

Article

Use of GIS to Evaluate Minor Rural Buildings Distribution Compared to the Communication Routes in a Part of the Apulian Territory (Southern Italy)

Marco Parlavecchia, Simone Pascuzzi , Alexandros Sotirios Anifantis , Francesco Santoro 
and Giuseppe Ruggiero *

Dipartimento di Scienze Agro Ambientali e Territoriali, Università degli Studi di Bari Aldo Moro,
70122 Bari, Italy

* Correspondence: giuseppe.ruggiero@uniba.it; Tel.: +39-080-544-2960

Received: 3 June 2019; Accepted: 26 August 2019; Published: 29 August 2019



Abstract: The aim of this paper is to analyze the relationship between minor rural buildings and the most relevant communication routes of the regional area made up of six municipalities which, until 2016, formed the Local Action Group Sud Est Barese (LAG SEB): Acquaviva delle Fonti, Casamassima, Conversano, Mola di Bari, and Noicattaro e Rutigliano (Apulia, Italy). Information on the territorial distribution and typological classification of buildings was obtained by the official cartography of Military Geographic Institute (IGM, 1:25,000) and the Regional Technical Map (CTR, 1:5000) using the Geographic Information System (GIS) software ArcMap ArcGis 10.1. IGM cartography was chosen due to the greater amount of information pertaining to typological classification as well as to toponymy identification. CTR cartography, used as a second cartographic source, has been useful for acquiring more up-to-date territorial information compared to the IGM, in particular concerning the infrastructures of the territory. Moreover, the use of the CTR has allowed us to verify whether buildings listed on IGM cartography still exist. The cartographic calculations have allowed us to investigate possible relationships between the typology and distribution of rural buildings and the network of public roads and urban centers. The study of the connection between building types, roads and urban centers has allowed us to better understand the spatial distribution criteria, thus acquiring useful information to outline intervention policies, the implementation of which would be used to attempt to recover and improve building structures.

Keywords: historical rural buildings; GIS; territory; Apulia; Italy

1. Introduction

As recent development policies seem to attest, Europeans believe in a close relationship between rural construction and the surrounding landscape [1,2]. The existing landscape and rural buildings are representative of places, cultures and identities. A strong relationship is recognized between historical rural buildings and the territorial context [3–6]. Considering today's changed territorial situation, it is necessary to promote a respectful refurbishment of the buildings in order to safeguard and preserve the territory and its heritage for generations to come [7–10].

Apulia is one of the Italian regions with the richest and most varied rural building heritage. However, these buildings have not been taken care of adequately; in some extreme cases, they have been destroyed. Therefore, it is essential to implement policies to safeguard and enhance this heritage, which require the preliminary knowledge of the essential characteristics of historical rural buildings and of the changed territory that encompasses them. These possible intervention policies cannot be limited to the architectural and historical value of a building, as they also need to appreciate its impact on landscapes [3,11].

The widespread Apulian rural heritage is characterized by different types of buildings with various functions, such as masserie (farmhouses), casini (houses with residential and productive function), ville (seasonal residential houses), trulli (dry stone conic dwellings), lamie (dry stone storage buildings), towers, castles, and building structures where activities, professions and manifestations of productive, social and spiritual life took place, such as mills, millstones, iazzi (sheep pens), posts, chapels, and in general, the most varied testimonies of the “minor” cultural heritage. Every building type is characterized by structural and functional specificity, except for masserie, where the structural complexity guaranteed the performance of diversified functions.

Most research regarding Apulian historical rural buildings have primarily focused on masserie (farmhouses) [12,13], due to their greater potential for recovery and re-use and their greater diffusion in the territory. However, minor rural architecture has always been ignored despite their extension and typological differentiation. Smaller buildings, much more often, tend to be neglected or reused in ways that are not in line with the characteristics of the buildings and the territorial context that encloses them. This common oversight often causes said buildings to be demolished while still being identified on official cartography (IGM). Hence, greater attention must be paid towards their preservation.

Recent research has aimed at identifying minor rural architecture in the changed territorial contexts, essential for land planning protection and redevelopment interventions [2,13–16].

In the past, some researchers studied the relationship between rural buildings and historical communication routes, such as Appia road or Trajan Road. However, nowadays, too little has remained of those roads network [17,18].

Instead, the relationship between historic rural construction and current viability has not yet been addressed by research despite the important role of road infrastructures in the configuration of new functional attributions to existing buildings.

The Italian policy concerning the protection of rural building heritage started with the law passed on 1 June 1939, no. 1089 “Tutela delle cose d’interesse Artistico o Storico” (Protection of things of artistic or historical interest) which, though enacted for historical, artistic and archaeological movable and immovable properties, is concerned with some traditional historical rural buildings [19].

After a long period of legislative stasis, a series of regulations were promulgated between 2003 and 2008 with the aim of financing regional plans for the protection and enhancement of rural architecture. The law passed on 24 December 2003 no. 378 “Disposizioni per la tutela e la valorizzazione dell’architettura rurale” (Provisions for the protection and enhancement of rural architecture) [20] and the consequent Decree of 6 October 2005 of the Ministry for Cultural Heritage and Activities outlined the types of rural architecture dating between 1200 and 1800, the works eligible for contribution, the technical specifications for the interventions on buildings and surrounding areas as well as the characterization of traditional crops [21]. The contents of the two laws were subsequently recalled by the Directive of 30 October 2008 of the Ministry for Cultural Heritage and Activities “Interventi in materia di tutela e la valorizzazione dell’architettura rurale” (Interventions on the protection and enhancement of rural architecture) [22]. However, the national regulatory framework mentioned above did not have any major impacts, so much so that even today many regions have not implemented any sector plans.

Meanwhile, the Legislative Decree passed on 22 January 2004 no. 42 “Code of cultural heritage and landscape” transposes the contents of the European Landscape Convention promoting the protection and enhancement of “the rural architectures with historical and ethno-anthropological interests as evidence of the traditional economy” [23–25].

The European Union’s rural development policies consider the preservation of the vernacular buildings as a priority goal [7,24]. In recent decades, Local Action Groups (LAGs) coordinated local planning within the EU initiative named Liaison Entre Actions de Développement de l’Économie Rurale (LEADER). This initiative promotes, through the activities of the LAGs, the sustainable development of rural areas in the EU, particularly in the agriculture, environment, rural tourism and handicrafts sectors.

The importance of historical rural buildings has also been acknowledged by a regional territorial planning policy through the Regional Territorial Landscape Plan (PPTR) (resolution no. 176 of 2015) which includes guidelines for the recovery, maintenance and reuse of constructions and rural assets as well as guidelines for the protection, restoration and interventions on dry stone buildings and manufactures [25].

The use of Geographic Information System (GIS) plays an important role in the digitization of basic maps that can be used to implement development plans aimed at the analysis and conservation of rural buildings [26]. GIS technology can be useful to obtain distributional and typological data of rural buildings. Some scholars suggested that the application of GIS can help correlate historical and geographical data to the analysis of rural heritage [3,11,26]. Moreover, through the overlapping of layers in ArcMap software, it is possible to obtain data relating to the relationship that links the various territorial components.

Each protection and requalification action requires the identification of the buildings and knowledge of the intimate relationship between them and the territory. Apulian rural constructions are varied, depending on the area and the agro-zootechnical sector to which they belong, and on the materials which were used to build them. Often, the original location of each building was related to the intended use or, sometimes and for some construction types, to the need for a seasonal dwelling.

This study focuses on the analysis of the relationship between rural buildings and the most relevant communication routes and urban centers within the area which, from 2010 to 2016, formed the Local Action Group Sud Est Barese (LAG SEB), located in the southeast area of the Province of Bari (Apulia, Italy), considering the historical and cultural value of the rural heritage spread throughout it.

2. Materials and Methods

2.1. Materials

Cartography and Software

Three cartographic sources were used:

- Military Geographic Institute cartography (IGM), including maps at a scale ratio of 1:25,000;
- Regional Technical Map (CTR), including maps at a scale ratio of 1:5000 (Territorial Informative System SIT Puglia);
- Digital orthophoto, at a scale ratio of 1:5000 (Territorial Informative System SIT Puglia) [27].

The official Cartography of the Military Geographic Institute (processed between 1947 and 1958) was considered valid to identify the traditional rural constructions on the regional territory, due to the information contained in it, in terms of both the typological classification and toponymical identification of the buildings.

In order to exclude from the analysis the buildings that have disappeared, the Regional Technique Map (CTR, scale ratio 1:5000), processed by photointerpretation in 2006 and updated in 2011, was used. This cartographic source is the richest in information and data about urban centers and communication routes of Apulian territory.

Finally, to validate the results of the cartographic comparison, we used the digital orthophoto with a ground resolution of 50 cm pixel elaborated in 2006.

Cartographic processing and data manipulation were carried out using GIS software (ArcMap ArcGis 10.1, (Environmental Systems Research Institute, Inc. (ESRI), Redlands, CA, USA).

2.2. Methods

2.2.1. Description of the Study Area

The study area is shown in Figure 1. The extension of the considered territory is ≈ 479 km². Almost all of it is part of the landscape area called Puglia Centrale in the Regional Territorial Landscape

Plan (PPTR), except for two small portions of the territory of Acquaviva delle Fonti and Casamassima, which are located in the PPTR areas Alta Murgia and Murgia dei Trulli, respectively.

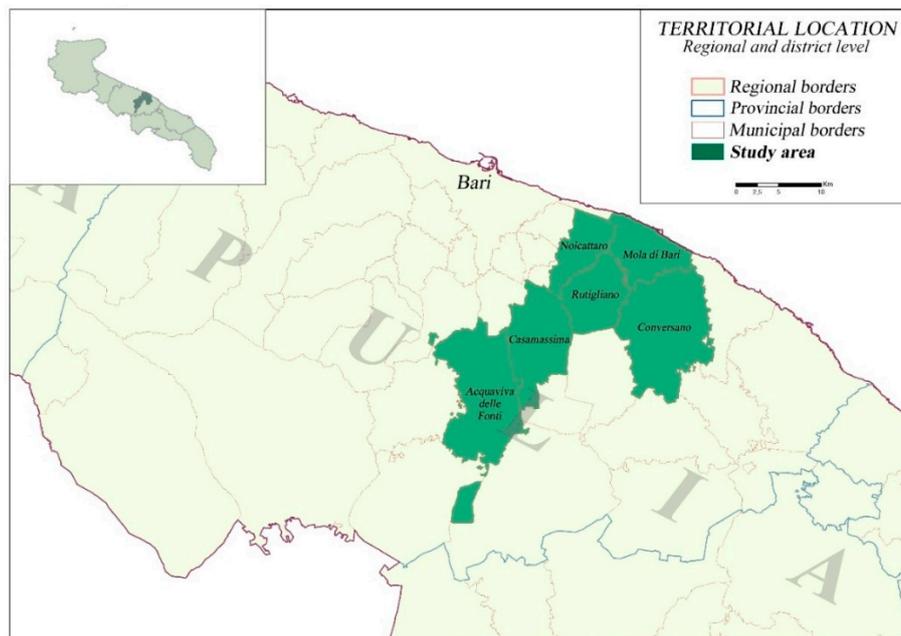


Figure 1. Territorial location of the study area at a regional and district level.

Geologically, the area typically consists of limestone and dolomitic rocks and is characterized by the presence of ravines, archaeological sites and caves. The ravines are generally micro-environments that are very favorable to anthropization, due to the presence of water, particularly fertile soils, a temperate microclimate and because they constitute natural communication routes. The Lama Giotta is the most southern erosive furrow among those that leave from the Murgia and flow towards Bari, passing through the territory of Noicattaro, after having crossed the area of the municipalities of Turi and Rutigliano, in turn crossed by the Lama di Mosca (initial stretch of the Lama Giotta), north of the town, and Lama dell'Annunziata, south of it. The two landslides are the only relict areas of the original natural landscape.

The study area includes a protected area of approximately 480 hectares including Sites of Community Importance (SCIs), Special Protection Areas (SPAs) and protected areas, amounting to over 1%, which are part of the Municipalities of Acquaviva delle Fonti and Conversano. Furthermore, there is an appreciable woodland heritage consisting of the “*Macchia di Marcedd*”, which extends for approximately 10 ha in the territory of Casamassima [28].

Hot summers and mild winters, with little rainfall concentrated in cold seasons, define a Mediterranean climate. There are big temperature variations between summer and winter [29].

From the socio-economical point of view, the agricultural sector has always been the engine of the local economy. In particular, some specific productions are very important, such as the production of wine, table grapes, olive oil, cherries, and vegetables. Agricultural and zootechnical activities have, therefore, molded the landscape and originated a rich rural heritage. There are approximately 10,000 workers in the primary sector, accounting for over 15% of the population employed in the area and over 25% of those employed in the primary sector of the entire metropolitan area of Bari. Employment in agriculture has enormous importance throughout the district, with important peaks in the territories of Noicattaro and Rutigliano, where over 10% of the resident population is employed in the sector in question. The Utilized Agricultural Area (UAA) is approximately 10% of the entire metropolitan area of Bari.

The local development strategy 2014–2020 of the LAG Sud Est Barese aims at making the territory more competitive and attractive through the consolidation of agro-food and fish supply chains,

the enhancement of environmental resources and the development of sustainable tourism. The two priority themes of the strategy are *sustainable tourism* and the development and *innovation of supply chains and production systems* [28].

In a context of sustainable territorial development, rural building heritage is considered an indispensable support for re-qualification activities.

2.2.2. Minor Rural Buildings in the Study Area

For centuries, the dry stone was the only real construction method for rural buildings, especially for the settlement elements belonging to the minor rural architecture spread throughout the regional territory. Traditionally, it is thought that a building may be attributed a historical character if it was created before the beginning of the Second World War [13].

As a methodological reference basis for typological identification, we can refer to the main building types of the Apulian territory, as defined by IGM cartography and identified by us in a previous study. Among these, we can distinguish dwellings such as villas, casini, towers, trulli, castles, lamie, etc., and operational structures such as iazzi (sheep pens), posts, frantoi (olive mills), palmenti (grape mills), etc. [13] Some examples of different buildings are shown in Figure 2.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 2. Examples of rural minor buildings in the study area: casino (a), tower (b), lamia (c), trullo (d), iazzo within a stable complex (sheep pen) (e), and palmento (grape mill) (f).

In the examined territory, the rural architecture includes some of the above-mentioned buildings, different from a typological, dimensional and functional point of view.

Houses and villas, identified by the IGM, are buildings with a residential function. The houses include different construction types that partly coincide with the others considered (*masseria*, *casino*, *villa*, etc.) and partly correspond to more recently built rural constructions. They are a building typology very similar to *casini* as they both represented seasonal residences for upper middle-class families at the turn of the 20th century. Compared to *casini*, they are larger and have valuable architectural features that symbolized greater socio-economic well-being. They were normally used for summer holidays and located in healthy areas of landscape value (hills, sea, etc.).

Casini are buildings dating back to XVIII and XIX centuries. They were intended for residential purposes for the families of wealthy landowners who used them only at certain times of the year, generally between late spring and early autumn or at the time of harvest. *Casini* are quadrangular based dwellings, structured on one or two floors. Sometimes, over time, they assumed more complex conformations due to the progressive aggregation of additional volumes with ancillary functions to the primary housing type. In this hypothesis, the structure evolved to the *masseria* model. A particular type of noble residence was the castle, in which the building and architectural characteristics of the *casinos* and *villas* were exalted, able to indicate the social and economic power of the owner family.

Towers are dwellings connected to the typical Apulian tree crops, used by peasant families in periods of cultivation activities (harvesting, pruning, etc.). In less evolved forms, they consist of a room on the ground floor (single-celled dwelling) with an almost cubic conformation, with a base side of approximately 5 m. The most complex towers have a square base, more rarely circular, and are developed on two or three floors, reaching heights of over 10 m. Multi-storey towers were also usually used for territorial surveillance purposes.

Casette (little houses) are stone buildings, used mainly as temporary dwellings, which can be included in the rather broad category of *trullo* constructions. The most basic typology was a rectangular plan with a barrel vault, consisting of a single compartment. The *casetta* lent itself to aggregative solutions in which several units were merged into a single complex that was typically used as a permanent residence.

Lamie are instrumental constructions, used as rooms for the storage and first handling of products, storage of equipment, as well as shelter and temporary beds for workers and working cattle. Inside, there is always a fireplace and animal feeders. If the dimensions are higher or lower than those of the *lamias*, the structures are called *lamioni* and *lamiede* respectively.

Iazzi represented sheep breeding structures permanently associated with a farmhouse, of which they were an integral part and from which they were easily reachable. They were located on hilly slopes facing south, south-east, sheltering flocks from the cold winds of the northern quadrants. The position of the complex, lying on the ground, following its natural slope, guaranteed the removal of manure. The slopes also ensured the runoff of rainwater and a good degree of ventilation, avoiding harmful water stagnation for the health of the animals.

Frantoi (*olive mills*) were often hypogean or semihypogean structures associated with olive growing and production.

2.2.3. Communication Routes Network

The area is characterized by comfortable infrastructure, road and railway. In the study area, the communication routes network is actually mostly made up of provincial roads (country roads) and state roads (trunk roads). In particular, the road infrastructures are based on three provincial roads (S.P. 240, 75, 65), two state roads (S.S. 16 and 100) and one highway (A14) [28]. The highway A14 that connects Bologna to Taranto, goes through the Acquaviva delle Fonti territory. The communication routes network is integrated by a dense system of rural roads.

In this study, we took state and provincial roads into consideration. In fact, they represent the main system which meets the needs of those who would use them to reach minor rural buildings.

2.2.4. Study Phases

Preliminarily, historical rural constructions were identified using IGM cartography, with a reduction ratio of 1:25,000, geo-referencing the buildings named, using GIS software (ArcMap ArcGis 10.1) (Figure 3).

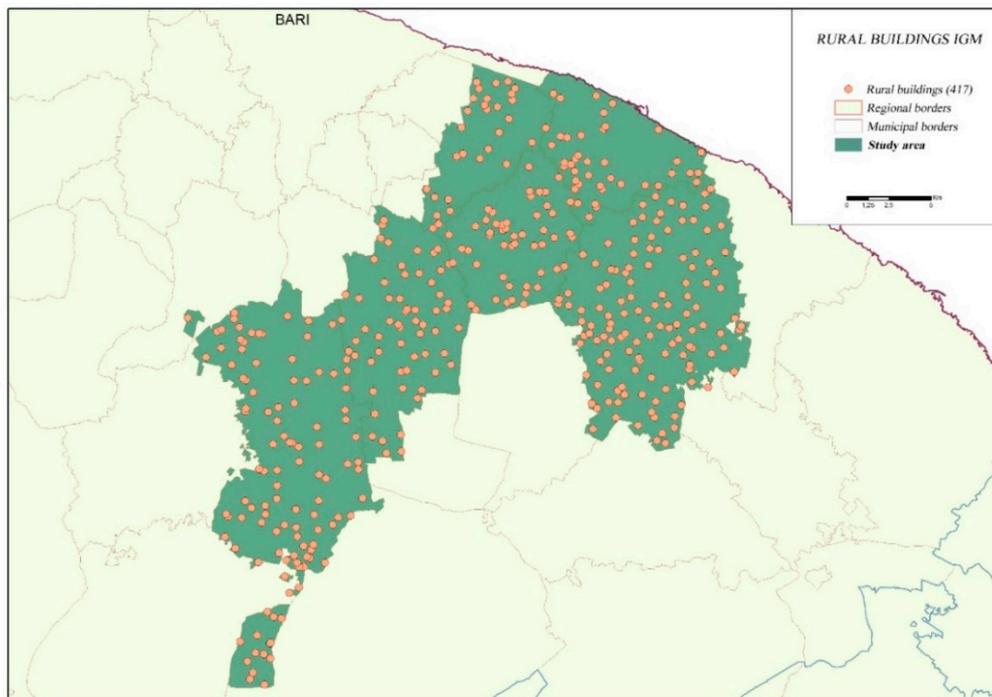


Figure 3. Historical rural buildings in the study area named by Military Geographic Institute Map (IGM).

The masserie (farmhouses) were excluded subsequently from the study so that only minor buildings were considered (Figure 4).

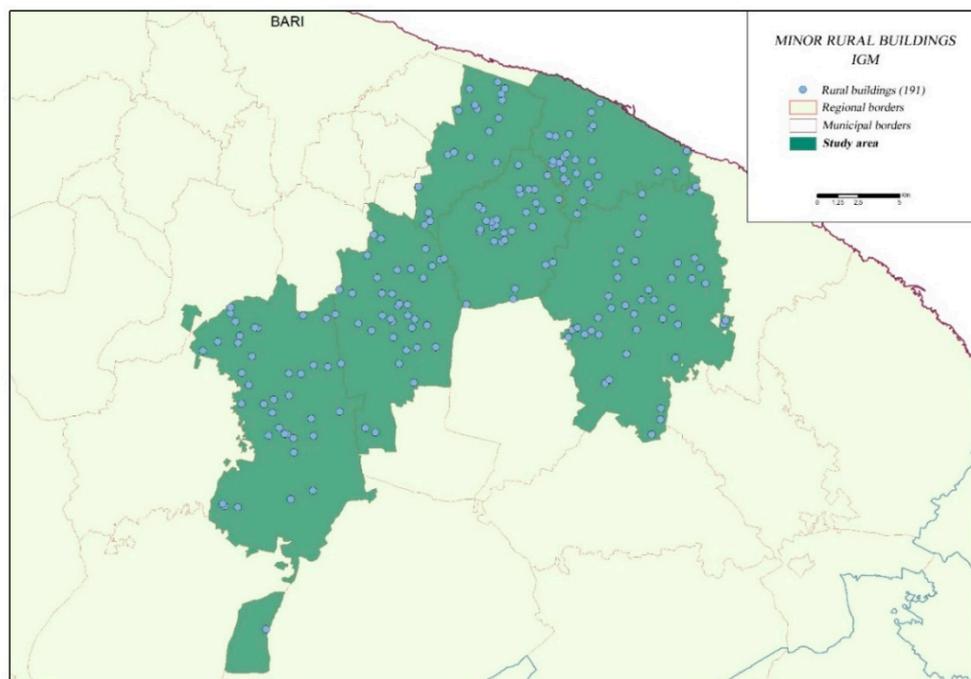


Figure 4. Historical minor rural buildings in the study area named by IGM.

Then, CTR cartography was used in order to remove from the analysis buildings that disappeared (Figure 5). The selected buildings were then grouped by type.

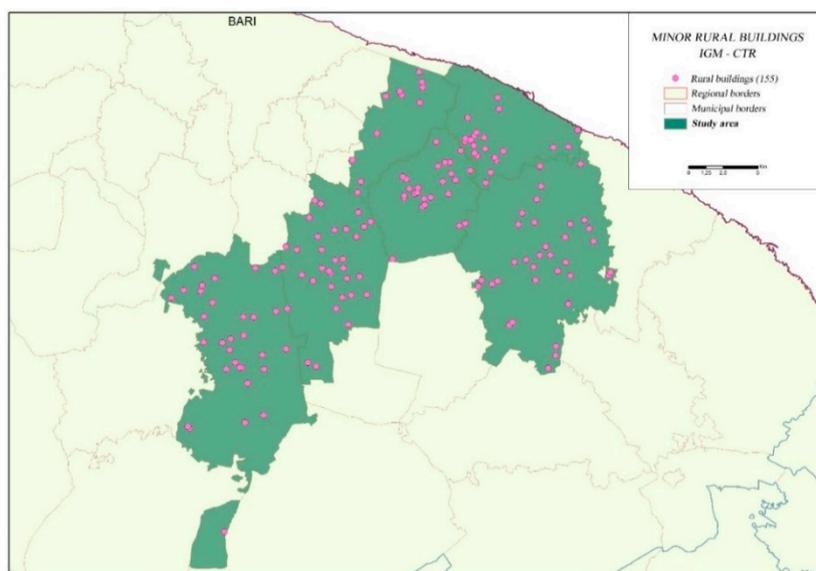


Figure 5. Historical minor rural buildings in the study area, individuated from overlapping the IGM Map and the Regional Technical Map (CTR).

Reading the digital orthophoto has allowed us to confirm the disappearance of the missing buildings in the CTR cartography.

To observe the connection between the typological distribution and the communication routes and urban centers, we proceeded to extract from the CTR an information layer composed of the different categories of roads and the urban centers identified (features) using GIS software. Subsequently, by overlapping the data extracted from the IGM 1: 25,000 and from the CTR 1:5000 the reference map for the study was obtained.

Finally, through a deep re-reading of the obtained map, it was possible to carry out an evaluation of the relationship between rural buildings and the road network and urban centers.

3. Results

We identified eight of the most recurrent constructive typologies in the regional territorial ambit (see Table 1), as shown in Table 2.

Table 1. Main types of historical rural constructions in the Apulian regional territory according to Military Geographic Institute (IGM) cartography.

Dwellings	Operation, Storage and Transformation Buildings
1. Masserie (farmhouses)	9. Iazzi and Poste (sheep pens and posts)
2. Casini	10. Ovili (sheep stables)
3. Ville (villas)	11. Stalle (stables)
4. Torri (towers)	12. Colombaie (dovecotes)
5. Trulli	13. Porcilaie (pigsties)
6. Pagliari	14. Frantoi (olive mills)
7. Lamie	15. Palmenti e cantine (grape mills and cellars)
8. Other dwellings	16. Molini (mills)
	17. Nevieri (icehouses)
	18. Other buildings used for operations, preservation and transformation

Source: Ruggiero et al. (2019) [13].

Table 2. Main types of historical minor rural buildings in the study area.

Dwellings	Operation, Storage and Transformation Buildings
1. Casini	
2. Case e ville (houses and villas)	
3. Torri (towers)	7. Iazzi (sheep pens)
4. Lamie	8. Frantoi (olive mills)
5. Casette (little houses)	
6. Castle	

Another result highlights the numerical importance of minor structures. Out of a total of 417 registered buildings, 191 (about 49%) are attributable to minor architectural categories.

From the overlapping of the IGM data to those derived from the CTR, it was also verified that as many as 36 constructions disappeared (18.85%), confirming the presence of 155 constructions as shown in Table 3.

Table 3. Number and types of minor rural buildings in the study area.

Type	Mola di Bari	Conversano	Acquaviva delle Fonti	Casamassima	Noicattaro	Rutigliano	Total	Total %
Case e ville	16 (20)	13 (15)	7 (8)	9 (10)	7 (11)	16 (19)	68 (83)	43.87
Casini	4 (4)	10 (12)	20 (22)	16 (19)	3 (5)	5 (7)	58 (69)	37.42
Torri	1 (2)	8 (12)	- (3)	-	1 (2)	2 (2)	12 (21)	7.74
Lamie e lamioni	-	1 (1)	5 (6)	4 (4)	-	-	10 (11)	6.45
Iazzi	-	1 (1)	-	2 (2)	-	1 (1)	4 (4)	2.58
Casette	-	1 (1)	-	-	-	-	1 (1)	0.65
Castelli	-	1 (1)	-	-	-	-	1 (1)	0.65
Frantoi	-	-	-	1 (1)	-	-	1 (1)	0.65
Total	21 (26)	35 (43)	32 (39)	32 (36)	11 (18)	24 (29)	155 (191)	81.15

The values in round brackets refer to the buildings on the IGM 1:25,000 before the overlapping process with the CTR map 1:5000.

The reading of the digital orthophoto has confirmed the absence of buildings in the CTR cartography.

It was found that the municipal territory of Conversano has the highest presence of minor buildings: 35 buildings, equal to 22.6% of the total. Both in the countryside of Acquaviva delle Fonti and in that of Casamassima, there are 32 buildings (20.6%). The remaining 36.2% is distributed among the municipalities of Mola di Bari with 21 buildings (13.5%), Rutigliano with 24 units (15.5%) and Noicattaro with 11 structures (7.1%).

Within the single municipal territories, the distribution of minor rural buildings is not homogeneous. It has been shown that in the municipalities of Acquaviva delle Fonti and Casamassima, buildings are spread evenly, while in the municipal areas of Conversano, Mola di Bari, Noicattaro and Rutigliano, the structures are concentrated in some areas (Figure 5).

Building density, assumed to be the ratio between the number of buildings surveyed and the surface of the study territory (buildings/sq km), was found to be quite low, as shown in Table 4.

Table 4. Density of minor rural buildings in the study area expressed in buildings/sq km.

Type	Mola di Bari	Conversano	Acquaviva delle Fonti	Casamassima	Noicattaro	Rutigliano	Total
Case e ville	0.314	0.102	0.053	0.115	0.172	0.230	0.142
Casini	0.078	0.079	0.150	0.204	0.074	0.094	0.121
Torri	0.020	0.063	-	-	0.025	0.037	0.025
Lamie e lamioni	-	0.008	0.038	0.051	-	-	0.021
Iazzi	-	0.008	-	0.026	-	0.019	0.008
Casette	-	0.008	-	-	-	-	0.002
Castelli	-	0.008	-	-	-	-	0.002
Frantoi	-	-	-	0.013	-	-	0.002
Total	0.412	0.276	0.240	0.408	0.270	0.450	0.324

In all the examined territories, the average density is equal to 0.32, which corresponds to 1 building every 3.12 km. Considering the individual municipalities, the density values vary between 0.24 (Acquaviva delle Fonti) and 0.45 (Rutigliano).

The GIS processing of territorial density data has allowed us to identify four value ranges, as shown in Figure 6, which confirm the previous assessments and, in particular, the presence of an internal core with a greater presence of minor rural buildings.

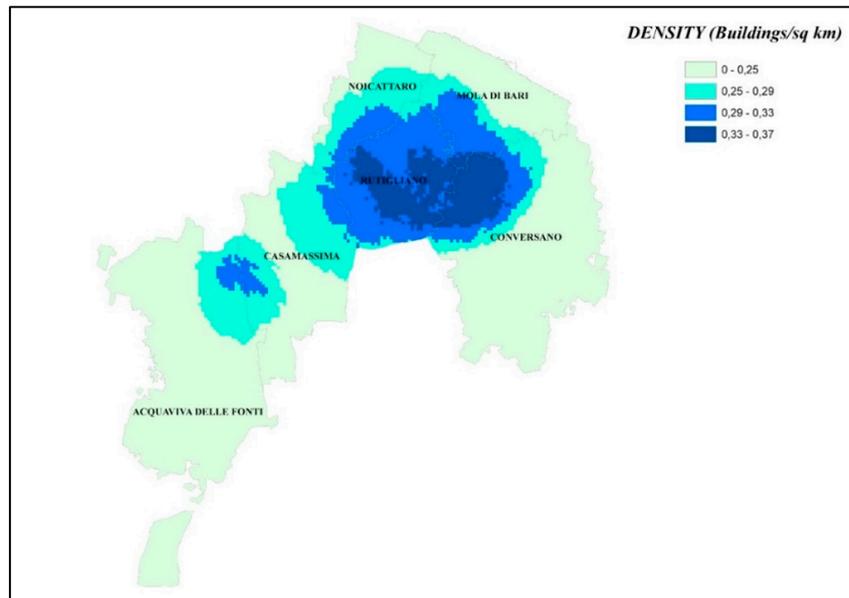


Figure 6. Density of minor rural buildings in the study area.

The study of the road network, extended 289 km, highlighted four density bands (Figure 7). Around the urban centers, the density varies between 3.34 and 4.45 roads km/sq km. Most of the territory is instead characterized by values lower than 1.11 roads km/sq km.

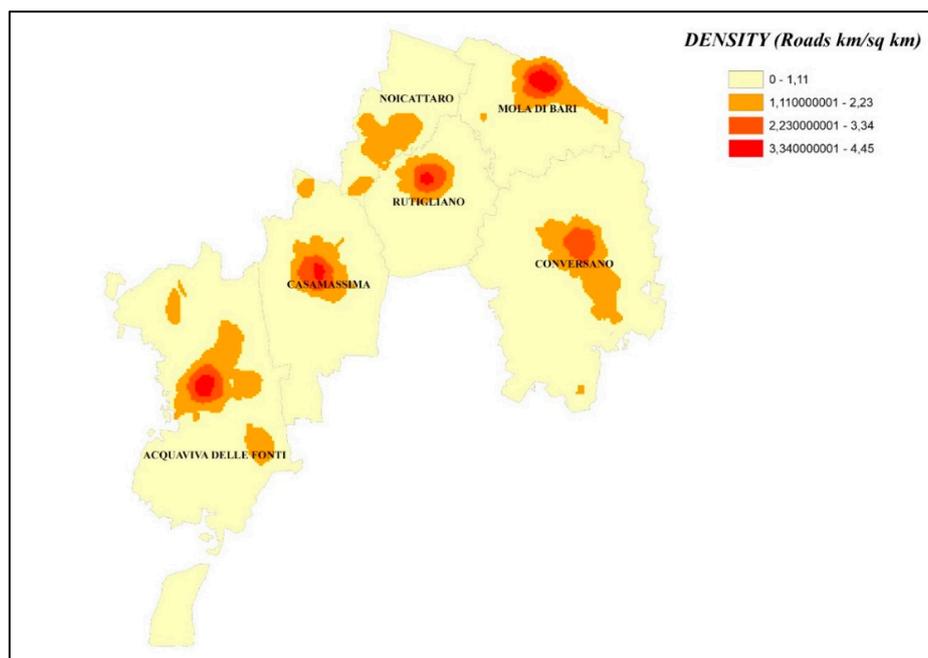


Figure 7. Density of main roads in the study area.

The spatial distribution of the constructions detected does not show a direct connection with the distance from urban centers. Numerically, 88.4% of the minor rural buildings are located within 5 km from the urban center to which they belong, as reported in Figure 8.

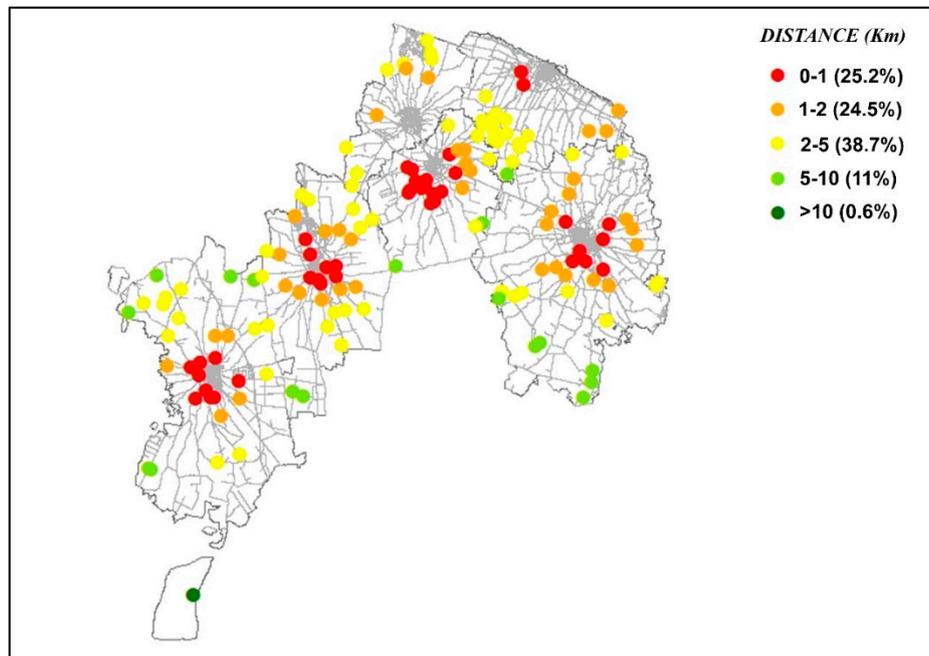


Figure 8. Distance of minor rural buildings from the urban centers.

Figure 9 shows the relationship between the most important communication routes in the examined area and the minor rural architecture. Most buildings are not far from the main roads. In fact, over 80% of them are located within a band of 1 km from the most significant communication routes (trunk roads and country roads).

Houses and ville are densified in hamlets, where they were historically used as seasonal residences for the summer, such as the zone of S. Maderno belonging to the municipality of Mola di Bari. Here, the buildings are served by a dense network of minor country roads that constitute a real residential zone in the countryside. Considering the entire study area, it is evident that the density of these construction types progressively increases approaching the urban centers and the main routes, whereas it decreases near the coast.

Casini, instead, are widespread throughout the territory but overwhelmingly in the proximity of country roads, far from urban centers—with the exception of the municipalities of Acquaviva and Casamassima, where the casini are evenly spread even close to the towns.

Towers are positioned along linear guidelines, to constitute integrated defense systems for the sighting and transmission of communications from the coast to the hinterland. This kind of communication was realized with acoustic, luminous or horse-relayed signals. For the municipality of Conversano, other towers, arranged in an arc, completed the defensive system towards the south.

Furthermore, in the area of Acquaviva delle Fonti located in the south-east, the relationship between the roads and the building structures is less evident. Here, there are several lamie, probably because of the prevalent production destination of the area, which is also very far from the urban center.

Iazzi (sheep pens) are another construction type mainly located in areas far from urban centers. This observation is supported by the intended use of the structures, which represented seasonal or temporary shelter for livestock.

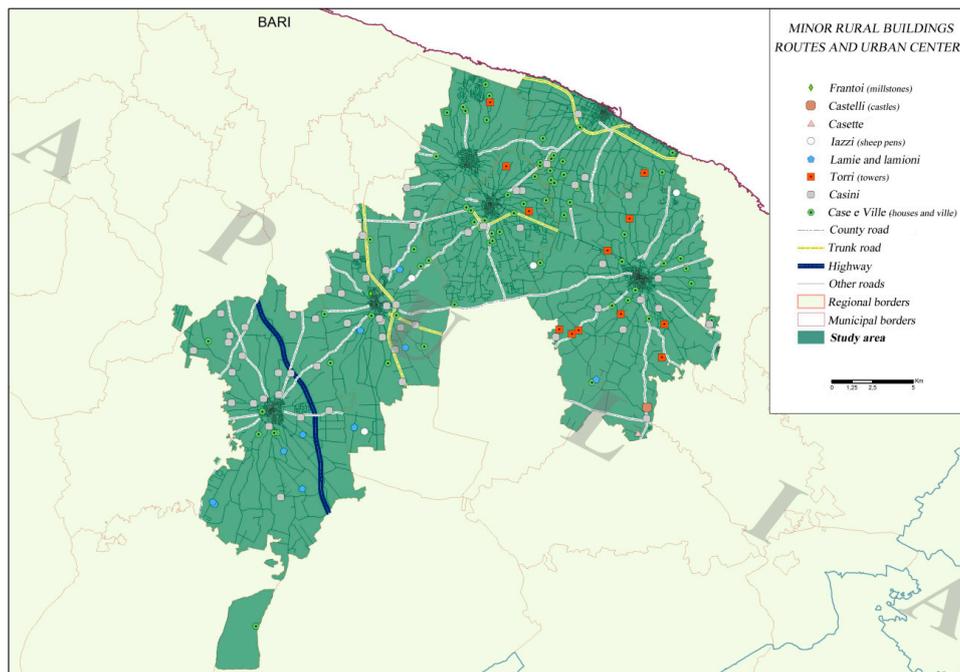


Figure 9. Minor rural buildings, routes and urban centers in the study area.

4. Discussion

The results obtained have confirmed the numerical importance and the typological variety of the Apulian historical minor rural heritage, as reported by Ruggiero et al. (2019) [13]. The limited number of typologies found (8), compared to the 18 types potentially present, is connected to an agricultural production system mainly oriented towards permanent tree crops (olive, almond, cherry, etc.) and to the scarce diffusion of animal husbandry. These productive orientations did not require the stable permanence of operators in the countryside. The processing plants (olive mills, cellars, etc.) were exclusively located in urban centers, according to Dal Sasso et al. [30].

The predominance of five building types, which together represent 98.06% of the heritage recorded, has preserved the deep connection between rural buildings and the territorial context. Indeed, temporary housing types prevail, which is an expression of a territory in which the tendency to permanently reside in the countryside is fundamentally absent. It is also easy to see that the lack of buildings related to livestock activity also highlights the poor significance of this production sector.

The overlapping of IGM and CTR cartographies data highlighted the numerical reduction of rural building heritage due to the disappearance of approximately 19% of minor historical buildings. What has been said confirms that since the 1950s, various economic, technological and political developments have caused a structural change in European rural areas, as Fuentes et al. reported in 2010 [2].

The low building density does not affect the numerical importance of the minor rural heritage. In fact, the low density is mainly due to the size of the considered area. However, the density values appear to be related to the territorial extension of the single municipalities with the exception of the territory of Noicattaro, where the density is roughly similar to the high surface areas (Acquaviva delle Fonti and Conversano). There are probably reasons linked to other components of the territory (for example land use, aptitude for urban residency, etc.) not examined in the present work, which could be taken into consideration in future investigations.

With regards to the main road density, the greatest values around urban centers are due to the convergence of the main roads towards the inhabited centers.

The presence of 88.4% of the buildings within 5 km of the urban centers, where the highest concentration of main roads was recorded, shows a correlation between roads, urban centers and rural buildings, which deserves future correlation analyses.

From the observation of the data, the location of minor buildings in the territory is not accidental: the houses and ville are clearly agglomerated in areas suited for seasonal summer residency. The casini are located in the proximity of country roads and far from the urban centers because they were used as a seasonal summer dwelling in touristic areas, or as a temporary residence during seasonal farm work. The towers are arranged to form an integrated defensive system, from the coast to the hinterland. Lamie and iazzi are inserted in purely productive contexts, more distant from urban centers. According to Dal Sasso and Caliandro (2010), a strong relationship exists between territorial development, the presence of these buildings, the land cover use, the crop productivity and the demographic historical changes. These characteristics explain the original agro-industrial use of the buildings and the new destination choices [30].

The proximity of the historic rural buildings to the main communication routes indicates high potential for functional recovery, especially if included in an integrated mobility system.

5. Conclusions

In order to pursue integrated objectives of rural landscape safeguard and enhancement, knowledge of the rural building heritage and the main territorial components becomes of crucial importance. The re-reading of the changed territorial context is necessary to evaluate the intimate relationship between architecture and landscape that has undergone profound changes over time.

GIS software can help with this kind of analysis to relate historical maps to current ones, updating the consistency of historical rural buildings in relation to the main territorial components. In this paper, in fact, by geolocating the historical buildings, typological distribution information was obtained and correlated to viability and urban centers through cartographic overlap.

It is to be hoped that this work may form the basis for further investigations aimed at the knowledge of the historical rural building heritage for the implementation of rural development policies and programs respectful of the rural building and landscape relationship.

Author Contributions: Conceptualization, S.P., A.S.A. and F.S.; Data curation, G.R.; Writing—original draft, M.P. The contributions to the article were equally offered by the authors.

Funding: This research received no external funding

Acknowledgments: This work was founded by the University of Bari Aldo Moro, Italy.

Conflicts of Interest: The authors declare no conflict of interest

References

1. Caruso, D.; Mirò, A.P. Rural tourism and sustainable rural development opportunities in Apulia region (Southern Italy). In Proceedings of the 9th International Scientific Conference “Business and Management 2016”, Vilnius, Lithuania, 12–13 May 2016; VGTU Press: Vilnius, Lithuania, 2016.
2. Fuentes, J.M.; Gallego, E.; García, A.I.; Ayuga, F. New uses for old traditional farm buildings: The case of the underground wine cellars in Spain. *Land Use Policy* **2010**, *27*, 738–748. [[CrossRef](#)]
3. Cano, M.; Garzón, E.; Sánchez-Soto, P.J. Historic preservation, GIS, & rural development: The case of Almería province, Spain. *Appl. Geogr.* **2013**, *42*, 34–47.
4. Del Lungo, S.; Sabia, C.A.; Pacella, C. Landscape and cultural heritage: Best practices for planning and local development: An example from Southern Italy. *Procd. Soc. Behv.* **2015**, *118*, 95–102. [[CrossRef](#)]
5. Picuno, P. Vernacular farm buildings in landscape planning: A typological analysis in a southern Italian region. *J. Agric. Eng.* **2012**, *XLIII*, e20. [[CrossRef](#)]
6. Torreggiani, D.; Tassinari, P. Landscape quality of farm buildings: The evolution of the design approach in Italy. *J. Cult. Herit.* **2011**, *13*, 59–68. [[CrossRef](#)]
7. Fuentes, J.M. Methodological bases for documenting and reusing vernacular farm architecture. *J. Cult. Herit.* **2009**, *11*, 119–129. [[CrossRef](#)]
8. Dower, M. An asset for local development: Heritage as a resource. *Lead. Mag.* **1998**, *17*, 7–13.
9. Van de Vaart, J.H.P. Towards a new rural landscape: Consequences of non-agricultural re-use of redundant farm buildings in Riesland. *Landsc. Urban Plan.* **2005**, *70*, 143–152. [[CrossRef](#)]

10. Amato, F.; Martellozzo, F.; Nolè, G.; Murgante, B. Preserving cultural heritage by supporting landscape planning with quantitative predictions of soil consumption. *J. Cult. Herit.* **2017**, *23*, 44–54. [[CrossRef](#)]
11. Ford, M.; El Kadi, H.; Watson, L. The Relevance of GIS in the Evaluation of Vernacular Architecture. *J. Archit. Conserv.* **1999**, *3*, 65–75. [[CrossRef](#)]
12. Ruggiero, G.; Sancilio, C. *Lettura del Territorio Attraverso un Modello di Catalogazione Della Masseria Pugliese*; Quadrifoglio: Bari, Italy, 1992.
13. Ruggiero, G.; Parlavecchia, M.; Dal Sasso, P. Typological characterization and territorial distribution of traditional rural buildings in the Apulian territory (Italy). *J. Cult. Herit.* **2019**. [[CrossRef](#)]
14. Ruggiero, G.; Dal Sasso, S.; Loisi, R.V.; Verdiani, G. Characteristics and distribution of trulli constructions into the site of community importance “Murgia of trulli”. *J. Agric. Eng.* **2013**, *XLIV*, 87–94. [[CrossRef](#)]
15. Picuno, C.; Laković, I.; Roubis, D.; Picuno, P.; Kapetanović, A. Analysis of the Characteristics of traditional rural constructions for animal corrals in the Adriatic-Ionian area. *Sustainability* **2017**, *9*, 1441. [[CrossRef](#)]
16. Mahayuddin, S.A.; Zaharuddin, W.A.Z.W.; Harun, S.N.; Ismail, B. Assessment of building tipology and construction method of traditional longhouse. *Procedia Eng.* **2017**, *180*, 1015–1023. [[CrossRef](#)]
17. Caliandro, L.P.; Loisi, R.V.; Dal Sasso, P. Historical road system and farmhouses in Apulia. *J. Agric. Eng.* **2013**, *XLIV*, 441–447. [[CrossRef](#)]
18. Caliandro, L.P.; Loisi, R.V.; Dal Sasso, P. Connections between masserie and historical roads system in Apulia. *J. Agric. Eng.* **2014**, *45*, 15–23. [[CrossRef](#)]
19. Legge 1 Giugno 1939 N. 1089, (Tutela Delle Cose D’Interesse Artistico o Storico). Available online: <http://www.convenzioneeuropeapeaesaggio.beniculturali.it/> (accessed on 3 June 2019).
20. Legge 24 Dicembre 2003 N. 378, (Disposizioni per la Tutela e la Valorizzazione Dell’Architettura Rurale). Available online: <https://www.gazzettaufficiale.it/> (accessed on 3 June 2019).
21. Decreto Ministeriale 6 Ottobre 2005, G.U. N. 238 del 12-10-2005, (Individuazione delle Diverse Tipologie di Architettura Rurale Presenti sul Territorio Nazionale e Definizione dei Criteri Tecnico-Scientifici per la Realizzazione degli Interventi, ai Sensi della Legge 24 Dicembre 2003, n°378, Recante Disposizioni per la Tutela e la Valorizzazione della Architettura Rurale). Available online: <https://www.gazzettaufficiale.it/> (accessed on 3 June 2019).
22. Direttiva del Ministro per i Beni e le Attività Culturali 30 Ottobre 2008, GU N. 286 6 Dicembre 2008, (Interventi in Materia di Tutela e Valorizzazione Dell’Architettura Rurale ai Sensi della Legge 24 Dicembre 2003, N. 378 e del Decreto Ministeriale 6 Ottobre 2005). Available online: <https://www.gazzettaufficiale.it/> (accessed on 3 June 2019).
23. Decreto Legislativo 22 Gennaio 2004 N. 42, (Codice dei Beni Culturali e del Paesaggio, ai Sensi Dell’Articolo 10 Legge 6 Luglio 2002, N. 137). Available online: <https://www.beniculturali.it/> (accessed on 3 June 2019).
24. Council of Europe. *European Landscape Convention*; Council of Europe: Strasbourg, France, 2000.
25. Delibera della Giunta Regionale 16 febbraio 2015 n. 17 (Piano Paesaggistico Territoriale Regionale (PPTR) della Puglia). Available online: <http://paesaggio.regione.puglia.it/> (accessed on 3 June 2019).
26. Ford, M.; Griffiths, R.; Watson, L. The Sandford Inventory of Earth Buildings constructed using a GIS. *Build. Environ.* **2005**, *40*, 964–972. [[CrossRef](#)]
27. Puglia Con. Available online: <http://www.sit.puglia.it> (accessed on 3 June 2019).
28. Strategia di Sviluppo Locale GAL Sud Est Barese. Available online: <https://www.galseb.it> (accessed on 3 June 2019).
29. Ladisa, G.; Todorovic, M.; Trisorio Liuzzi, G. A GIS-based approach for desertification risk assessment in Apulia region, SE Italy. *Phys. Chem. Earth* **2012**, *49*, 103–113. [[CrossRef](#)]
30. Dal Sasso, P.; Caliandro, L.P. The role of historical agro-industrial buildings in the study of rural territory. *Landsc. Urban. Plan.* **2010**, *96*, 146–162. [[CrossRef](#)]

