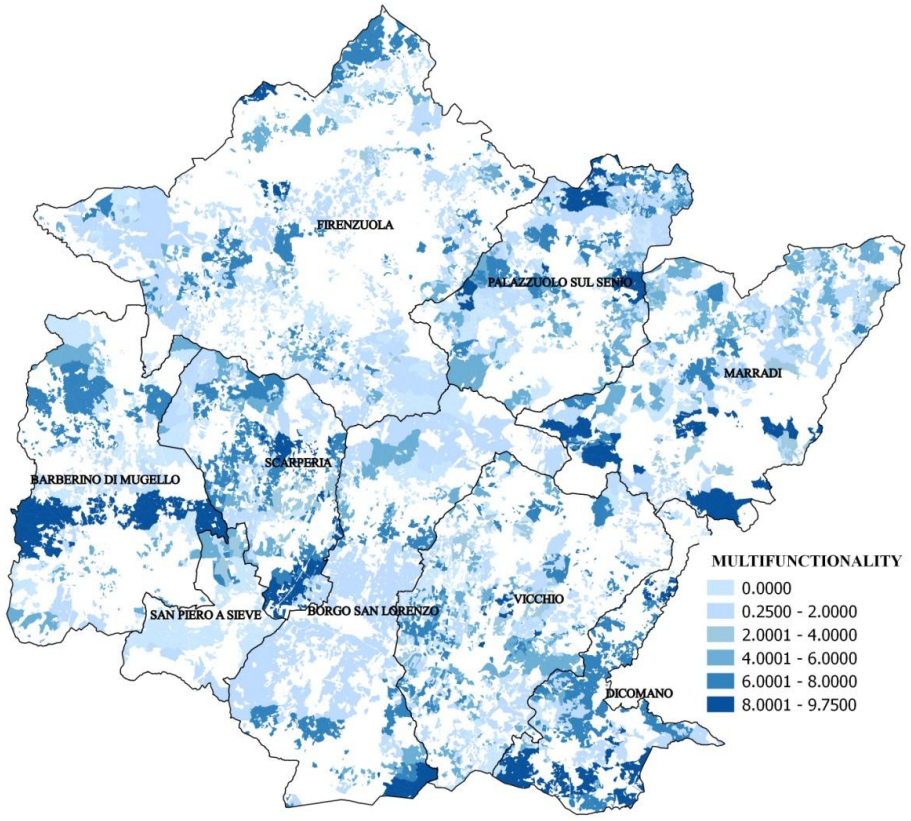
The Q-GIS package allowed to make a spatial analysis on the farms operating the Mugello area showing their distribution within the area. Figure 8 shows the spatial distribution of the *dinamicity* among farmers. The highest levels of dinamicity are located in the municipalities of Dicomano and Scarperia, however even some area of the Upper Mugello are characterized by a high *dinamicity* level such as the north part of Firenzuola and Palazzuolo sul Senio. Surprisingly the municipality of Borgo San Lorenzo, characterized by a more favorable area to crops, shows the lowest level of dinamicity

Figure 8. Dinamicity map



Source: own elaboration

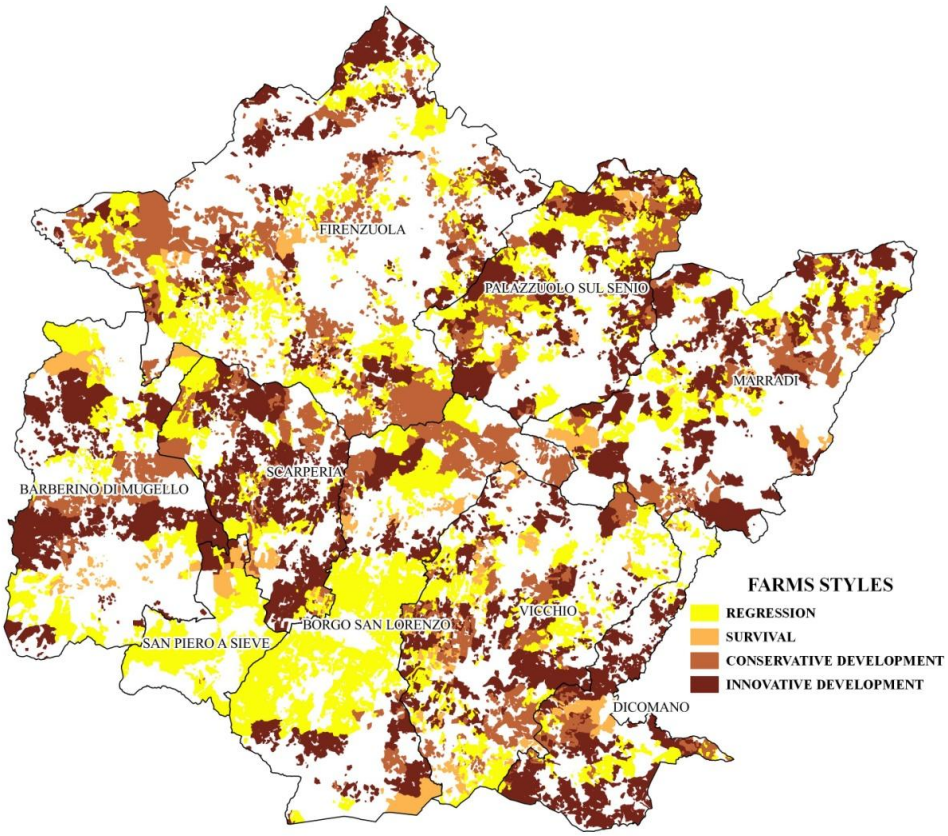
Figure 9. Multifunctionality map



Source: own elaboration

As showed by Figure 9 the majority of farms operating in the Mugello show low levels of *multifunctionality* if compared to the dinamicity map. However the Upper Mugello seems to be more oriented to the multifunctionality. Actually, in terms of number of farms, Firenzuola municipality has the majority of *multifunctional* farms since over 50% of farms can be considered as multifunctional. Similarly Palazzuolo sul Senio shows high level of *multifunctionality*. This result may be explained by the geographical attributes of the area which is characterized by declivity and high altitude. Actually, the agricultural activity in this area requires high level of labour intensity resulting in a lower land productivity if compared to south area of Mugello. Hence, in order to survive, farms operators operating in these areas, given the lack of off-farm opportunities, the beauty of the rural landscape and the presence of natural and environmental resources, seek to adopt diversification strategies.

Figure 10. The farm's styles



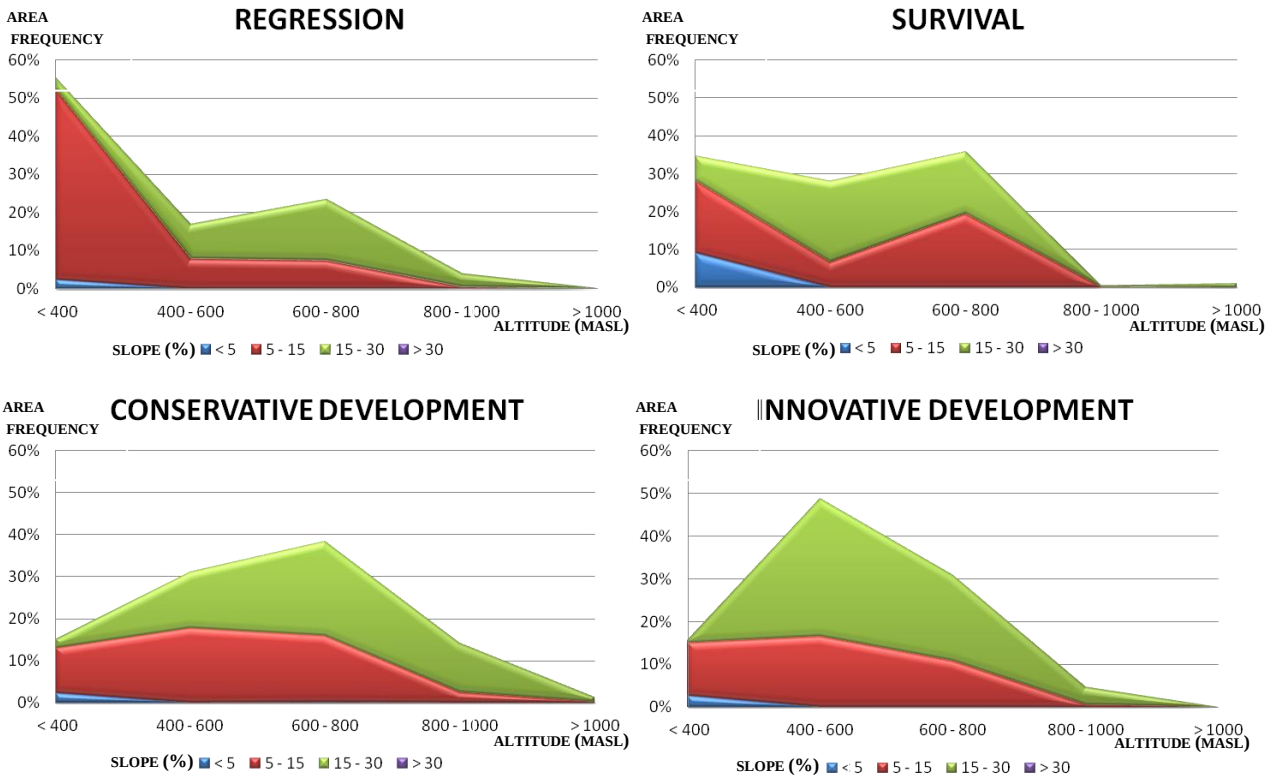
Source: own elaboration

Figure 10 illustrates the spatial distribution of the four farm styles. The majority of farms included in the *Innovative development* are located in the municipalities of Dicomano and Scarperia in the south of Mugello area which rapresent an area with less development problems if compared to the north of Mugello. Instead the municipality of Borgo San Lorenzo, which represent an area suitable to crops, includes many farms stemming from the *Regression.* This aspect surely need a deeper analysis.

In order to assess whether a cause-effect relationship between the quality of land in terms of geographic attributes and the farms' styles exists figures 11 shows for each farm's style, the total area according to different classes of slope and altitude. Results show that farms included in the *Regression* operate in "better" areas since they are associated to lower altitudes and slope. Conversely farms included in the *Innovative and Conservative development* operate in area with higher development problems. This may

be due to the fact that the location in more difficult area push the farms operators to seek alternative development paths.

Figure 11. Farm's total area according to slope and altitude



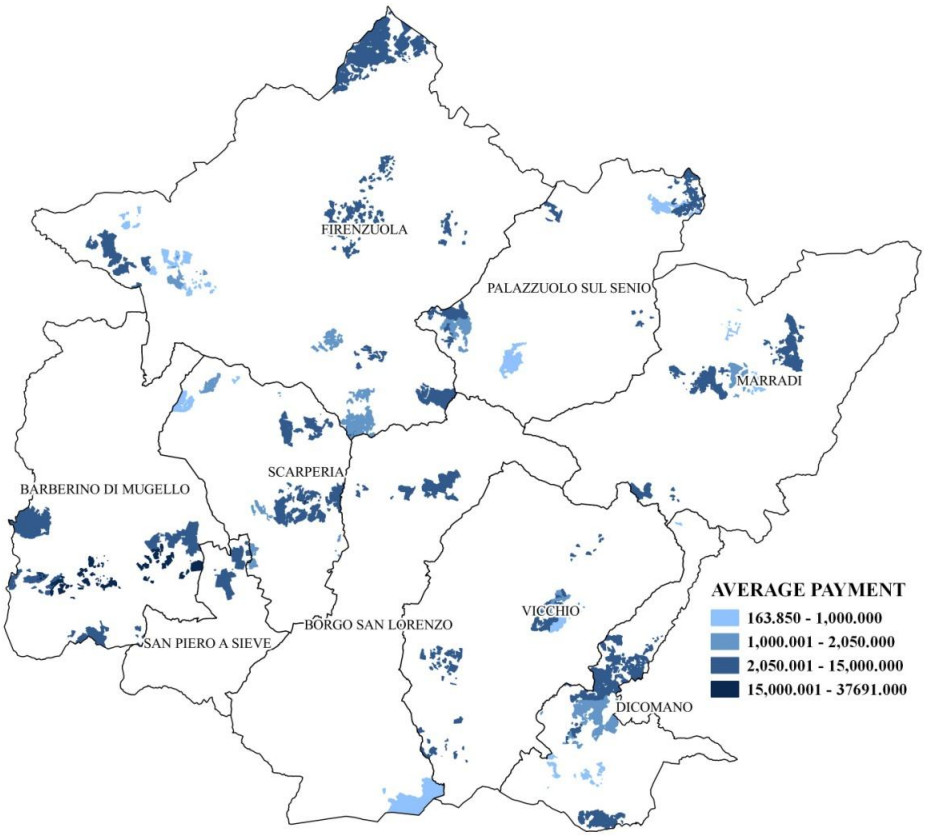
Source: own elaboration

The analysis related to the share of public payments detected by each farms style confirms the validity of our classification. Farms included in the *Regression* are the less dynamic since they receive the lowest amount of RDP payments from pillar 2, showing a CAP dependent attitude. Actually the majority of rents stems from public payments of pillar 1, highlighting how farms included in the *Regression* seeks to maintain the status quo which grant them a sufficient amount of money enough to survive in the short run. Conversely, farms included in the *Innovative development* show higher average payments stemming from the pillar 2 since they perceive RDP payments as an opportunity to build different development strategies. The *Conservative development* is strictly dependent pillar 1 payments (5,708 €) with a share of payments on the standard output equal to 32%. However even the accessibility to pillar 2 is quite high. Finally the *Innovative survival* shows similar characteristics to the *Innovative development* but with lower public payments. A further analysis could assess whether the farm's styles affect or are affected by the access to public payments which represent an important aspect within the changing policy situation we are going trough.

Finally, in order to asses the spatial distribution of RDP payments, a spatial analysis on the measure 212 related to area with natural disadvantages has been produced. As result we note that only 55 farms operating in the Mugello area received this type of payments (see figure 12) with a total amount of 173,000 euros over the period 2009-2012. Results show that many farms located in the south of Mugello where the soil is less steep and more suitable for cropping, received these types of payments. Conversely many areas located in the upper Mugello did not receive any kind of payments due to the development problems. It is evident, therefore, a lack of coherence in the use of the measure 212 which should have helped farms located

in area with natural deficiency, since we note that the payments are distributed without taking into account the characteristics of the territory. Beyond this lack of coherence, this analysis highlights the problem of access to public payments, which affects especially the farm style of the *Regression.* Only 2% of the farms included in this style received the payments, whilst 11% of the *Conservative Development* farm style received the payments over the period 2007-2012. Furthermore, we need to note that the next RDP 2014-2020 impose the obligation to be a farmer recognised as "imprenditore agricolo a titolo principale" as basic condition to access to public payments. This may imply a strong limit to the development of rural area which are often charcaterized by part-time farms, non-professional farms, life-stylers farms which, however, play a key role for agri-environmental protection.

Figure 12. Average payment related to area with development problems



Source: own elaboration

5. CONCLUSIONS

The paper provides a spatial analysis of the farm structures in the Mugello area. The analysis is conducted using data at farm and at the territorial level, including information on farm and family structure, public payments and territorial information. The resulting database, composed by 812 agricultural holdings operating in the Mugello area, has been geo-referenced to localize the cadastral parcels of the farms. Then trough a multicriteria analysis four different farms' styles have been defined according to their *dinamicity* and *mutifunctionality* level i.e. *Regression, Survival, Conservative Development and Innovative Development*. Our results show a significant internal differentiation within the Mugello area which allow the survival of different farm structures. Especially almost 50% of farms included in the sample seems to be close to the exit, as they are included in the *Regression.*

The main strength of this contribution is the intertwining between farms and territorial data which allows to localize all the parcels of every farm included in the sample. Actually this contribution represents a first attempt to show the potential of GIS as it performs a deeper analysis on the area at the farms and territorial level. The policy maker should use these information in order to design, monitoring and assess the impact of the proper local agricultural policy which is able to fit the needs of specific rural areas and farms.

Regarding the access to public payments stemming from pillars 1 and 2 we note that the higher amounts of moneys go to farms included in the *Conservative* and *Innovative development* which represent farms with the highest level of *enterpreunership capacity*. A further analysis could explain whether this capacity is the cause or the effect of the resulting amounts of payments. However a deficiency in the access to public payments surely emerge. Farms included in the *Regression* face higher barrier to entry in the system. Hence new activities such as information practices, should be put in place to address this issue. However we need to note that the RDP 2014-2020 will allow only "*imprenditore agricolo a titolo principale*" to accede to public payments. On one side this measure aims to drive out the system "life-stylers" farmers focusing on active farmers. On the other side, from a territorial point a view, this measure does not promote the rural development, as even life-stylers farmers may contribute to the landscape maintenance (Lobley and Potter 2004). Finally focusing on the RDP measure related to area with natural disadvantages we note that the measure is not best performing since marginal areas are excluded. This result confirms the need to use more efficient evaluation tools, and in this framework GIS analysis could be an important support.

REFERENCES

Adisa R.S. (ed) (2012). Rural Development - Contemporary Issue and Practice. Available at www.intechopen.com

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

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 of European Union.

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 of European Union.

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.

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.

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

Malczewski, J. (2004) GIS-based land-use suitability analysis: a critical overview. *Progress in Planning* 62 (2): 1 - 65.

Rocchi, B. e Landi, C. (2013). Livelli di imprenditorialità nell'agricoltura Toscana. *Agriregionieuropa* 9 (34): 1- 11

Spaziante, A., Rega, C. e 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.

Spaziante A., Murano C. (2009), Rural Development Programmes and Strategic Environmental Assessment: Towards a Sustainable Rural Territory. *International Journal of Agricultural Resources, Governance and Ecology* 8: 205-222.