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VALORISATION OF HISTORICAL FARM BUILDINGS FOR PROTECTING THE RURAL LANDSCAPE

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SUMMARY

Rural buildings play a central role on the environmental characteristics of the rural land, because they accompanied in the centuries the development of agricultural activities; the farmer-man built them also considering the specific characteristics of the economic, social, climatic and cultural rural context. They are important elements of the rural landscape which, in addition to having a considerable architectural value, constitute a witness of the economic and productive organization of a specific territory. Mostly in some southern European countries - as in the Basilicata region (Southern Italy) – these rural structures have been built based on the agricultural needs and land characteristics. Considering the land abandonment occurred during the last centuries, also historical farm buildings, in most cases, have been abandoned, since people living there moved to more comfortable residences within urban settlements, causing a loss of the historical-cultural heritage of the rural landscape. In this context, it would be fruitful to improve the knowledge about the specific characteristic of farm buildings considering also their geographic location, in order to include each one of them into a geo-database and, through the use of new advanced tools, to connect the valorisation of these rural buildings within the relevant landscape. The use of advanced technological tools may considerably support the protection of landscapes with high cultural and naturalistic value. In recent years, open data and geographic technologies are allowing the implementation of multidisciplinary information, which may reveal crucial for a sound management of the rural landscape, including also an important focus on rural buildings. In this paper, the potential of a Geographic Information Systems (GIS) have been explored, with the aim to improve the cataloguing system of the Basilicata region's farm buildings, traditionally known as: "masserie". After the realization of a specific geo-database incorporating different datasets, specific tools have been used to provide some particular analyses that can be used both for the management and valorisation of farm buildings, even for touristic purposes. In addition, by

integrating some typical aspects of the landscape studies, an innovative approach has been implemented, so as to preserve not only each individual building, but even the entire rural landscape context in which these important witnesses of the rural history are included.

***Keywords**: Historical farm building, Geographical Information System, Rural landscape, Sustainable development.*

INTRODUCTION

Farm buildings, designed over the centuries in order to fulfil their primary agricultural role, now constitute a widespread heritage that in some cases possesses an irreplaceable architectural value, playing a central role for the sustainability of the rural environment as well. Conceived to host biological production, the farm building constitutes indeed a unique example in the wide epistemological sector of building construction (Picuno, 2012). The birth, growth and development of living vegetal or animal organisms contained ***inside*** these volumes raise architectural and technical issues that are radically different if compared to those of other building sectors. Aimed at producing optimal environmental conditions for plants and animals, while at the same time protecting the hygiene and health of workers involved in the daily operations for the care of living organisms at different stages of their development, the rural building constitutes therefore a unique and unrepeatable technological model (Fuentes, 2010; Fuentes et al., 2010; Picuno et al., 2015).

The originality of what happens inside the farm building corresponds to what happens *outside*. The role that the buildings have historically played is strictly connected with the surrounding context, due to the need of the farmer to live in close contact with agricultural land and animal husbandry (Cañas et al., 2009; Hernandez et al., 2004; Jeong et al., 2012; Lista et al., 2013/a; Lista et al., 2013/b). While the organization of human beings involved in the activities of the industrial or tertiary sector allowed aggregation in urban centres, the need to live in constant contact with the agricultural production developed a synergetic function of close proximity to the extra-urban land. This aspect led to the spread in rural areas of many examples of buildings that served for farming, storage and processing of agricultural products constituting, at the same time, housing for the farmer and his family. This form of settlement has been, and still is, a unique way by which humans have populated, in harmony with the natural elements, the agricultural land, joining the primary production needed for human nutrition with the control and care of rural land. So, the activities made by the Man have often strongly influenced the agricultural environment and the visual perception of its landscape (Statuto et al., 2014/a; Statuto et al., 2014/b; Statuto et al., 2015; Tortora et al., 2015).

The recent expansion of rural tourism currently registered in Europe (Ana, 2017) makes it necessary to monitor rural buildings, both to preserve them as historical and cultural heritage and to redevelop in the perspective of sustainable tourism planning. Besides the importance from a tourism point of view, there is also a growing interest focused onto the ecological effects of the rural buildings on landscape, then on the importance of applying a sustainable rural development strategy to improve the protection of habitats and ecosystem services (McKenzie et al., 2011; McCann et al., 2017). In fact, as reported by Haller & Bender (2018), there is a strong link between biodiversity and conservation/restoration of grassland, which necessarily passes through the conservation of the rural building heritage. This is especially true for some Natura2000 priority habitats such as the semi-natural dry grasslands *code 6210*

(Calaciura and Spinelli, 2008). The monitoring of the rural buildings and of surrounding landscape, considering the multidisciplinary and the strong spatial component of the information, requires therefore a suitable approach, which is now possible when based on new geographic technologies (Cano et al., 2013, Palmisano et al., 2016; Jeong et al., 2013).

In the present study, the potential of a Geographic Information System (GIS) applied to the monitoring, conservation and enhancement of the rural heritage of one southern Italian region, *i.e.*: the Basilicata region, has been explored. After the creation of a preliminary geo-database of rural buildings and spatial data related to the rural landscape, two methodologies have been implemented: the first one, was aimed to evaluate the role and impact of the rural buildings in the conservation of semi-natural environments of the surrounding context; the second one, has been focused on the assessment of the safeguarding of the visual quality of the rural landscape.

MATERIALS AND METHODS

The study area, consisting of the total land of the Basilicata region (Southern Italy), covers a total surface of almost 10,000 km^2 and 90% of the whole territory being mountain (Fig. 1). It has a population of about 600,000 units distributed into the two provinces of Matera and Potenza. The territory has a strong agricultural vocation; indeed almost 50% of the regional area is cultivated, the main agricultural activities having an influence on the structure and the biotic components of the landscape are *arable land* and *pasture*, which occupy 29% and 13% of the territory respectively. The other main component of the landscape of the Basilicata region is constituted by *forests*, which cover 35.6% of its territory.

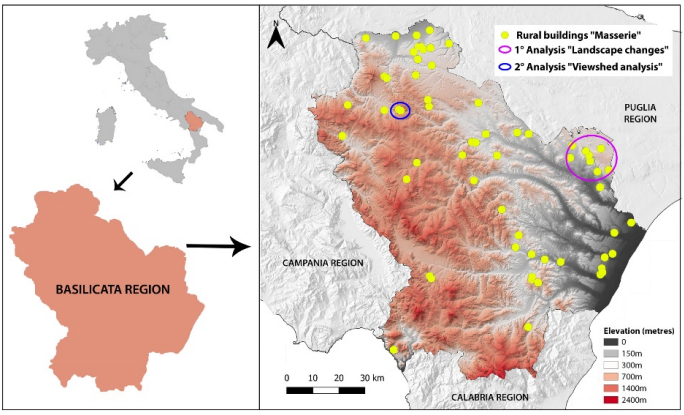

Figure 1 Study area, rural buildings at regional level and areas of analysis

One of the most important elements of the Basilicata's landscape, expression of a type of agriculture that is not particularly intensive, is constituted by the old rural buildings. These have a considerable architectural and cultural value and they are a testimony of the historical economic and productive organization of this territory (Grano, 2014; Picuno, 2012).

The first fundamental operation conducted has been the collection and standardization of the various datasets, so as to be able to realize a Geographical Information System (GIS)

model able to include and link all the information related to the rural buildings. Thanks to an available open dataset of the Basilicata Region, it has been possible to collect the position of the main rural buildings (so-called: "*masserie*"), having a cultural interest and protected by specific regulations. In according with Cano et al., (2013), this is the starting point for the cataloguing process. Thanks to the potential of GIS tools, it has been possible to connect different datasets coming from both field survey (measuring, photographic report, field databases) and spatial analysis work (studies on land use and surrounding landscape, socio-economic analysis, viewshed analysis, index creation) so as to create a single GIS-based model of rural buildings. This database model can be exploited for several purposes: planning and management; protection and conservation of the surrounding rural landscape (Jeong et al., 2016); valorisation of the existing rural buildings; strategic decision on the localization of new farm buildings; *etc*. The creation of a geo-database has been the preliminary and fundamental operation for implementing and monitoring concrete valorisation actions (Cillis and Statuto, 2018).

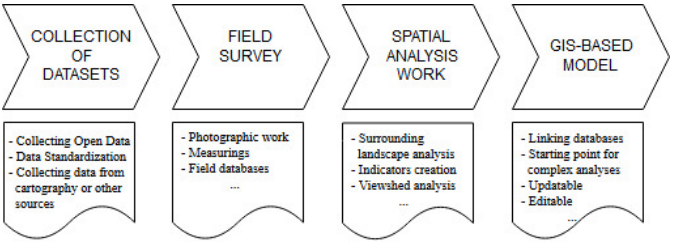

Figure 2 Flowchart of the GIS-based model implementation

In this study, to explore the GIS tools potential to be applied to the rural building and landscape management, a specific framework has been implemented (figure 2). To examine in depth the potential in the use of GIS tools for the management of rural buildings and the surrounding rural landscape, two types of analysis have been implemented, so as to contribute to the valorisation of historical farm buildings, in the framework of the protection of the rural landscape. All operations were performed with the open source QGIS software and all used dataset are free and open.

After the creation of the geo-database, the first analysis performed has been finalized to set each single rural building to understand, as proposed by McKenzie et al. (2011), if it can have an important ecological role on the surrounding environment and habitats. To do this, spatial analyses have been carried out regarding changes in land use in the surrounding area of each rural building, so as to highlight any transition that can have negative repercussions on some important habitats for the biodiversity such as, for example, the loss in grasslands (Eriksson and Cousins, 2014; Hallen and Bender, 2018). To this aim, it has been decided to carry out this spatial analysis only on some rural buildings which are located in the neighbouring or even within a protected natural area, due to the critical ecological role that these buildings could have for the protection of some natural habitats. On the basis of the analysis of the information levels that compose the GIS-based model realized in the first phase, the analysis has been restricted to the Regional-Natural Archaeological Park of the Rupestrian Churches of Matera (EUAP0419), which has been selected because it is the area of the Basilicata region around which it is concentrated the higher number of rural buildings.

Considering a 1-km-radius buffer zone around each rural building (309,02 ha), the land cover changes during 1990-2000, 2000-2006 and 2006-2012 have been detected. To enable a more detailed analysis, proposing at the same time a methodology that can be replicated to the entire rural heritage as well, a specific rural building has been identified, for which the dynamics of change between the different land use classes have been analyzed. The datasets used are those provided by the free Network of the National Environmental Information System (SinaNET – ISPRA).

The second analysis involved an inter-visibility assessment of rural buildings (Hernández et al., 2004). These buildings, as well as being an important safeguard for the ecological protection of the rural landscape, have also an important historical and cultural value, for which there is a need to preserve simultaneously the farm building and the surrounding rural landscape. Through the *"Viewshed Analysis"* QGIS plugin, it is possible to calculate the visible surface from a given observation point to a digital elevation model. With this type of analysis, it is possible to evaluate the visual quality of the landscape (La Rosa, 2011), then exploit it for planning purposes, such as the identification of some negative visual impact assessment that new constructions and land use transformations can have on the surrounding landscape. The plugin, based on a raster of the digital model of the surface (with a resolution of 5 meters, and freely available on the cartographic portal of the Basilicata region) and the position of the viewpoint on panoramic roads close to rural buildings, returns a cumulative integer raster grid in which each cell stores the number of visible viewpoints. To limit the survey region, an area of influence of 1-km-radius around the building has been considered even in this second application. This methodology can be useful for tourism purposes as well to enhance points of panoramic view from which to appreciate the rural landscape as a whole.

RESULTS AND DISCUSSION

From the first spatial analysis (Table 1) it emerged that in the first period (1990 - 2000) there have been no important changes in terms of surface. In fact, only around the "*Masseria Monacelle*" there has been a change in land use of about 24 ha (8% of the buffer area). The following period (2000 - 2006) is that one in which the greatest changes have occurred. In each one of the buffer areas of each farm, a percentage of change has been recorded, with even 50% of changes in the case of "*Masseria San Francesco*". In the last period (2006 - 2012) a reduction in the area subject to change has been registered, with a maximum value of 28% (in the case of "*Masseria Monacelle*"). This methodology, which in this study has been applied at a small scale, can reveal useful to identify how the landscape around the farms has been transformed, mainly identifying those farms playing an important ecological role within the rural landscape.

Moreover, with the construction of a geo-database including rural buildings, it is possible to carry out some geospatial surveys, from simple mapping to geo-statistical surveys and cross tabulation (McKenzie et al., 2011; Statuto et al., 2018). For example, it is possible to identify the rural building around which there have been more land use dynamics, to be linked to an area with high naturalistic value. A preliminary analysis is shown in table 2, in the case of "*Masseria San Francesco*". Here, after having identified the rural building showing the highest level of variations, the relevant changes in land use classes, which could have characteristics related to semi-natural grassland habitats, have been assessed (Figure 3).

It can be noted that an increase, in the period 2000-2006, of natural grasslands (50 ha) that potentially (excluding 2 ha that in the period 2006-2012 were converted into cultivated areas), could turn into habitats of interest (*code 6210*) and then be monitored accordingly.

Table 1 Surfaces (in percentage and hectares) that changed with respect to the buffer analysis in the three analysis periods

Name of the Rural Building	Changes 1990-2000		Changes 2000-2006		Changes 2006-2012	
	ha	%	ha	%	ha	%
Masseria Parco dei Monaci	0.00	0.00	24.78	8.05	0.00	0.00
Masseria Malvezzi	0.00	0.00	37.01	11.98	26.70	8.64
Masseria Monacelle	24.80	8.03	42.72	13.82	87.18	28.21
Masseria S. Francesco	0.42	0.14	154.27	49.92	3.00	0.97
Masseria Selva Malvezzi	0.00	0.00	24.98	8.08	39.89	12.91
Masseria Torre Spagnola	0.00	0.00	35.44	11.47	23.09	7.47

Table 2 Changes in land use classes (in hectares) for the three-time period of analysis in the area close to "*Masseria San Francesco*"

Changes in land use classes	Masseria San Francesco		
	1990 - 2000	2000 - 2006	2006 - 2012
Annual crops with permanent crops to Non-irrigated arable land	18.37		
Non-irrigated arable land to Complex cultivation patterns		11.87	
Industrial or commercial units to Complex cultivation patterns		0.42	
Olive groves to Natural grasslands		52.45	
Annual crops with permanent crops to Complex cultivation patterns		27.06	
Complex cultivation patterns to Discontinuous urban fabric		20.26	
Annual crops with permanent crops to Olive groves		31.29	
Natural grasslands to Complex cultivation patterns			2.76
Complex cultivation patterns to Olive groves			0.24

The second application which has been here performed, has concerned a viewshed analysis related only to two neighboring rural buildings: *"Masseria Serra dell'Olmo"* and *"Borgo Rurale Piano del Conte"*. These two historical rural buildings have been chosen since they are located close to an area with an high landscape value, at the same time affected by some re-development actions. This operation has been done starting from the information collected in the geodatabase: geolocalization of the rural buildings; digitalization of panoramic roads; and implementation of the digital surface model (DSM) of elevation.

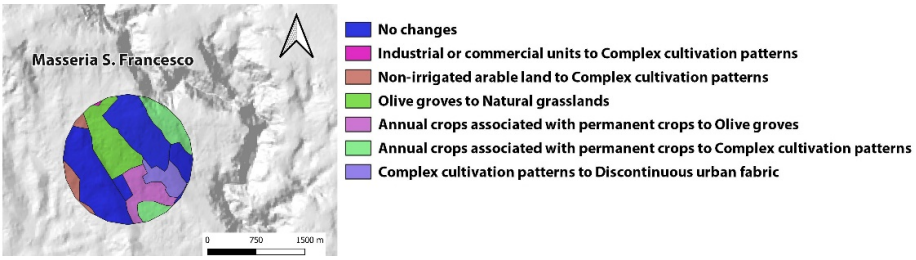

Figure 3 Land use changes in case of the "*Masseria San Francesco"* (year 2000-2006)

From the mapping of the cells visible from the panoramic roads (Figure 4), it is possible to calculate the percentage of visible surface in the reference area buffers (470.17 ha). Specifically, from the results of the analysis reported in Table 3, it is noted that almost 30% of the area is not visible from the roads (percentage less than 1.5%) and that about 72 ha are visible from 25-50% of the study area. Moreover, when considering the area close to the rural buildings in relation to the planning needs (as an example, a buffer 100-meters-radius and about 3 ha was taken), it is possible to make an even more detailed analysis. Table 4 shows indeed that almost 80% of the area surrounding the rural building "*Masseria Serra dell'Olmo*" is visible from 10 to 50% of the scenic roads. Instead, for the other considered farm (*Borgo Rurale Piano del Conte*), most of the surrounding area is not visible from the panoramic roads. In this way, it is possible to contextualise the rural building within the landscape, then evaluating its potential in terms of increase/decrease of the visual quality of the rural landscape and therefore, during the relevant planning activities, regulate any constructions or changes in land use that could affect its aesthetic value.

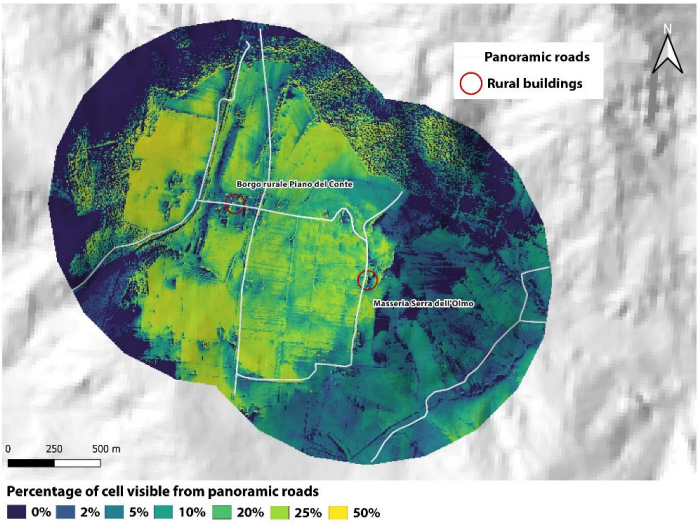

Figure 4 Viewshed analysis performed in the buffer area of rural buildings "*Masseria Serra dell'Olmo*" and "*Borgo Rurale Piano del Conte*".

Table 3 Surface modification inside 1-km-buffer (in hectares and %) of different percentage class of cell visible from panoramic roads.

Percentage of cell visible from panoramic roads (%)	Surface	
	ha	%
< 1.5	140.47	29.88
1.5 - 5	62.49	13.29
5 - 10	72.03	15.32
10 - 20	77.72	16.53
20 - 25	45.11	9.59
25 - 50	72.35	15.39
Total	470.17	100

Table 4 Surface variation inside the 100 metres buffer (in hectares and %) of different percentage class of cell visible from panoramic roads for "*Masseria Serra dell'Olmo*" e "*Borgo Rurale Piano del Conte*".

Percentage of cell visible from panoramic roads (%)	Masseria Serra dell' Olmo Surface		Borgo Rurale Piano del Conte Surface	
	ha	%	ha	%
< 1.5	0.22	7.12	0.51	16.59
1.5 - 5	0.17	5.42	0.72	23.14
5 - 10	0.30	9.71	0.77	24.84
10 - 20	1.35	43.69	0.79	25.65
20 - 25	0.66	21.20	0.15	4.69
25 - 50	0.40	12.86	0.16	5.10
Total	3.09	100.00	3.09	100.00

CONCLUSIONS

Farm buildings play a central role for improving the sustainable growth of agriculture, even through new alternative ways for living the extra-urban land, as the rural tourism. The role of rural building is indeed fundamental for enabling practices aimed to reduce resources consumption, combat environmental degradation and create better living environments, preserving at the same time architectural and historical assets that constitute a living witness of the building heritage left by our forefathers, who marked the rural territories, influencing and steering the spontaneous development of nature, while leading to production that enabled to get food.

In this study, an approach based on geographic technologies has been proposed, in order to implement new methodologies useful for the enhancement and conservation of agricultural built heritage and rural landscape. The implementation of a GIS for cataloguing historical rural buildings with geo-referenced information and subsequently using them as a basis for

more complex spatial analysis, has allowed the assessment of the role and impact of these buildings within the surrounding context. This approach would reveal a suitable tool for future possible application in rural landscape analysis, planning and management.

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