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Rural Buildings for Sustainable Development: A Real Estate Market Analysis in Southern Italy

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Abstract: The profound transformations of traditional rural landscapes have heightened attention towards the recovery and valorisation of their buildings, often abandoned, to accommodate new landscape usage needs. This aligns with the principles of sustainable landscape management. However, knowledge of the rural real estate market remains largely unexplored. This research aims to define and examine the key features influencing the purchase of rural buildings, for shedding light on their market. The objective is to provide useful new insight to the property appraisers and real estate agents involved in the sale of traditional rural buildings, even if in conditions of degradation or abandonment and in traditional landscape contexts. Furthermore, these results could serve as a valuable resource for policymakers, enabling them to indirectly evaluate the impacts of urban and landscape policies on buyers' preferences regarding key features of rural properties. The research focused on the '*trulli*', traditional buildings located in the Valle d'Itria (Puglia, Southern Italy). First, a detailed market analysis was carried out with the support of local real estate experts, to survey the transactions of *trulli* and identify the features influencing their purchase. Second, the obtained dataset was analysed through network analysis, which enabled us to explore the role and importance assigned by buyers to the identified features. The results highlighted that the quality of the landscape where *trulli* are located changed the buyers' viewpoint on the purchase features. In greater detail, price, area, potable water accessibility and level of maintenance of *trulli* were the most crucial features, particularly in high and medium landscape value zones, compatible with touristic and recreational activities. On the other hand, the annex agricultural surface covered a central function in low landscape value zone for possible agricultural uses.

Keywords: rural areas; territorial planning; rural heritage; rural development; *trulli*; network analysis

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1. Introduction

Rural buildings represent the natural connection between the human and rural environment [1]. Constructed with locally sourced materials and traditional techniques, they address the environmental and social needs of their respective territories [2]. These structures embody a valuable cultural heritage [3] and provide sustainable solutions for rural communities to which they belong [4,5]. Over time, many rural areas have suffered progressive depopulation or undergone radical transformations due to profound societal, environmental and economic changes. These changes have led to the loss of diversity, cohesion and identity in many traditional rural landscapes [6,7]. Traditional landscapes can be defined as those landscapes having clear and recognizable structures reflecting distinct relationships between their abiotic, biotic and cultural elements. These landscapes, the result of a long evolution, are threatened by rapid changes initiated with the Industrial Revolution (late XIXth century) and intensified during the economic boom after World War II (1940–1945) [8]. These changes have created modern landscapes characterised by uniform and rational solutions, lacking in identity and personality [6,8]. This has adversely impacted

extensive rural areas, particularly within the European Union [9,10], fuelling growing concerns expressed even under the European Landscape Convention [11]. Adopted in Florence (Italy) on 20 October 2000, this convention aims to promote the protection, management and planning of European landscapes, ensuring a harmonious balance between social needs, economic activity and the environment [12].

In modern rural European landscapes, traditional rural buildings have lost their original function related to agriculture, consequently, in many cases, there has been abandonment, demolition or conversion of these buildings [13]. Demographic growth and shifts towards an increasingly urban lifestyle, coupled with loss of profitability in agriculture due to globalisation, have exacerbated the phenomenon of abandonment of rural areas and their traditional constructions [14–16]. This reflects a shift in values and in how rural landscapes and their resources are utilised, shaped and perceived [6]. The abandonment of rural areas can lead to the evolution of landscapes towards more natural or semi-natural forms, where rural structures may decline and be abandoned [13,17]. In other situations, rural abandonment does not necessarily entail human depopulation, but rather the cessation of certain types of productive activities, often replaced by new modes of resource exploitation, of which rural buildings are a part [11].

From this emerges a new form of market for rural buildings of non-productive agricultural holdings. Interest in rural buildings has shifted towards new uses other than agriculture, such as for residential purposes [18–22]. This phenomenon has led to the confluence of rural buildings in the residential market, with the obvious effect of increasing their exchange price [23]. In addition, there has been a significant increase of investments in properties for tourism, particularly in the rural and coastal areas of southern Europe, where favourable climatic conditions, rich historical and cultural heritage and attractive landscapes have encouraged the expansion of the tourism sector in these regions [24,25].

The dynamism of the rural real estate market has positively influenced the number of rural buildings renovated and related price levels, reflecting the change and reorganisation of rural landscapes to adapt them to the new human needs. Considering that landscape changes are inevitable, it is crucial to preserve the most valuable elements of traditional rural landscapes while also accepting their evolution to maintain their relevance over time [6,8]. Sustainable landscape management should abide by this principle, recognizing that the recovery and enhancement of rural buildings, even for new uses, can play a crucial role in rural sustainable development [6,7]. This can be achieved by generating new employment opportunities and preserving the natural, cultural and social aspects of the territory acting in line with the three pillars of sustainable development as well as with the goals of the Agenda 2030 [26].

Established by the United Nations in 2015 [27], Agenda 2030 for Sustainable Development includes specific Sustainable Development Goals (SDGs) related to the buildings' recovery and valorisation, namely: (i) Goal 9: 'Construct resilient infrastructure, promote inclusive and sustainable industrialisation and encourage innovation'; (ii) Goal 10: 'Reduce inequality within and among countries'; (iii) Goal 11: 'Develop cities and human settlements that are inclusive, safe, resilient and sustainable' [5]. Specifically, Goal 11 addresses significant aspects related to the protection and promotion of natural and cultural heritage, where historic rural buildings emerge as an important cultural asset [3,28] and highlighting the importance of safeguarding these legacies in according to the Target 11.4.

The lack of comprehensive studies and the limited transparency in the rural real estate market [14] are factors that can discourage the sale, purchase and restoration processes of traditional rural buildings. While more efforts have been made to improve knowledge of dynamics in the market of urban properties, knowledge of rural real estate market dynamics remains limited and fragmented. Moreover, for rural real estate, unreliable data are available, also because they are often based on offer prices by agents instead of on real purchase prices. In this respect, the lack of scientific literature underlines the need for further investigation.

In this general framework, this research aims to define and examine the key features influencing the purchase of rural buildings, to shed light on the market. In the purchase of a property, the buyer has to consider many choice features that are related to each other, but some of them can have a stronger influence than others. The objective is to provide valuable insights for property appraisers and real estate agents handling the sale of traditional rural buildings, including those that are in poor condition or abandoned. Identifying the most important features for the purchase of these properties can guide decisions aimed at enhancing the appeal of rural buildings to buyers, potentially boosting sales and property values. Furthermore, these results serve as a valuable resource for policymakers, enabling them to indirectly evaluate the impacts of urban and landscape policies on buyers' preferences regarding key features of rural properties.

The market of the typical rural buildings, or '*trulli*', located in the Valle d'Itria (Puglia Region, Southern Italy), was considered as a case study. The Valle d'Itria represents a traditional rural landscape with a strong identity, where increasing tourist and urbanistic interest has contributed to the growth of the *trulli* market in recent years. Due to the complexity of the rural real estate market, network analysis was selected as a methodology to address the research objective, allowing for the representation and analysis of decision-making processes among buyers of *trulli*. Network analysis, in particular, enables one to measure and represent non-linear relations among the features occurring in the market negotiations, avoiding the risk of biases due to potential multicollinearity among these features [29]. By analysing the relationships between the characteristics of rural buildings in the real estate market, it is possible to identify which features primarily influence purchasing decisions. In addition, this analysis makes it possible to also consider the selling prices of rural buildings and the attached land in relation to their specific features and reciprocal influences. This research represents the first application of the network analysis to explore the real estate market in rural areas, as part of a global strategy to foster rural sustainable development.

This paper is organised as follows: in Section 2, the network analysis is described from a theoretical point of view. It then presents, the study area and the characteristics of *trulli*, the data collection and the application of the network analysis to the case study. Section 3 illustrates the results and discussions, while Section 4 reports conclusive remarks.

2. Materials and Methods

2.1. The Network Analysis

Network analysis aims to model the interactions among numerous variables (i.e., features) that characterise complex phenomena [30]. It incorporates theories and approaches derived from diverse realms of research, such as graph theory from mathematics, statistical mechanics from physics, inferential modelling from statistics and data mining and information visualisation from computer science, as well as the examination of social structures from sociology [31]. Network analysis is widely applied in biological, social and economic sciences, but innovative research has shown its applications in studying sustainability [32]. Sustainable development requires the comprehensive achievement of the sustainable development goals (SDGs), each with its own nature and level of importance. The UN 2030 Agenda includes 17 SDGs deeply interconnected with and related to the three pillars of sustainable development (environmental, economic and social). The interconnections between these goals are essential to ensure the fulfilment of the Agenda's purposes [27]. Understanding the nature and scope of these interconnections is crucial for assessing, achieving and monitoring the SDGs [32,33]. Consequently, network analysis can be useful to facilitate the identification of key targets, interlinkages and network communities across various SDGs, offering valuable insights to policymakers regarding the prioritisation of SDG objectives [32–34].

A network, in its basic configuration, is a collection of nodes (or vertices) and edges (or links) connecting the nodes [30]. According to Bali Swain and Ranganathan [32], two nodes have 'synergy' when there is a positive interlinkage, and they have a 'tradeoff' when

there is a negative interlinkage. Specifically, two nodes are synergistic when they are measured in the same direction (e.g., the increase is good for both nodes), leading to a positive correlation coefficient. Likewise, two nodes have a tradeoff interlinkage when they show a negative correlation coefficient in the data.

There are various centrality measures to explore the importance of a node within a network. In this research, three centrality measures were calculated as follows.

Degree centrality relies on the count of connections established by a node with its adjacent nodes [35,36]. The degree centrality of an *i*-th node is given by:

$$Cd_{(n_i)} = \frac{k_{n_i}}{N-1} \tag{1}$$

where k_{ni} is the degree of the *i*-th node, while *N* is the total number of nodes in the network. The degree of a node within a network measures the probability of direct interaction with all other nodes. Nodes with higher degrees assume central positions within the network, whereas nodes with lower degrees are in peripheral regions [30]. Degree centrality, being a measure of local centrality, contemplates the *i*-th node and its neighbourhood [35].

In the context of weighted networks, where the existence of a link is not merely binary (absent or present) but implies various degrees of importance or intensity, the centrality assessment can consider node strength [36]. This is defined as the absolute sum of connection weights of the *i*-th node in relation to the others. Centrality based on node strength is known as strength centrality and expresses information on the importance of a given node within a weighted network [30,36,37].

For the nodes placed as intermediaries at a certain point of the network, closeness centrality assesses the distances from a node to all other nodes in the network. In other words, it quantifies the proximity of a node to all the other nodes. A node reaches a high centrality in the network when it is closer to many other nodes, facilitating quick interactions [30]. The closeness centrality of an *i*-th node (n_i) is given by

$$Cc_{(n_i)} = \frac{N-1}{\sum_{k=1}^{N} d(n_i + n_k)} \tag{2}$$

where the denominator corresponds to the sum of the geodesic distances (shorter paths) between the *i*-th node and all *k*-th nodes of the network. Closeness centrality is characterised by an inverse proportionality to the sum of geodesic distances between the *i*-th node and the *k*-th nodes within the network [38]. This means that a high closeness centrality value denotes a shorter average distance of the specific node from all the others. Consequently, a node with high closeness is quickly influenced by changes occurring throughout the network and concurrently exerts a rapid influence on other regions of the network [39].

Finally, betweenness centrality measures the proximity of the *i*-th node to any other point of the graph. This metric represents the frequency with which a node participates in the shortest path between all pairs of interconnected nodes within the network [36,40]. Practically, a node with higher betweenness centrality has a pivotal role in facilitating the 'communication' pathways among diverse node pairs within the network [30]. The betweenness centrality of an *i*-th node (n_i) is given by

$$Cb_{(n_i)} = \sum_{j=1}^{N} \sum_{k=1}^{N-1} \frac{D_{jk}(n_i)}{D_{jk}} \tag{3}$$

where the denominator is the sum of the geodesic distances connecting all pairs of *j*-th and *k*-th nodes of the network, while the numerator is the sum of the distances connecting all pairs of *j*-th and *k*-th nodes of the network passing through the *i*-th node. According to the betweenness centrality measure, a node is central when it is involved in the maximum number of geodetic distances connecting each pair of nodes in the network [36]. This metric quantifies the importance of a node based on its involvement in the minimum paths

between pairs of nodes [36,41]. The node assumes a pivotal role in the network dynamics when it is frequently in the shortest path between two other nodes [42]. Consequently, the greater the centrality of a node, the more its participation in the interactions among the nodes within a network, assuming the role of intermediary [36].

The network analysis was developed to examine social phenomena and decision-making processes. Therefore, it was employed as a suitable methodology for investigating the purchasing decisions of buyers of *trulli* in the Valle d'Itria using the centrality measures described previously. The network analysis procedure of the software JASP (version 0.18.3) was utilised for this purpose. This software made it possible to deal with nominal ordinal and continuous features (i.e., the variables), to plot the networks and calculate the centrality measures. Additionally, it calculated the weight matrix (i.e., the correlation matrix) by setting and applying automatically the most suitable correlation method (e.g., Pearson, tetrachoric or polychoric) according to the type of features.

2.2. Study Area and Characteristics of Trulli

The Valle d'Itria, also named 'Valle dei Trulli', is located in the Apulia region (Southern Italy) among the provinces of Bari, Taranto and Brindisi and overlaps the landscape context of the 'Murgia dei Trulli'. Encompassing the municipalities of Alberobello, Cisternino, Ceglie Messapica and Locorotondo, as well as parts of Fasano, Ostuni and Martina Franca (Figure 1), this region embodies a unique geographical and cultural identity.

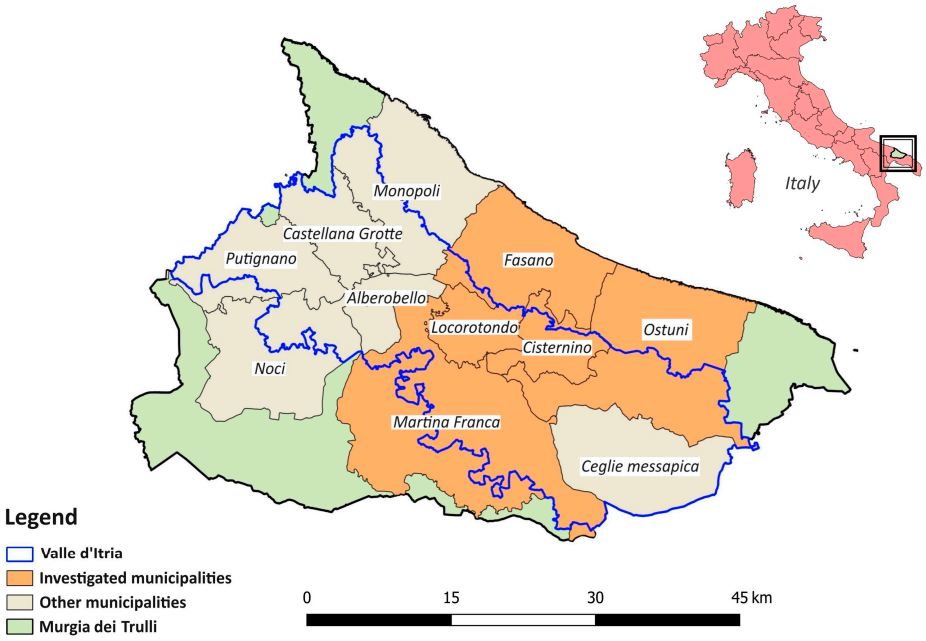

Figure 1. Study area.

Defined by an extensive limestone plateau, the Valle d'Itria is a evocative landscape shaped by the combination of human, natural and geological elements. The rural landscape consists mainly of small agricultural fields, alternating between pastures, scrublands, forests of '*fragno*' (*Quercus trojana Webb*) and patches of exposed limestone. Olive and grapevine cultivation is prevalent, accompanied by almonds and other fruit trees [43].

The defining feature of the Valle d'Itria is the widespread presence of numerous dry-stone rural buildings, with *trulli*—also known locally as '*casedde*' or '*caselle*'—standing out as the predominant and emblematic expression of the local's cultural heritage [43,44].

The *trullo* is a typical rural building with a rectangular or circular plan surmounted by an embedded-stones cone-shaped roof (Figure 2). The walls are built with roughly worked limestone with the dry-stone wall technique, without the use of mortar or cement [45–47]. The building materials are extracted during excavations for the construction of a cistern beneath the *trullo* or collected from the countryside and nearby limestone formations [46].

Finally, the walls are outfitted with a door and small windows, while an internal hearth and alcoves are realised as internal niches. The double-layer roof has a cone-shaped stone inner layer capped by a closing stone and a waterproof external layer built of limestone slabs called '*chianche*' or '*chiancarelle*' [48,49]. To better fulfil their function of diverting rainwater, the *chiancarelle* are laid dry, in overlapping layers, staggered horizontally. This prevents rainwater from infiltrating into the underlying layers while effectively draining it away [50]. In some cases, rainwater is collected via projecting eaves at the base of the roof, from which it then flows into the underground cistern of the *trullo* [50].

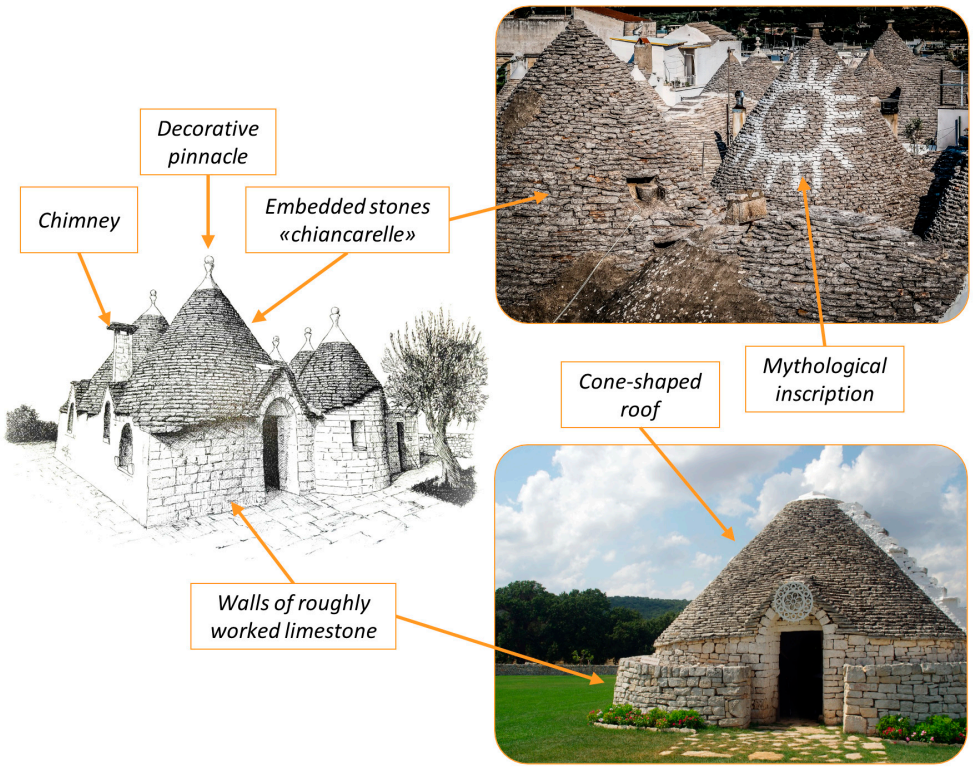

Figure 2. Example of *trulli* in the Valle d'Itria (artwork by the author Giuseppe Parete; photos with a free license from pixabay—http://pixabay.com/, accessed on 26 April 2024).

The roofs of *trulli* are often painted with mythological or religious inscriptions and end with decorative pinnacles originally intended to ward off malignant influences and misfortune [46].

The spread of *trulli* in the Valle d'Itria can be traced back to the fragmentation of feudal land occurring between the 1400s to early 1700s in the region. This phenomenon led to the first appearance of *trulli* as rudimentary dwelling units, characterised by their dome-shaped roofs, fireplaces and adjoining vegetable gardens [38]. These rural buildings served as both temporary rural shelters and farmers' permanent dwellings [46,47].

From the late 1600s to the early 1700s, there was an expansion of existing structures and the construction of new *trulli* with multiple rooms. Subsequently, in the late 1700s and 1800s, profound transformation of the old buildings occurred, and they were transformed using bricks instead of the traditional dry-stone methods [44,47]. Over the last decades, these rural buildings lost their importance as agricultural facilities, but were recovered and valorised for new uses, such as seasonal touristic hospitality or residential purposes [20,51]. In December of 1996, the *trulli* were acknowledged as a World Heritage Site by UNESCO.

2.3. Sample Composition: Selection and Collection of the Trulli Features

A direct inquiry was conducted in 2022 to collect sales contracts of *trulli*; this was done by involving several real estate experts (e.g., agencies and notaries) and enabled

us to collect a sample of 96 contracts of *trulli* sold between 2017 and 2021. No correlation with the effects of the COVID-19 pandemic was found in the number of sales contracts for *trulli*, which remained relatively stable. The average number of trades per year was 20 in the pre-pandemic period (2017–2019) and 17.5 during the pandemic years (2020–2021). Subsequently, several descriptive features of the *trulli* were selected and collected from the sales contracts. This was accomplished through a preliminary focus group that involved ten stakeholders (e.g., practitioners, agents, agronomists, etc.) selected for their deep knowledge of the local rural architecture and rural real estate market, which were supported by the research group that provided thematic scientific literature [22,52–54]. During the initial phase, sales contracts of *trulli* in Valle d'Itria were presented. Following this, experts were engaged in discussions to assess the crucial purchase features of *trulli* for buyers.

Hereafter is the detailed description of the features considered relevant by the buyers according to the focus group:

- The building surface expressed as m^2, which is strictly linked to the number of conic-shaped roofs (BS);
- The surface of annex agricultural land (AS), expressed as m^2;
- The surface ratio of '*trulli*' area on the total property area (SR), expressed as m^2/ha;
- The level of maintenance/renovation (LM), expressed as dummy variable with 3 possible values: 0 = property to be completely restored, as in decay conditions and without windows and finishes; 1 = property in good condition or partially renovated; 2 = property completely renovated, equipped with new windows and finishes and sometimes with porches and swimming pool;
- The accessibility to the potable water supply network (WS), expressed as a dichotomous variable: 0 if the water availability depended on private sources (tanks or wells) and 1 if water was supplied by the public water network. Generally, the buildings closer to urban centres or main roads supplied water from the public network;
- The distance from the nearest urban centre (DUC), expressed as km and calculated through the software 'Google Earth' (version 10.0);
- The sale price (PRICE), expressed as EUR. This feature was treated as dependent variable together with all the other features;
- The level of landscape quality of the area where the '*trulli*' were located (LQ), expressed as a dummy variable quantified by analysing aerial photos. Three landscape contexts (Figure 3), referred to as zones, were defined: (i) The low-value zone, which lacks significant landscape elements or shows minimal landscape or touristic importance, since it is often close to industrial areas, waste collection centres or quarries. This zone may also include agricultural land abandoned or untilled. (ii) The medium-value zone, which encompasses both valuable and lower-quality landscape characteristics simultaneously. (iii) The high-value zone, which includes or is close to tourist attractions, protected natural areas or parks or historical, cultural or archaeological heritage. This zone may also include agricultural land with typical crops, such as olive groves, vineyards or orchards. A value proportional to the corresponding average prices of *trulli* was assigned to each zone, thus a value equal to 1 to the high-value zone and proportional values to the medium-value and low-value zone (0.75 and 0.62, respectively). It should be noted that the three zones described do not correspond to clearly defined territorial areas, but consider only the landscape characteristics of the surrounding area of each *trullo*. This prevents the possibility of depicting the distribution of the three zones on a map.

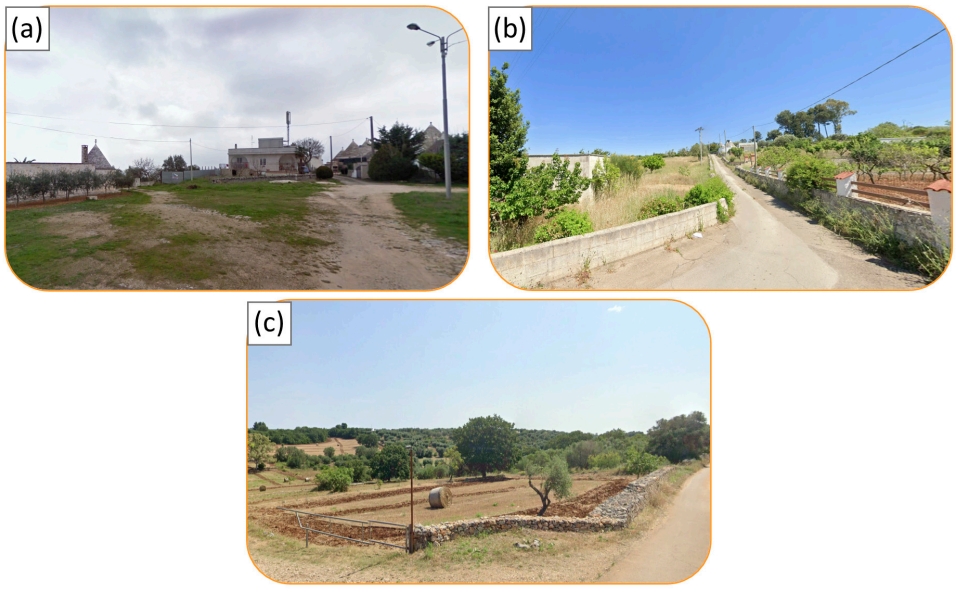

Figure 3. Examples of landscape contexts of *trulli* in the Valle d'Itria: (**a**) low-value zone in Contrada Ritunno (Locorotondo, BA); (**b**) medium-value zone in Contrada Primicerio (Martina Franca, TA); (**c**) high-value zone in Contrada Barbagianni (Ostuni, BR) (source: Google Street View).

3. Results and Discussion

3.1. Sample Description

The overall sample consisted of 96 *trulli* sales that were distributed across the territories of Fasano (25 cases), Martina Franca (23 cases), Cisternino (18 cases), Locorotondo (15 cases) and Ostuni (15 cases). Table 1 shows the descriptive statistics of this sample for all the features, considering the entire study area as well as each territorial scenario (i.e., the high-, medium- and low-value zones). Specifically, the mean surface of *trulli* was 100.3 m^2, while the annex agricultural land covered an average area of 0.51 hectares. The surface ration of *trulli* area on the total property area was equal to 586.34 m^2/ha. The prevailing level of maintenance/renovation was 'partially renovated' (42%), and a potable water supply network was available in 72% of cases. The average distance of the buildings from the nearest urban centre was 3.86 km, and the average sale price was EUR 113,078.

The distribution of sales within the three landscapes contexts was as follows: 38 in the high-value zone, 31 in the medium-value zone and 27 in the low-value zone; all the municipalities were covered. In particular, the mean surface of *trulli* is higher in the high-value and medium-value (107 m^2 and 101 m^2, respectively), whereas the average area of annex agricultural land was 0.49 ha in the medium-value zone and 0.55 ha in the high-value zone. The incidence of *trulli* area on the total property area was higher in the low-value zone (863.15 m^2/ha). The main maintenance levels observed in the high-value zone were 'completely renovated' (42.1%) and 'partially renovated' (36.9%); this feature contributes to enhancing the level of landscape quality of these areas [51]. In the medium- and low-value zones, most of *trulli* were 'partially renovated' and in 'decay conditions'. In all the three zones, the majority of *trulli* were not connected to the public potable water supply network; the average distance from the nearest urban centre did not vary among the three zones, ranging from 3.3 to 4.3 km. According to the classification provided by the Italian Statistics Institute [55], the municipalities within the Valle d'Itria are categorised as service centres, in contrast with the peripheral areas where proximity to the nearest city or service centre becomes significant. Finally, the average purchase price varied significantly across the three zones: in the high-value zone, the average purchase price was 153,000 EUR; in the medium-value zone, it was slightly lower (105,467.7 EUR), whereas it was the lowest in the low-value zone (65,629.6 EUR). Considering the easy access to a wide range of essential services in the Valle d'Itria, differences in the average property prices may be due

to the characteristics of the tree landscape scenarios where the *trulli* were located. Both the closeness to services and the quality of the landscape contribute to increasing the sale prices of real estate units [56].

Table 1. Descriptive statistics of the features of the case study sample.

Features	Scale of Measurement	Frequency (%) or Mean ± SD
Valle d'Itria—Tot. 96 *trulli*		
Building Surface (BS)	Continuous (m^2)	100.3 ± 47.37
Annex Agricultural Surface (AS)	Continuous (ha)	0.51 ± 0.44
Surface Ratio (SR)	Continuous (m^2/ha)	586.34 ± 1318.8
Level of Maintenance (LM)	0 = decay conditions	29%
	1 = partially renovated	42%
	2 = completely renovated	29%
Water Supply (WS)	0 = private water sources	72%
	1 = public water network	24%
Distance from the nearest Urban Centre (DUC)	Continuous (km)	3.86 ± 1.73
PRICE	Continuous (EUR)	113,078.1 ± 102,556.8
High-value zone—Tot. 38 *trulli*		
Building Surface (BS)	Continuous (m^2)	107.7 ± 52.6
Annex Agricultural Surface (AS)	Continuous (ha)	0.55 ± 0.40
Surface Ratio (SR)	Continuous (m^2/ha)	470.4 ± 676.8
Level of Maintenance (LM)	0 = decay conditions	21%
	1 = partially renovated	36.9%
	2 = completely renovated	42.1%
Potable Water Supply (WS)	0 = private water sources	60.5%
	1 = public water network	39.5%
Distance from the Nearest Urban Centre (DUC)	Continuous (km)	3.9 ± 1.5
PRICE	Continuous (EUR)	153,000 ± 129,272.8
Medium-value zone—Tot. 31 *trulli*		
Building Surface (BS)	Continuous (m^2)	101 ± 46.2
Annex Agricultural Surface (AS)	Continuous (ha)	0.49 ± 0.42
Surface Ratio (SR)	Continuous (m^2/ha)	487.4 ± 517
Level of Maintenance (LM)	0 = decay conditions	32.3%
	1 = partially renovated	38.7%
	2 = completely renovated	29%
Potable Water Supply (WS)	0 = private water sources	80.6%
	1 = public water network	19.4%
Distance from the nearest Urban Centre (DUC)	Continuous (km)	4.3 ± 1.89
PRICE	Continuous (EUR)	105,467.7 ± 84,813.4
Low-value zone—Tot. 27 *trulli*		
Building Surface (BS)	Continuous (m^2)	89.1 ± 39.9
Annex Agricultural Surface (AS)	Continuous (ha)	0.50 ± 0.50
Surface Ratio (SR)	Continuous (m^2/ha)	863.1 ± 2298.45
Level of Maintenance (LM)	0 = decay conditions	37%
	1 = partially renovated	51.9%
	2 = completely renovated	11.1%
Potable Water Supply (WS)	0 = private water sources	88.9%
	1 = public water network	11.1%
Distance from the nearest Urban Centre (DUC)	Continuous (km)	3.3 ± 1.71
PRICE	Continuous (EUR)	65,629.6 ± 40,156.7

3.2. Network Analysis Application

The overall network of the study area showed the relationships among the features of *trulli* listed in Section 2.3 (Figure 4). In this network, the price (PRICE), the building surface (BS), the level of maintenance (LM) and the accessibility to a potable water supply network (WS) were interconnected by thick blue lines, meaning a strong positive correlation. Conversely, the remaining features showed thinner blue lines (i.e., less meaningful) and negative correlations highlighted by red line connections, such as between the surface of the annex agricultural land (AS) and the surface ratio of the *trulli* area on the total property area (SR).

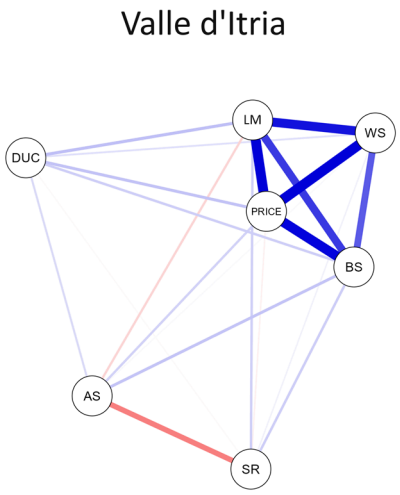

Figure 4. Overall network of '*trulli*' sales in the Valle d'Itria.

The weights matrix (Table 2) associated with the network in Figure 4 provides the detailed values of positive and negative correlations among the features of the overall sample [57]. The values in Table 2 show that the price (PRICE) had the strongest positive correlations with the accessibility to the potable water supply network (WS, 0.71), the level of maintenance (LM, 0.69) and the building surface (BS, 0.68). Thus, properties connected to a potable water supply network, in a well-maintained state and with a medium-large building surface were sold at high prices, in line with relevant literature in the field [22,52–54]. The surface ratio of *trulli* area on the total property area (SR, −0.04) was considered a disincentive to purchase, while the distance from the nearest urban centre (DUC, 0.17) and the area of the annex agricultural land (AS, 0.12) had minimal impact on the purchase decisions.

Table 2. Weights matrix related to the overall network of *trulli* sales in the Valle d'Itria.

Feature	BS	AS	SR	LM	WS	DUC	PRICE
BS	0.00	0.16	0.13	0.53	0.46	0.13	0.68
AS	0.16	0.00	−0.35	−0.11	0.01	0.10	0.12
SR	0.13	−0.35	0.00	0.13	0.04	−0.01	−0.04
LM	0.53	−0.12	0.13	0.00	0.63	0.18	0.69
WS	0.46	0.02	0.04	0.63	0.00	0.08	0.71
DUC	0.13	0.10	−0.01	0.18	0.08	0.00	0.17
PRICE	0.68	0.12	−0.04	0.70	0.71	0.17	0.00

The centrality measures of the overall network of *trulli* sales in Valle d'Itria (Table 3), made it possible to identify the features that influence mostly the purchase process [35,58,59]. The feature with the highest strength centrality was price (PRICE, 1.06), followed by the level of maintenance (LM, 0.91), the building surface (BS, 0.68) and the availability of potable water supply network (WS, 0.47). Negative strength centrality was observed for the remaining features, indicating their limited relevance for buyers. Similarly, closeness

centrality values were high for BS (0.96), LM (0.94), PRICE (0.81) and WS (0.43), indicating their significant mutual influence on purchase. Betweenness centrality showed the highest positive values for BS (1.96) and LM (0.65), while PRICE, WS, SR and DUC assumed the same negative value (−0.65).

Table 3. Centrality measures related to the overall network of *trulli* sales in the Valle d'Itria.

Feature	Strength Centrality	Closeness Centrality	Betweenness Centrality
BS	0.68	0.96	1.96
AS	−0.89	−0.84	0.00
SR	−1.10	−1.14	−0.65
LM	0.91	0.94	0.65
WS	0.47	0.43	−0.65
DUC	−1.14	−1.16	−0.65
PRICE	1.08	0.81	−0.65

Strength centrality values indicated that the level of maintenance (LM) was considered important because it strongly affected the value of rural buildings [20]. In this respect, the restoration of the cone-shaped roofs is particularly expensive, due to the scarce availability of high-skilled manpower and to difficulties in finding limestone roof tiles (*chiancarelle*). These aspects may have negatively affected the demand of unrenovated properties in the study area, thus encouraging the demand for 'ready to use' or partially renovated buildings. The building surface (BS) also proved to be a crucial feature in buying a *trullo*, especially concerning its potential for residential or touristic use.

Closeness centrality identifies BS, LM, PRICE and WS as a cluster of features (or a set of connected nodes) that frequently co-occur in the buyers' decision-making processes, in accordance with Epskamp [38]. DUC, AS and SR showed negative closeness centrality values, suggesting that buyers evaluate these features at later stages or do not evaluate them at all.

Betweenness centrality values indicated a low significance of PRICE in acting as a mediator among different purchase features. This could depend on the fact that buyers would be willing to exceed their budget to buy *trulli* sufficiently large, in good maintenance conditions and equipped with a potable water supply network. The surface of annex land (AS) and the surface ratio of *trulli* area on the total property area (SR) assumed negative centrality values, which may suggest the interest in purchasing these buildings mainly for touristic and recreational purposes. This is further supported by the significant importance attached to the building's surface, which was crucial in mediating among different purchase features.

The distance from the nearest urban centre (DUC) showed negative centrality measures. Although the Valle d'Itria lacks large, densely urban centres, it is characterised by a strong development of human activities, as indicated by high levels of land consumption [60]. As a result, it is reasonable to say that essential services are well-distributed in the study area, thus the distance of *trulli* from the nearest urban centre was considered negligible by the buyers.

It is also interesting to note that the purchase choices were influenced by the landscape quality of the context where the buildings are located; this aspect is confirmed by Garrod [61]. In this regard, to further investigate how the features may influence the purchase decisions, three additional networks were established, each considering different landscape contexts classified into high, medium and low value zones (Figure 5). These classifications were based on the level of landscape quality of the area where the *trulli* were located (feature LQ) [54]. Figure 5 showed three networks that enabled us to understand how the landscape quality affected buyers' purchasing preferences.

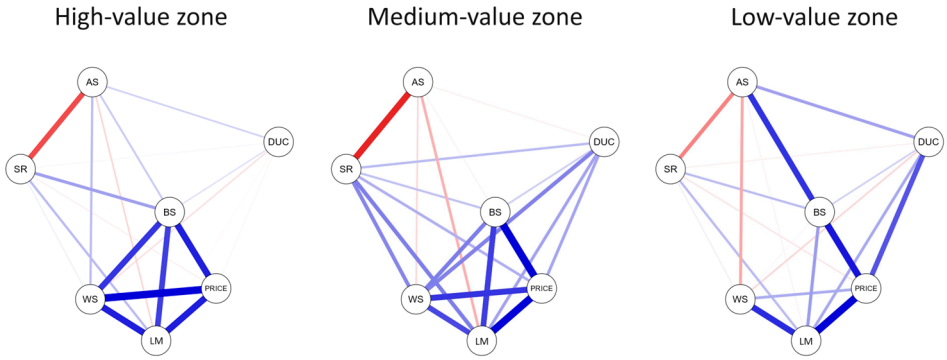

Figure 5. Networks of the *trulli* sales in the three different landscape contexts.

For the high-value zone, the related network in Figure 5 shows that the features that mostly influenced the purchase were accessibility to a potable water supply network (WS), the price (PRICE), the building surface (BS) and the level of maintenance (LM). In detail, the related weights matrix (Table 4) show that the sale price, established positive strong correlations with WS (0.80), LM (0.69) and BS (0.69), leading to a joint effect of these three features in affecting the purchase. The correlations between PRICE and the other features are weak or slightly negative.

Table 4. Weights matrix related to the network of *trulli* sales in the high-value zone.

Feature	BS	AS	SR	LM	WS	DUC	PRICE
BS	0.00	0.04	0.30	0.60	0.63	0.09	0.69
AS	0.04	0.00	−0.56	−0.12	0.21	0.14	0.16
SR	0.30	−0.56	0.00	0.21	0.05	0.02	−0.05
LM	0.60	−0.12	0.21	0.00	0.69	−0.01	0.69
WS	0.63	0.21	0.05	0.69	0.00	−0.10	0.80
DUC	0.09	0.14	0.02	−0.00	−0.10	0.00	0.01
PRICE	0.69	0.16	−0.05	0.69	0.80	0.01	0.00

In this regard, it can be assumed that the relationship between PRICE and DUC was not significant because the municipalities within the Valle d'Itria are classified as service centres [55], offering direct access to a wide range of services. Buyers may be not interested to use the annex land for agricultural purposes, but for building tourist-oriented or recreational facilities or for cultivating family food gardens [62–64]. The strong positive correlation between PRICE and WS (0.80) supported the hypothesis that potable water in inner rural areas is a significant facility for attracting tourists [65]. The requalification of traditional rural buildings for different uses may contribute to achieving the objectives of rural sustainable development [28]. However, in some cases, the revitalisation of rural areas can sometimes compromise their cultural integrity and landscape quality. In this sense, recovering traditional rural buildings for tourist-recreational activities rather than for agricultural uses may lead to a depletion of the rural essence of the area [66].

Strength centrality values (Table 5) for the high-value zone highlighted that the availability of a potable water supply network (WS, 0.85), the price (PRICE, 0.78), the surface of the building (BS, 0.71) and the level of maintenance/renovation (LM, 0.67) had the strongest influence on purchase decisions. The remaining features showed less influence. These findings were further confirmed by the closeness centrality, which showed high positive values for BS (0.88), WS (0.78), PRICE (0.39) and LM (0.26). Conversely, SR (0.07), AS (−0.32) and DUC (−2.07) showed low closeness centrality values, suggesting their irrelevant role in the purchase decisions. Betweenness centrality highlighted that WS (1.73) and BS (0.87) favoured the connection among all the other features, while PRICE, MD and DUC did not cover this role.

Table 5. Centrality measures for the purchasing features of *trull* sales in the high-value zone.

Feature	Strength Centrality	Closeness Centrality	Betweenness Centrality
BS	0.71	0.88	0.87
AS	−0.64	−0.32	0.00
SR	−0.70	0.07	0.00
LM	0.67	0.26	−0.87
WS	0.85	0.78	1.73
DUC	−1.67	−2.07	−0.87
PRICE	0.78	0.39	−0.87

In this specific zone, all the centrality measures highlighted the strong significance of the availability of potable water supply network (WS) and the building's surface (BS). This may indicate a strong interest in purchasing *trulli* for recreational or tourism purposes. This hypothesis may be supported by the low significance of the area of annex agricultural land (AS). Moreover, the distance from the nearest urban centre (DUC) assumed scarce relevance for the buyers. This could be due both to the high level of human activity in Valle d'Itria and the high landscape value of the high-value zone, which contributed to increasing selling prices in this zone [56], as shown in Table 1. Furthermore, recent research highlighted how the COVID-19 pandemic prompted many people to seek more space and purchase properties away from urban centres [67]. This trend was also reflected in an increased interest in rural tourism [68].

For the medium-value zone, the related network in Figure 5 highlights the greatest number of strong positive connections among the purchase features (i.e., thick blue connections). They were observed among the price (PRICE), the building's surface (BS), the level of maintenance (LM) and the accessibility to the potable water supply network (WS). Weaker positive connections were established between the distance from the nearest urban centre (DUC) and the surface ratio of *trulli* area on the total property area (SR). The related weight matrix (Table 6) indicated the highest correlation values between PRICE and BS (0.77), LM (0.76) and WS (0.60). These results may suggest that buyers preferred *trulli* with medium-large surface, with a good level of maintenance and equipped with a potable water supply network.

Table 6. Weights matrix related to the network of *trulli* sales in the medium-value zone.

Feature	BS	AS	SR	LM	WS	DUC	PRICE
BS	0.00	0.03	0.18	0.57	0.39	0.15	0.77
AS	0.03	0.00	−0.65	−0.24	−0.12	−0.04	0.00
SR	0.18	−0.65	0.00	0.38	0.36	0.20	0.24
LM	0.57	−0.24	0.38	0.00	0.54	0.28	0.76
WS	−0.12	0.36	0.54	−0.12	0.00	0.38	0.60
DUC	−0.04	0.20	0.28	−0.04	0.38	0.00	0.27
PRICE	0.00	0.24	0.76	0.00	0.60	0.27	0.00

Strength centrality for the medium-value zone (Table 7) highlighted that the level of maintenance (LM, 1.14), the price (PRICE, 0.93) and the availability of a potable water supply network (WS, 0.53) were the most important features for buyers, while the building's surface (BS, 0.07) had a minor role. Closeness centrality highlighted the central role assumed by LM (1.25) and WS (1.06) within the cluster of features most present in purchasing decisions, which also included PRICE (0.51). Betweenness centrality highlighted the key role of SR (1.66) and LM (1.20) in favouring the connections among all the other features.

Table 7. Centrality measures for the purchasing features of *trulli* sales in the medium-value zone.

Feature	Strength Centrality	Closeness Centrality	Betweenness Centrality
BS	0.07	−0.25	−0.66
AS	−1.51	−1.31	−0.66
SR	−0.03	−0.13	1.66
LM	1.14	1.25	1.20
WS	0.53	1.06	−0.66
DUC	−1.13	−1.13	−0.66
PRICE	0.93	0.51	−0.20

All the centrality measures in the medium-value zone indicated that buyers paid great attention to the level of maintenance (LM). This is likely due to the high renovation costs of these rural buildings [20]. All the centrality measures for LM, as well as the strength and closeness centrality measures for WS and PRICE, indicated that buyers preferred well-maintained *trulli* equipped with potable water networks and at fair price, probably for different purposes than agriculture. The building's surface (BS) and its annex agricultural land surface (AS) did not seem to be relevant. The high Betweenness Centrality value of the surface ratio of *trulli* area on the total property area (SR) is probably derived from buyers' intention to use the annex agricultural land for tourism or recreational activities. Lastly, even in the medium-value zone, the distance from the nearest urban centre (DUC) is not a central factor in buyers' decisions.

In the low-value zone, the related network in Figure 5 showed the price (PRICE), the level of maintenance (LM), the availability of a potable water supply network (WS) and the building surface (BS) at its core. A positive correlation was observed between BS and the surface of annex agricultural land (AS) and between PRICE and the distance from the nearest urban centre (DUC). The connection between PRICE and WS was less relevant compared to those in the high and medium-value zones. The weights matrix (Table 8) underlined that the correlation between PRICE and LM was 0.63, followed by the correlation between PRICE and BS (0.55), DUC (0.42) and the annexed agricultural land (AS, 0.24). These results indicated that in the low-value zone, *trulli* in good maintenance condition, with adequate internal space, not far from the nearest urban centre and with sufficient attached agricultural land were sold at a higher price. A high surface ratio (SR) discouraged the purchase, probably because buyers wanted to use the annex land for agricultural purposes. The distance from the nearest urban centre (DUC) established the strongest positive correlation with PRICE. The lower average selling price within this zone (Table 1) might suggest how low landscape quality contributes to decreased property values. This would explain why the DUC established a closer correlation with the selling price of *trulli* in this area. Proximity to urban centres and their services could potentially mitigate the lower landscape quality level and increase the selling price, as also highlighted by Riccioli [56].

Table 8. Weights matrix related to the network of *trulli* sales in the low-value zone.

Feature	BS	AS	SR	LM	WS	DUC	PRICE
BS	0.00	0.49	0.16	0.24	−0.01	0.11	0.55
AS	0.49	0.00	−0.31	−0.02	−0.22	0.23	0.24
SR	0.16	−0.31	0.00	0.17	0.04	−0.04	−0.06
LM	0.24	−0.02	0.17	0.00	0.51	0.21	0.63
WS	−0.01	−0.22	0.04	0.51	0.00	−0.10	0.20
DUC	0.11	0.23	−0.04	0.21	−0.10	0.00	0.42
PRICE	0.55	0.24	−0.07	0.63	0.20	0.42	0.00

In the low-value zone, centrality measures (Table 9) revealed that the price (PRICE, 1.50), the level of maintenance (LM, 0.78), the building's surface (BS, 0.33) and the area of

annex agricultural land (AS, 0.20), have assumed the highest value of strength centrality. Similarly, high positive closeness centrality values were observed for PRICE (1.42), MD (0.59), AS (0.50) and BS (0.35), suggesting that PRICE represented the first feature considered by buyers in low-value zone. Betweenness Centrality has assumed high and medium values for PRICE (1.57), AS (0.73), BS (0.33) and LM (0.33).

Table 9. Centrality measures for the purchasing features of *trulli* sales in the low-value zone.

Feature	Strength Centrality	Closeness Centrality	Betweenness Centrality
BS	0.33	0.35	0.30
AS	0.20	0.50	0.73
SR	−1.40	−1.55	−0.97
LM	0.78	0.59	0.30
WS	−0.74	−0.68	−0.97
DUC	−0.68	−0.63	−0.97
PRICE	1.50	1.42	1.57

In this area, the sale price (PRICE) was the most significant feature in influencing the buyers' purchase decision, in relation to the highest value of strength, closeness and betweenness centrality. These results might suggest the buyers' need to purchase at a low price, due to the low landscape quality of this zone. Additionally, the centrality measures also highlighted the higher importance of annex land surface (AS) for possible agricultural purposes over touristic uses. The negative centrality measures related to the availability of potable water supply network (WS) could support this hypothesis, because the planning of tourist activities sees the availability of drinking water as an indispensable factor [69].

The lower importance attributed to the surface ratio of the *trulli* area on the total property area (SR) may depend on more interest in the annex agricultural land. It is to be noted that cultivating land in rural-urban fringe areas, characterised by low landscape quality (such as the low-value zone), can contribute to achieving sustainable territorial development. In fact, peri-urban agriculture supports the creation of more sustainable and resilient cities and food systems while addressing challenges such as climate change, ecological degradation, food insecurity and economic crises [70,71]. Moreover, establishing agricultural parks could be an effective strategy for revitalising and enhancing peri-urban agricultural landscapes [72] and rural buildings for agricultural or tourist activities [73].

4. Conclusions

The aim of this research was to identify the main characteristics influencing the purchase of rural buildings in traditional landscape contexts. The objective was to understand and analyse how these characteristics have impacted the decision-making processes of buyers. This research provides a tool that facilitates the work of property appraisers and real estate agents specialized in the sale of traditional rural buildings, including those in poor condition or abandoned, thereby contributing to increasing knowledge of the rural real estate market and shedding light on its internal dynamics.

Network Analysis has proven to be a valuable tool for investigating real estate purchasing decisions. The adopted method enabled the identification of key features influencing the purchase of rural properties and provided insights into the underlying decision-making processes of buyers. It is noteworthy that the variable PRICE, typically considered a dependent variable in practical estimation, has been treated as a normal independent variable. Centrality measures position it at the core of the network, effectively classifying it as a pivotal element in the logic of the contracting parties. Network Analysis has facilitated understanding the relationships between price and other features of the properties purchased, offering valuable information for estimating the value of rural properties.

In the traditional rural landscape of the Valle d'Itria, analysis of *trulli* sales has revealed that the level of maintenance and the building's surface area were the primary factors influencing buyers' decisions. The high importance placed on the maintenance levels of these

buildings is likely attributed to their unique architectural features, as *trulli* often require specialised skills and important resources for restoration. In addition, buyers showed a preference for medium to large-sized buildings over extensive annexed agricultural land, suggesting an interest in residential or recreational purposes rather than agricultural uses. The relatively low importance assigned by buyers to the distance from the nearest urban centre can be explained by the significant urban development in the Valle d'Itria, driven by the growing tourist popularity of the area.

In the three landscape contexts considered, buyers have assigned different degrees of importance to the purchasing features of *trulli*, depending on the different potential uses of these buildings. For *trulli* in high-value zones, the presence of a potable water supply network assumed relevance in buyers' decision-making processes, followed by the building's surface area. These characteristics are compatible with residential or touristic uses and the limited relevance for buyers of the surface area of the annexed agricultural land, seems to confirm the intention to purchase *trulli* for non-agricultural purposes. In medium-value zones, the level of maintenance represents a crucial feature for buyers of *trulli*, who seem to be interested in residential or touristic uses of the building. In low-value zones, the sale price and the surface area of the annexed agricultural land are key features for buyers of *trulli*, while the presence of potable water assumed lesser relevance. These results suggest that buyers of *trulli* in low-value zones are more oriented towards agricultural purposes, which can effectively contribute to the revitalisation of the most degraded landscape contexts.

The urban and touristic development of the Valle d'Itria revitalised the importance and attractiveness of *trulli*. The restoration and valorisation of these traditional rural building have become essential to ensure their preservation while also accommodating the ongoing changes in the territory. The results of this research also provide valuable insights for local administrations to assess the effectiveness and impact of urban and landscape policies on the rural real estate market or to allocate resources towards measures supporting the restoration and valorisation of local traditional rural buildings. This could promote an increase in the number of restored and enhanced buildings, even in the most isolated and degraded contexts, aligning with the objectives of sustainable development and management of traditional rural landscapes outlined by the European Landscape Convention and the goals of the Agenda 2030.

Despite the limitations associated with the challenge of obtaining data of recent transactions, this research acquires particular significance as it relied on data directly collected from the rural real estate market. Possible future research will deal with the real estate market of the '*case cantoniere*' (roadside houses), which are state-owned properties decommissioned since the 1980s due to high maintenance costs and changes in techniques and forms of management of suburban roads. Although these *case cantoniere* are a significant real estate heritage in Italy and may contribute to achieve rural sustainable development, their recovery and valorisation is still unexplored.

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