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**AN INVESTIGATION OF THE LAND MARKET AND
THE FACTORS AFFECTING PRICE FORMATION IN
AGRICULTURAL LAND APPRAISAL: FISCAL ASPECTS,
BARRIERS, STANDARDS AND INNOVATIVE
VALUATION PROCEDURES**

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Introduction

If we tried to define land, we would not be able to find a single expression that encapsulates all that it can be. Often forgotten is that land is a finite, irreplaceable, and non-reproducible resource. Indeed, nothing can be considered a worthy substitute for such a precious asset. Land has witnessed the succession of human evolutions over the centuries, adapting each time to uses most beneficial to humans, from agricultural to non-agricultural purposes. Regardless of its use, land remains one of the most important sources of wealth for people on every continent, making the study of its economic and financial processes essential.

A thorough economic analysis of what land represents is presented by Ascuito et al. (2009), who, discussing the Italian land market, define land as a measurable and divisible asset, an investment source capable of generating income without depleting its capital value, particularly within small enterprises. It is a productive factor with an extremely rigid supply, often unable to meet demand, which drives up prices. Generally, the most common market form within the land market is that of a bilateral oligopoly and, to a lesser extent, a bilateral monopoly. For years, it has been considered a safe haven asset (Binswanger and Rosenzweig, 1986; Grillenzoni and Bazzani, 1996) or, at certain times, as a refuge asset, given that land values generally increase faster than the inflation rate (Schimmenti et al., 2013).

Thus, it can be inferred that it is an imperfect market where uniform pricing does not occur across the entire market due to various factors. The main among these ones is the lack of homogeneity that characterizes land assets, owing to their specific characteristics that make it challenging to find two identical plots with the same value. Moreover, the land market is local in nature, with a relatively small number of operators (buyers and sellers). Consequently, prices are set within a market regime, which is very similar, as previously noted, to that of a bilateral oligopoly; as a result, high market costs are incurred due to lengthy negotiations and the frequent involvement of intermediaries.

In 1970, specifically regarding the transparency of the Italian land market, it was already asserted that transparency is a requirement of such importance that it has become widely accepted that a country is as economically developed as it is able to bring transparency to the market for goods subject to exchange (Grillenzoni M., 1970).

The limited transparency of the land market is linked to the natural confidentiality of agricultural operators and the scarcity of informational sources on market prices, compounded by the low transaction volume (Ascuito et al., 2009).

The average annual land area sold in Italy, slightly more than 0.5% higher in 2023 than the previous year, is about 1-2% of the total area (Arzeni, 2023). This reflects a sluggish market, as

foreseen by Vanzetti as early as in 1965, who accurately predicted that the level of activity in the land market would increasingly depend on incentives for buyers. Indeed, according to the CREA annual report (2023), many farmers preferred renting land rather than purchasing it, given the lingering uncertainty regarding funding opportunities from the 2023-2027 CAP Strategic Plan; the trend of land leasing, moreover, has been present for several decades and it is growing. Often, therefore, the economic and scientific importance of land market is overlooked in favour of the urban real estate market. However, there are several reasons why land market plays a fundamental role, from an economic, environmental, and social perspective. Indeed, land remains a symbol of stability for the economy of every country. Excessively high or rapidly rising land prices can lead to speculative bubbles (Povellato, 2013), with serious consequences for a country's economy. Conversely, a stable and transparent land market contributes to balanced economic growth. Land is also one of the safest and most stable investments. Many investors view the land market as a value reserve (Savastano, 2011), especially during economic uncertainty (Povellato, 2009). Moreover, it is essential to highlight that agricultural lands are one of the main sources of collateral for mortgage loans (Nickerson et al., 2012), making a reliable valuation crucial to prevent financial crises in the banking sector. Land is recognized for its pronounced multifunctionality, allowing it to be used for both agricultural and non-agricultural purposes (Menghini, 1998; Henke, 2004; Casini, 2009). However, land is a finite resource; it is also a limited supply asset that often cannot meet demand, leading to increased competition for land. Especially now, many potential buyers or entrepreneurs (with significant financial resources) want to buy land for non-agricultural purposes. In this context, differentiated markets emerge based on the types of actors involved in land demand. On one side, there is a predominance of demand for land from farmers for agricultural use, focusing primarily on soil fertility and certain accessory features (such as irrigation and other land improvements); thus, the interest of this type of potential buyer is directed towards the land income-generating capacity. In this case, considerations are primarily related to the trends of major agricultural product markets and agricultural policy, which generally have a significant impact on agricultural income. On the other hand, there is a land demand depending on the alternative (even if only potential) non-agricultural use of land; in this case, demand is highly heterogeneous, and land values are no longer based on agricultural income parameters. Sometimes, the two markets overlap, resulting in land prices no longer solely correlated with the agricultural sector's economic performance (Asciuto et al., 2009).

Therefore, it is necessary to regulate and achieve a balance between agricultural and non-agricultural uses to prevent significant portions of land from being taken away from agricultural production, given that, as early as in 1987, Grittani argued that, in the last thirty years, human encroachment has irreversibly removed about 1 million hectares from agricultural activity.

Recently, significant interest has arisen from the 17 Sustainable Development Goals (SDGs) outlined in Agenda 2030, which address various challenges to promote sustainability in the agricultural sector. Among these, food production, environmental sustainability, and poverty alleviation are three of the 17 goals linked to the land and agricultural sector. Several of these goals reflect the importance of a sustainable approach to agriculture, integrating environmental, social, and economic aspects to foster a more resilient, equitable, and ecologically sustainable agricultural sector capable of guaranteeing food security for the entire population.

Literature on the Land Market

Internationally, scientific literature regarding the land market has always attracted the interest of a limited number of researchers and authors.

Over the years, this topic has acquired increasingly varied dimensions: while initially focused on studying the land market from a macro/trend perspective, scientific interest is now growing in understanding the effects of changes in modern society, which seems to seek salvation in its origins, returning to the land as a key to achieving sustainability goals, green energy production, and combating climate change.

Alston (1986), analysing the growth of land prices between 1963 and 1982, suggested that most of the increase in real land prices could be explained by the real growth of net rental income for land. In 1991, Rey analysed the trend of agricultural land prices in France over three decades (1950-1986), as did Murphy and Nunan (1993) in Ireland from 1901 to 1986. The economic effects of state policy on land transactions in Egyptian agriculture after government intervention in 1952 were studied by El-Ghonemy (1992).

Donoso et al. (2013) studied the relationships between farmland values and factors associated with the growth in Chilean agriculture.

Jadevicius et al. (2018) studied the dynamics of English average farmland prices through a two-century analysis of English farmland price series.

Shigeto et al. (2008) examined trends in the land market, including prices and rents, in Japan, while Buday (2007) studied the land market in Slovakia, highlighting the demand increase due to investors buying land to build mechanical industries, while land for agricultural purposes recorded very low prices. A few years later, Buday (2011) found that plots smaller than one hectare had higher unit prices than larger plots, concluding that buyers intended to use these lands for non-agricultural purposes, such as construction, recreation, sports, etc.

In Brazil, the study by Palludeto et al. (2018) aimed to assess whether variations in the cultivation and prices of three staple products for agriculture in the state (sugarcane, soy, and corn) could affect agricultural land prices.

Kuethé and co-authors (2022) focused on market operators' expectations regarding land value trends.

Indeed, fluctuations in agricultural land prices can depend on (i) the inflation rate and variations in real capital returns (Just and Miranowski, 1993); (ii) transaction costs (Lence, 2001); and (iii) improved incentives for farming, urbanization, rising population density, and improved tenure security, which are possible drivers of rising land prices (Wineman and Jayne, 2018).

According to Kionka et al. (2022), land market liquidity is characterized by regional and temporal heterogeneity.

However, other factors, such as the type of buyer, can influence land demand. Curtiss et al. (2013) found that non-agricultural sector participants make higher offers than agricultural operators, showing greater interest in locational rather than productive characteristics of land. This type of non-agricultural operator now plays an almost dominant role in the land market, substantially contributing to the increase in land demand, as observed in the Czech Republic from 2008 to 2014 (Curtiss et al., 2021).

In this regard, Mishra and Moss (2013) examined the impact of off-farm income on farmland values, finding that a 1% increase in off-farm income could increase per-acre farmland value by between 0.15% and 0.21%.

Similarly, studying land ownership structure in terms of fragmentation and pulverization (Schwarcz et al., 2013) is also important, as these aspects can influence land market dynamics. It is essential to understand the effects of community policies (Weersink et al., 1999; Lerman and Shagaida, 2007; Mishra et al., 2011; Vyn et al., 2012; Loughrey and Geoghegan, 2024) and environmental policies (Vukina and Wossink, 2000; Lee et al., 2021).

Feichtinger and Salhofer (2016) examined the impact of the CAP and, in particular, the Fischler reform on agricultural land prices.

Latruffe et al. (2008) analyzed the effect of various financial supports on land prices. In a country like the Czech Republic, where most agricultural land is leased rather than owned, EU incentive benefits are more likely to be transferred to landowners than to producers, thus threatening the financial stability of the entire agricultural sector.

Research conducted by Lee et al. (2022) provides some evidence on the causal impact of green payment programs on farmland prices, finding that green payment schemes raise agricultural land prices by an average of 3.9 percentage points. On the other hand, a 10% reduction in agricultural financial support would reduce land prices by 3.3% to 5% (Feichtinger and Salhofer, 2013).

However, the use of appropriate land policy tools that leverage multifunctional role of land to achieve sustainable development goals is an effective means of promoting the land market (Ibatullin et al., 2024).

The interventions implemented by the CAP have indirectly contributed to changing farm structure, as noted in Poland, where a study by Sikorska et al. (2009) showed that the most stable farms are those incentivized by the CAP. The result is a trend towards the polarization of farm structure, with a high incidence of large and small farms.

Several authors have studied the determinants of land values through hedonic pricing (Boisvert et al., 1997; Weliwita and Govindasamy, 1997; Maddison, 2004; Patton and McErlean, 2003; Patton and McErlean, 2004; Huang et al., 2006; Devadoss and Manchu, 2007; Gracia et al., 2007; Marks-Bielska, 2013; Nilsson and Johansson, 2013; Sklenicka et al., 2013; Reydon et al., 2014; Awasthi, 2014; Choumert and Phélinas, 2015; Lehn and Bahrs, 2018; Sufyan Ali et al., 2018; Lee, 2021; Giuffrida et al., 2023).

Recently, De Noni et al. (2019) and Giuffrida et al. (2023) employed a spatial lag model to consider spatial dependence between agricultural land prices of geographically close areas due to factors such as soil quality, climatic conditions, access to markets or infrastructures, etc. The spatial lag model includes a term representing the weighted average of values of adjacent areas, correcting the bias resulting from spatial autocorrelation. It allows the inclusion of both direct and spillover effects by providing more accurate and reliable estimates than traditional linear models, which ignore spatial interactions. Some authors investigated the variation in farmland prices in specific vineyard production zones such as PGDO areas (Tempesta et al., 2021), analysed the causal effect of losing access to water for irrigation on farmland prices (Chang et al., 2024), the negative influence of proximity to biorefinery plants on agricultural land value in the U.S. (Park, 2022), or factors driving the number of agents competing for specific farmland in Brittany, France (Piet et al., 2021).

Other authors focus on soil quality parameters to reconstruct their influence on land prices over time (Nivens et al., 2002; Meissner and Musshoff, 2022).

According to other studies, assessing the reliability of land value data sources used for analysing agricultural land market trends is important (Zakrzewicz et al., 2012; Kuethe and Ifft, 2013), by paying particular attention to discrepancies between estimated values and market prices (Tempesta et al., 2021).

Another objective in the literature has been to understand the effect of urban expansion on land values (Shi et al., 1997; Cavailhès and Wavresky, 2003; Livanis et al., 2006; Delbecq et al., 2014; Lee et al., 2020). Salois et al. (2012) aimed to realise whether farmland values are more closely related to urban pressure or to farm income. According to Hanson et al. (2018), between 2000 and 2010, the influence of agricultural productivity increased while urban influence on agricultural land prices decreased.

In Italy as well, Tempesta and Thiene (1997) analysed factors determining land values in a metropolitan area heavily influenced by urban effects.

Additionally, Sheng et al. (2018) find that infrastructure can positively impact land value.

In recent years, the theme of green energy production has become increasingly prominent, and some authors are studying how the spread of alternative energy production methods may be related to the agricultural land market.

Myrna et al. (2019) investigate the impact of wind energy and biogas production on agricultural land purchasing prices in Germany.

Lee et al. (2021) examined the effect of solar energy incentive projects on agricultural land prices before and after energy market liberalization.

Abashidze and Taylor (2023) also note that the presence of photovoltaic plants can indirectly influence land values, considering their adaptability, which is beneficial for future solar energy development. Conversely, according to Chang and Lin (2023) in Taiwan, the regulation of territorial zoning and rules for solar panel installation have led to a 21.8% decrease in agricultural land prices.

Another critical issue that is increasingly impacting the agricultural sector is climate change. The first authors to explore the effect of climate change on land values were Mendelsohn et al. (1994). They found out that climate changes not only affect production but that the effects of these changes would also be reflected in the capital value of land. Subsequently, other researchers were attracted to this issue, conducting empirical studies in various parts of the world (Weber and Hauer, 2003; Reinsborough, 2003; Polsky, 2004; Deschenes and Greenstone, 2004; Schlenker and Roberts, 2009; Ortiz-Bobea, 2020; Quaye et al., 2018; Shakhawat Hossain et al., 2020).

Structure and Objectives of the Thesis

This thesis aims to consolidate the results of three years of doctoral research, during which various topics were explored, all sharing a common focus on the land market and, more specifically, on the concept of land value. Indeed, the objective of this thesis has been to address the theme of land value from multiple perspectives: examining the factors that influence its variation over time and space, emphasizing the importance of accurate valuation for its fiscal and broader implications, and proposing practical solutions in the hope of overcoming issues that have become almost entrenched in the Italian valuation system.

Chapter 1 contains a Systematic Literature Review (SLR) on the characteristics of agricultural land that contribute to the formation of agricultural land value and consequently affect their market prices.

To date, to the best of our knowledge, the only available information in this respect is found in grey literature or belongs to the knowledge and experience of professionals working in the field of agricultural land valuations.

For this reason, we decided to conduct a systematic literature review to collect and explore all the intrinsic and extrinsic characteristics involved in a valuation process or affecting the market prices of land. Specifically, this SLR focused on parcel-level characteristics, but did not overlook studies that also included macro-level factors in their analyses.

In Italy, the lack of transparency and the absence of a database containing real estate transaction prices, coupled with the low number of transactions within the land market, make it challenging to adopt scientifically rigorous and reliable appraisal procedures, such as those used in Mass Appraisal, which are widely used in countries where there are no barriers to data dissemination and sharing. Currently, the most widely used method by professionals is the single-parameter comparative method, a parsimonious procedure that is operationally simple but potentially lacking in objectivity, leaving too much room for the discretion of the appraiser in estimating the value of an asset.

However, there is a method recognized by all valuation standards, known as the Market Comparison Approach (MCA), currently applicable only to urban property valuation, which could represent a breakthrough in the valuation discipline for estimating market values of land assets. So far, there have been few attempts in the literature to adapt the MCA to the valuation of agricultural land, mainly due to the characteristics of land, which are often qualitative and difficult to quantify and standardize compared to those of urban properties. Among these, we find our article titled "Analysis of the initial steps of the Market Comparison Approach (MCA) for its application to agricultural land: parameters of the market segment and real estate data," published

in *Aestimum* and discussed in Chapter 2. This work focuses on two of the seven stages that characterize the MCA: selecting the parameters that define the market segment and identifying the characteristics of agricultural land to include in the procedure.

For both stages, each step was adapted to the specificities of agricultural land and the land market in general.

The path to potentially validating the MCA for agricultural land valuation is still long and uncertain. There is no guarantee that satisfactory results will be achieved that could lead to its future application. However, success in this endeavour would mark a significant breakthrough for the entire field of valuation.

However, even the results of MCA (Market Comparison Approach) can be hindered by the lack of market transparency, which limits the information available to appraisers.

In Italy, the real estate market, and especially the agricultural land market, has historically been characterized by a lack of transparency, making it difficult to produce accurate and reliable valuations. Until recently, real estate appraisal in Italy relied primarily on the individual experience of experts, using simple procedures subject to subjective interpretations, referred to as *expertise*. This approach was justified by the opaque nature of the market, which made it challenging to gather reliable data on real estate transactions.

Over time, inspired by experiences from other countries (such as the United States, where the market is notably more transparent), Italy has also promoted the adoption of market-oriented valuation methods to move away from reliance on *expertise*. However, a significant gap remains between what valuation standards require and what appraisers can actually implement in professional practice. This discrepancy stems from legal, technical, and economic issues that hinder the comprehensive collection of market data necessary for accurate appraisals.

In this regard, we published a study in *Journal of Infrastructure, Policy and Development* titled “A wall between real estate valuation standards and professional appraisal practice: A focus on the Italian market” (Chapter 3). The study provides a detailed analysis of these obstacles and presents a case study describing an actual real estate valuation, highlighting the degree of uncertainty associated with the estimates. In particular, the article emphasizes how the lack of transparency in the Italian real estate market and the absence of centralized access to data make it difficult for professionals to obtain reliable estimates, as required by standards.

Chapter 4 includes the article titled “The Land Cadastre in Italy and some fiscal implications: a case study,” published in *Aestimum* in 2022. This work was conceived to assess whether the current cadastral rates adequately reflect market prices by analysing agricultural land transactions in two areas of Western Sicily. Given that the last revision of the cadastral rates dates back to

1978-1979, it is necessary to determine whether the principles of vertical and horizontal equity are observed or whether fiscal inequality exists to the detriment of taxpayers. The methodological approach used is based on comparing the fiscal values of land properties with the prices paid for them. Using paid prices as a benchmark is essential since prices more accurately reflect not only the true value of a property but also economic dynamics.

Thus, the research aims to bring out these inequalities to emphasize the need for a revision of cadastral rates, or preferably, the enactment of a reform that replaces the income-based taxation system with one based on market values. This approach would help ensure that the concept of fiscal equity is respected as much as possible.

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CHAPTER 1

Agricultural land market: a Systematic Literature Review on the factors affecting the price discovery process

Paper in **submission**

Agricultural land market: a Systematic Literature Review on the factors affecting the price discovery process

ABSTRACT

The agricultural sector has been paid significant attention by the 17 Sustainable Development Goals (SDGs) outlined in Agenda 2030, where the main agricultural issues are dealt with to foster sustainability in the primary sector. The main aim of this study is to sort out the factors which contribute to the explanation of the agricultural land prices variability both at micro (parcel) and at macroeconomic (country) level. To achieve this goal, a Systematic Literature Review (SLR) was conducted to synthesize existing studies on this topic, by selecting the papers from the Scopus and Web of Science (WOS) databases through specific keywords. The SLR is carried out through the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement 2020 guidelines, therefore ensuring a rigorous and comprehensive review of relevant literature.

Keywords: farmland values; parcel-level characteristics; land assessment.

1. INTRODUCTION

The land market is essential to economy of each nation, significantly impacting food production and security, environmental sustainability, and poverty reduction (Deininger and Byerlee, 2011; Muraoka et al., 2018; Petrescu-Mag et al., 2019). As a limited resource, land is vital for preserving ecosystems, and the increasing worries about soil degradation, desertification, and biodiversity loss (Lal, 1994) highlight the necessity of maintaining a delicate balance to ensure sustainable land use practices.

Historically, land has been considered a *safe haven asset* (Grillenzone and Bazzani, 1996; Gorton, 2017), a resource whose importance could be crucial in specific economic circumstances (Povellato, 2009). It is seen as capable of safeguarding the value of capital from inflation, as land values sometimes grow more than the inflation rate and sometimes they do not (Schimmenti et al., 2013). For instance, in Italy, according to the latest report from the Council for Agricultural Research and Economics Analysis (CREA), in the period 2000-2022 the real price of agricultural land has dropped by about 20% except for some years (Povellato, 2022).

However, land remains one of the most valuable resources. In countries like the United States, according to the data published by United States Department of Agriculture (USDA), the farm real estate was 84% of the total value of the country's farm assets in 2009 balance sheet of the sector (Nickerson et al. 2012). Despite being fundamentally important, the land market often takes a back seat to urban real estate, neglecting the vital role of land in sustaining welfare. The transition of land from agricultural to non-agricultural uses, combined with instances of land abandonment, has placed considerable pressure on the availability of cultivable land. These factors have contributed to a decreased interest in the land market, even among real estate appraisers (Agosta et al., 2023). However, recent developments suggest a potential shift in this trajectory. Significant attention has been drawn to the 17 Sustainable Development Goals (SDGs) outlined in Agenda 2030, which aim to tackle various agricultural challenges and promote sustainability in the sector (United Nations, 2015).

Several of these 17 SDGs reflect the importance of a sustainable approach to agriculture, integrating environmental, social, and economic aspects to promote a more resilient, equitable, and ecologically sustainable agricultural sector able to guarantee food security for the entire population. Additionally, ensuring safe and equitable access to land remains a crucial component (Weitz et al., 2014).

The FAO report 2023 highlights that agriculture value added went up by 84% between 2000 and 2021, reaching USD 3.7 trillion. In recent years, farm real estate values have surged to historic levels, setting new records across much of the United States in both real and nominal terms (Borchers et al., 2014). From 2009 to 2023, the average value of both irrigated and non-irrigated cropland in the U.S. increased by 107% (USDA, 2023). Similarly, in European Union countries, the unit price of arable land saw a 3% rise from 2021 to 2022 (Eurostat, 2024). In Italy an increase of 1.7% in property transactions compared to 2021 has been recorded (Povellato, 2022), confirming the ongoing growth trend in the sector and a contextual increase of the total transaction area (+ 7.5%). Moreover, the annual number of property transactions exceeds 150,000, well above the figures recorded in the last decade. These data demonstrate a growing interest in the land market likely stemming from increased public awareness of environmental sustainability and land consumption.

The increasing demand for land-based products such as food and bioenergy has intensified competition for land (Haberl et al., 2014). This has contributed to the escalation in farmland prices, which can also be attributed to the rising participation of non-agricultural investors. Factors driving this include low-interest rates and concerns about potential high inflation (Lehn and Bahrs, 2018).

However, the real estate market still faces challenges related to transaction transparency and the availability of scientifically rigorous data, especially concerning agricultural land transactions, which often lack precise information (Festa et al., 2021; Gholipour et al., 2023). In France, greater transparency in the land market is requested in order to monitor and analyse changes in demand-supply relationships across time (Buitelaar, 2014).

The opacity of the land market is derived from insufficient information about market prices, both due to limited transactions and the traditional caution of industry operators (Asciuto et al., 2009). It is also a consequence of mutual distrust between citizens and the tax authorities, perpetuated by an ill-conceived fiscal policy in Italy, despite the opposite trend in many European countries (Grillenzoni, 1992). Overall, prices, contracts, rights, and land use plans data should thus be publicly available to help public institutions and local people monitor the land market trends and the effect size of the fiscal policies adopted. Moreover, if this information were available, it would be very useful for those who want to invest in the agricultural sector (Deininger and Byerlee, 2011).

This lack of transparency, a *normal business practice* in some places (Gholipour et al., 2023), also affects the reliability of real estate valuations, which are often based more on the personal experience of the appraiser (so-called expertise) than on traceable data (Simonotti, 2003; Ciuna et al., 2014; Ciuna et al., 2015). It is important to consider the limited uniformity of land as a valuable asset, possessing unique characteristics that reduce homogeneity, making it challenging to generalise the market at progressively broader territorial levels, such as regional and national levels (Schimmenti et al., 2013). Each parcel of land is potentially different from others, and considering all the features that make up the land asset, it is difficult to find two perfectly identical pieces of land with the same value.

Moreover, it is essential to highlight that agricultural lands are one of the principal sources of guarantee for mortgage loans (Nickerson et al., 2012), and a reliable valuation becomes crucial to prevent a financial crisis in the banking sector (Tempesta et al., 2021).

To overcome these challenges, as suggested by some authors (Simonotti, 2011; Berloco, 2012; Agosta et al., 2023), it is necessary to have databases containing all the information relevant for valuation purposes and to develop an estimation process that is scientifically rigorous, suitable for heterogeneous assets such as agricultural lands, straightforward to apply by the appraisers and compliant with real estate appraisal standards.

The development of an appraisal method, capable of assigning the right value to characteristics related to sustainable agricultural practices and environmental protection (such as water availability, presence of landscape constraints, proximity to pollution sources, etc.), could be useful in understanding the

risk associated with an irresponsible use of natural resources actually under immense pressure (Riaz et al., 2020).

The value of agricultural land is influenced by a complex interplay of economic, social, political, and institutional factors such as inflation, economic and demographic development, and fiscal policies. These factors explain why land values vary over time and across large geographic regions. Additionally, specific intrinsic characteristics like topography, soil composition, hydrology, and structural attributes further contribute to the variability of land values within the same area and at any given moment (Gallerani et al., 2011).

This research aims to comprehensively identify both intrinsic and extrinsic factors that contribute to the pricing of agricultural land. As Nickerson et al. (2012) suggested, many factors influencing farmland values are specific to individual parcels. To achieve this goal, a Systematic Literature Review (SLR) was conducted to synthesize existing studies on this topic. The SLR adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement 2020 guidelines (Page et al., 2021), ensuring a rigorous and comprehensive review of relevant literature. To the best of our knowledge, there is not a SLR on this specific topic.

Identifying the characteristics influencing agricultural land prices is essential to ensure accurate valuations that contribute to: i) ensuring fairness in real estate transactions to avoid unbalanced or asymmetrical financial exchanges between buyers and sellers; ii) preventing overestimation or underestimation that leads to land speculation and undermines market stability.

For those deciding to invest in the agricultural sector, the role of each characteristic and its contribution to the potential productivity of the land, translating into economic value, should be clear. Furthermore, in addition to the research objective mentioned above, this SLR study aims to answer to these other questions: Which countries are interested in the topic and when? Which reasons moved the researchers to study the land market and its price formation mechanisms? In the case of an empirical analysis, what data were utilised by the researchers for the survey? And lastly, what methodology did they use?

Answering these questions is fundamental for starting to take a step forward in the academic world on these issues.

2. METHODS

The SLR conducted in this study followed the PRISMA Statement 2020 guidelines, employing the PRISMA flow diagram to ensure transparency in the review process. Data were extracted from two prominent research databases, Scopus and Web of Science (WoS), known for their comprehensive coverage and suitability for bibliometric analysis (Singh et al., 2021).

To gather relevant studies, a query was formulated using a Boolean algorithm tailored to the research objectives. This query was then applied and refined in the "Advanced Search" functionalities of both Scopus and WoS, aiming to identify studies that address the intrinsic and extrinsic factors influencing agricultural land market prices comprehensively.

The search query used in Scopus was: *TITLE-ABS ((agricultural-land* OR land* OR farmland*) W/5 (price* OR valu* OR appraisal) AND (characteristic* OR factor*)) KEY (land-price* OR land-market OR land-value* OR agricultural-land-price* OR agricultural-land-valu* OR farmland-valu* OR farmland-price* OR assess* OR valuation*) SUBJAREA (econ OR agri).*

The search query used in WoS was: *TI=((agricultural-land* OR land* OR farmland*) NEAR/5 (price* OR valu* OR appraisal) AND (characteristic* OR factor*)) OR AB=((agricultural-land* OR land* OR farmland*) NEAR/5 (price* OR valu*) AND (characteristic* OR factor*)) AND KP=(land-*

price OR land-market OR land-valu* OR agricultural-land-price* OR agricultural-land-valu* OR farmland-valu* OR farmland-price* OR assess* OR valuation*) AND SU=(Econ* OR Agri*).*

Searches were performed in December 2024.

Initially, during the identification phase, queries were tailored to search for key terms within the titles and abstracts. It should also clearly be stated that the Boolean operator “W/n” (in Scopus) and “NEAR/n” (in WoS) in combination with the terms reported in the queries were inserted to refine the search since it is usual that these terms are near. The terms sought in titles and abstracts were chosen to focus the research as much as possible on the intended goal. Subsequently, the search was refined by adding terms identified like keywords, *KW*. These *KW*, which include terms commonly used in this field, were added to capture as wide a sample of articles as possible.

Furthermore, the search was refined by applying filters related to specific subject areas of interest, specifically economic and agricultural sciences, *SA*. Non-English records were excluded, and no temporal limits were imposed.

Following the identification phase, which involved removing duplicates and addressing inaccessible reports, one researcher assessed the eligibility of records based on the exclusion criteria: i) Off-topic, ii) Pertaining to non-agricultural land uses, iii) Territorial studies not focusing on parcel-level analysis.

Subsequently, during the screening phase, three researchers independently reviewed the full texts of eligible records. They collected data using a predefined matrix, reported in Appendix, which included: Authors; Year of publication; Paper type; Journal; Journal ranking; Citations in Scopus and WoS databases; Publisher; Country; Research objective; Data type; Data source; Sample size; Methodology; Characteristics (parcel-level and macro-level).

Additional exclusion criteria were applied in this screening phase. Studies were excluded if they did not address the factors influencing land prices or values, focused solely on macro indicators or socio-economic factors without considering site-specific characteristics, or primarily dealt with land rent, credit, leasing, or auction markets unrelated to agricultural land dynamics. Studies investigating non-agricultural uses such as residential, urban, or industrial lands were also excluded.

Through this rigorous process, studies falling into the aforementioned categories were removed, resulting in the selection of articles for inclusion in the systematic literature review.

Concerning the use of meta-analysis, the main objective of this systematic review is to provide a narrative overview of the studies that dealt with the topic rather than a quantitative synthesis of them. Given this and the nature of the available data, the application of a meta-analysis was considered inappropriate since meta-analysis is a statistical approach to quantitative data for estimating the effect size of a specific intervention using highly homogeneous studies in terms of designs, sample size or outcomes (Pati and Lorusso, 2018).

3. RESULTS

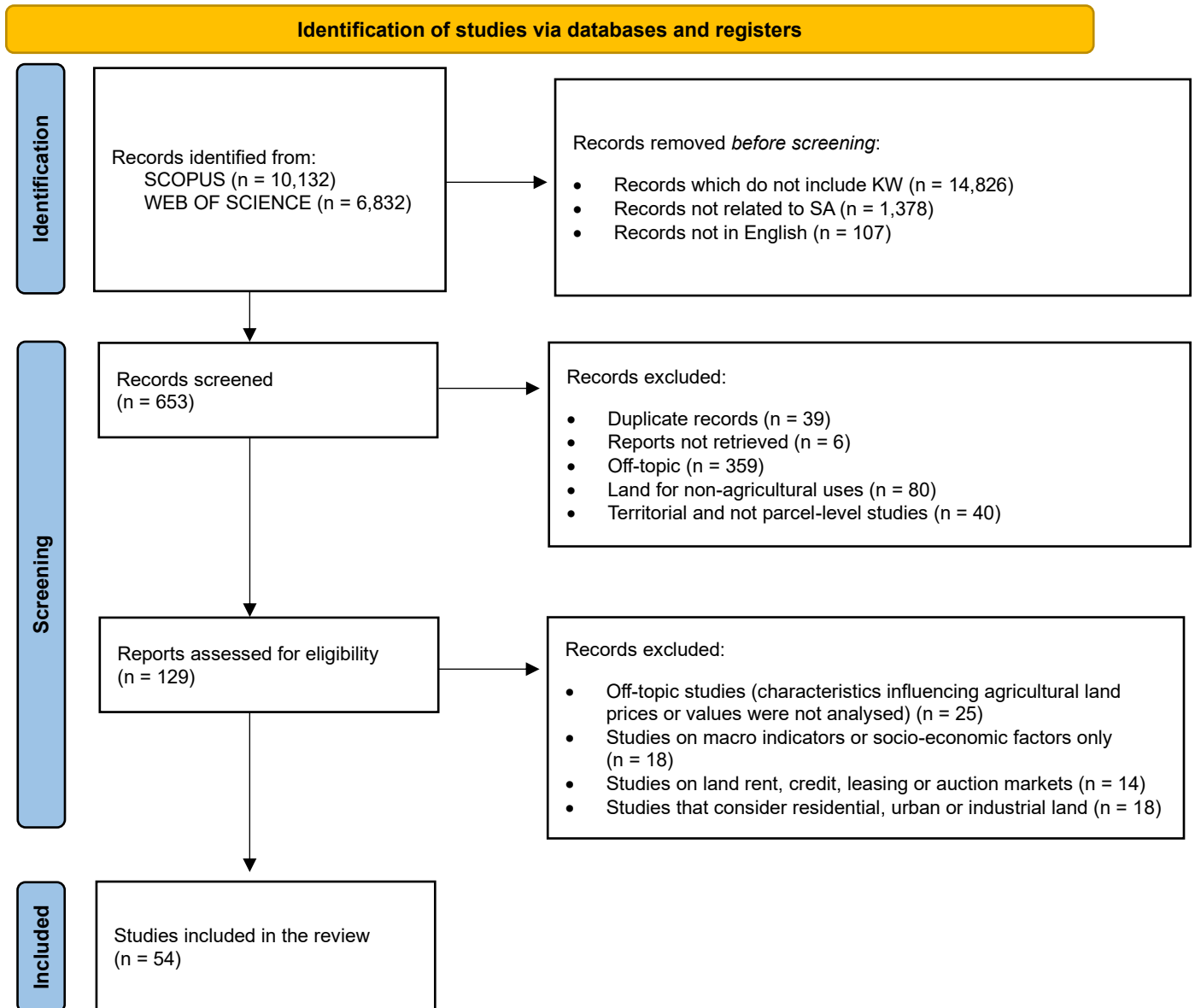
The SLR followed the PRISMA 2020 guidelines, documenting each step in a flow diagram (Figure 1). Initially, 10,132 records from Scopus and 6,832 from WoS were identified. After excluding records without key terms (14,826), those not related to agricultural land (1,378), and non-English records (107), 653 records remained (475 from Scopus, 178 from WoS). Among these, 39 duplicates were found, and 6 reports could not be accessed.

Upon reviewing titles and abstracts, 359 records were deemed irrelevant. Subsequently, 120 records were excluded: 80 were related to non-agricultural land uses, and 40 were territorial studies not focused on parcel-level analysis. This left 129 reports for eligibility assessment.

After full-text evaluation, 25 studies were found off-topic, not addressing factors influencing agricultural land prices. Additionally, 18 studies focused solely on macro indicators or socio-

economic factors, 14 on land rent, credit, leasing, or auction markets, and 18 on residential, urban, or industrial lands. Consequently, 54 studies were included in the final SLR analysis.

Figure 1. PRISMA 2020 flow diagram

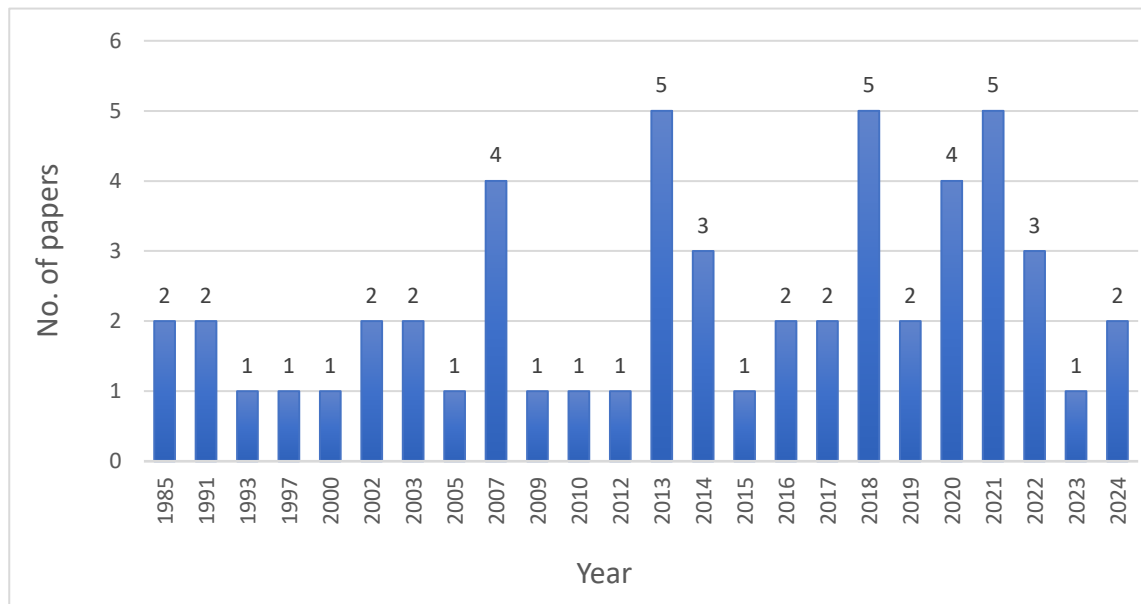


3.1 Years

The time frame in which the studies included in this SLR were published spans from 1985 to 2024, as set out in figure 2 in which the number of publications for each year is reported. It is noteworthy that the first detected papers date back almost 40 years ago, indicating that the topic was already

beginning to arouse interest. Starting from 2012, temporal continuity of the studies can be observed even if with an annual variability. On the whole, the annual scientific production on the topic is rather limited even if a moderate increase seems to be underway since 22 studies have been published in the last seven years under observation (2018-2024), namely over 41% of the overall number.

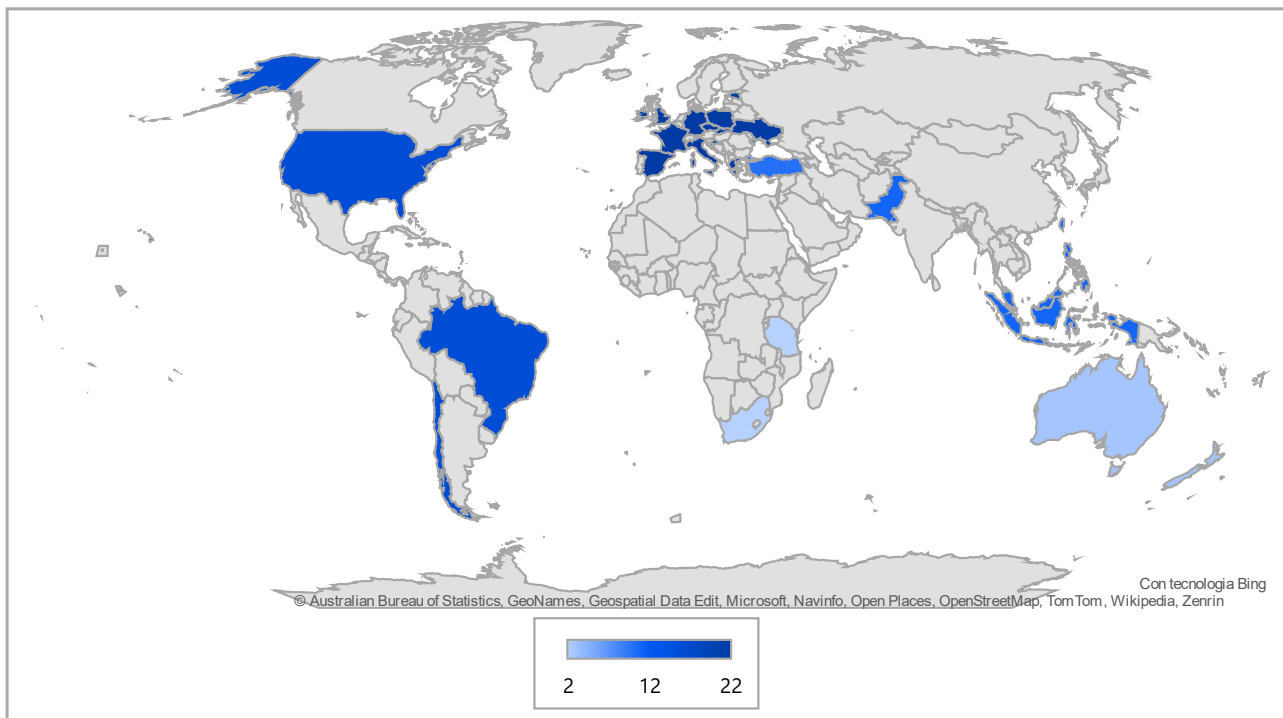
Figure 2. Trend of the fifty-one papers published in the period 1985–2022



3.2 Countries

Research on the topic is geographically diverse, with studies conducted across various countries and with varying degrees of representation (Fig.3). The breakdown by continent of the 54 scientific papers sees Europe in the first place with 22 articles, followed by America with 16, then by the Asia continent with 11 and finally by Oceania and Africa, which contribute with 3 and 2 studies respectively. The United States of America makes a substantial contribution with sixteen studies conducted, highlighting a significant interest in the subject since the first period under observation (1985-1997). The Czech Republic stands out with five studies, indicating a research focus on this topic within the region. Turkey follows with four studies. Italy and Germany have carried out two studies each, but one additional research was conducted in conjunction between the two countries. In several other countries such as Brazil, Chile, Croatia, England, Estonia, France, Greece, Indonesia, Ireland, Malaysia, New Zealand, Pakistan, Philippines, Slovakia, South Africa, Spain, Taiwan, Tanzania, and Ukraine, one or two studies at most have been conducted.

Figure 3. Worldwide distribution of the SLR studies



3.3 Paper type and Journal ranking

Out of the 54 studies included in the review, the majority (91%) are Research papers, while 5% and 4% of the total are represented by Conference papers and Working papers, respectively.

About Journal ranking, this analysis showed that eighteen studies (35%) fall into the Q1 (Top Quartile) category. Other thirteen studies (about 24%) are placed in Q2 (Second Quartile). Eight studies (15%) fall into Q3 (Third Quartile) and only three studies (6%) in Q4 (Fourth Quartile). Furthermore, for eleven studies (about 20%), this information is "Not available". The reason could be that either they are conference papers or the ranking for that journal was not available in the year of the paper's publication. Moreover, in terms of a merely quantitative relevance of the topic in the scientific literature, the most cited paper has respectively 84 (Scopus) and 78 (WoS) citations, while the least cited one has zero citations in both databases.

3.4 Research objectives

The research objectives of the studies included in the SLR present a rich tapestry of enquiries into the dynamics of agricultural land prices and values. These objectives collectively emphasize the multidimensional nature of the field, with a focus on various aspects influencing the agricultural real estate market. Most of the studies (56%) seek to identify the characteristics which affect agricultural land prices or values, reflecting a broad exploration of the factors that play a crucial role in determining the economic value of agricultural lands. Some studies (6%) focus on more specific objectives such as characteristics influencing prices of irrigated farmland (Vasquez et al., 2002), arable land (Maasikamäe et al., 2015), crop and pastureland (Borchers et al., 2014).

More recent research objectives (about 10%) concern agricultural land grading addressed to fair assignments (Tezcan et al., 2020; Ertunç et al., 2021; Ertunç and Uyan, 2022) and the identification of characteristics (Demetriou, 2016; Kilić et al., 2019) in the valuation processes within land consolidation schemes.

Few studies (about 4%) aim to understand which characteristics have shaped historical agricultural land prices and values (Copenheaver et al., 2014; De Noni et al., 2019). Others (about 4%) focus on

Evaluated Soil Ecological Units (ESEU) to determine the official land prices in the Czech Republic (Slaboch and Čechura, 2020; Slaboch and Malý, 2022).

Lee et al. (2021) extend the research question to contemporary issues, by exploring the impact of solar power promotion plans on farmland prices in response to the liberalization of the energy market and to the increasing awareness about the evolving green energy sector and its implications for agricultural land values.

Environmental factors come to the forefront in four studies (8%) with objectives like the influence of soil quality (Pichura et al., 2021), the impact of the flood (Ismail et al., 2016) and the effect of water rights (Jenkins et al., 2007) and natural amenities (Uematsu et al., 2013) on agricultural land prices or values. These objectives recognize the impact of natural elements and resource access on the valuation of agricultural lands.

The integration of technology is evident in the purpose of the study carried out by Naudé et al. (2012) who develop a farm valuation support system that aids appraisers in applying the sales comparison approach. This objective reflects a commitment to advancing methodologies and tools for accurate valuation processes.

On the other hand, according to Jafary et al. (2024), there is a growing necessity to adopt mass appraisal automatized methods for land valuation to facilitate decision-making process aligned with the SDGs.

Economic considerations are addressed by Peterson (1986) whose aim is the construction of a quality constant land price index for use in long-run agricultural profit or cost functions and by Coelli et al. (1991) who determine the marginal price of a comprehensive water supply scheme for evaluating its expansion.

Social dynamics are explored by Cavailhes et al. (2003), Kostov (2010) and Giuffrida et al. (2023). The former assess how the vicinity of the towns affects periurban land prices; the two latter studies aim to detect if the role of buyers and sellers and their personal relationship can have an impact on land prices. These objectives recognise the societal influences on land values, acknowledging the role of proximity to urban centres and interpersonal relationships.

Moreover, there are studies with the aim to uncover factors leading to the distortion of farmland prices (Chen et al., 2018), which is critical for addressing market inefficiencies and ensuring fair valuations, and others whose goal is to detect what portions of farmland value are due to productivity, location, and potential for environmental contamination (Boisvert et al., 1997).

The diverse range of research objectives shows a commitment by the academic community to address the multifaceted nature of the agricultural real estate market.

3.5 Data type and data source

The data analysis reveals several relevant trends regarding the types of data and sources used in the studies included in the SLR, reported in figure 4a and 4b.

Firstly, there is a clear emphasis on prices, constituting about 57% of the data, primarily sourced from institutions, deeds, surveys among buyers and sellers, and real estate agencies.

Additionally, it is noteworthy to highlight the significant contribution of values, representing about 28% of the data. These data mainly originate from institutional sources, advertisements in magazines, surveys among appraisers, real estate experts, and farmers, offering a picture of agricultural real estate valuation from different perspectives and stressing the need for more public sources and direct involvement of farmers in the context of property valuation.

Although it must be stressed that in some papers the concepts of price and value often overlap not finding a clear distinction between the two.

Furthermore, there is a substantial consideration of ecological aspects in 4% of the studies, which use data on Evaluated Soil Ecological Units (ESEUs) and capitalized rental income weighted for soil quality classes to determine land property values, predominantly obtained from institutional sources. This reflects a growing awareness of environmental impact in real estate valuation and profitability. Besides, geospatial factors which influence land values (2%) and the guidelines for developing a farm valuation support system (2%) were investigated through surveys among real estate experts, farmers, and appraisers, adding a social dimension to the analysis, integrating subjective perceptions into the context of valuation. These studies have been categorised as “Other” in the figure 4a.

Finally, about 6% of the publications used Cadastral Parcels as data type on which to conduct the analysis.

It is pointed out that in four studies, the data source is not specified.

Figure 4a. Data type

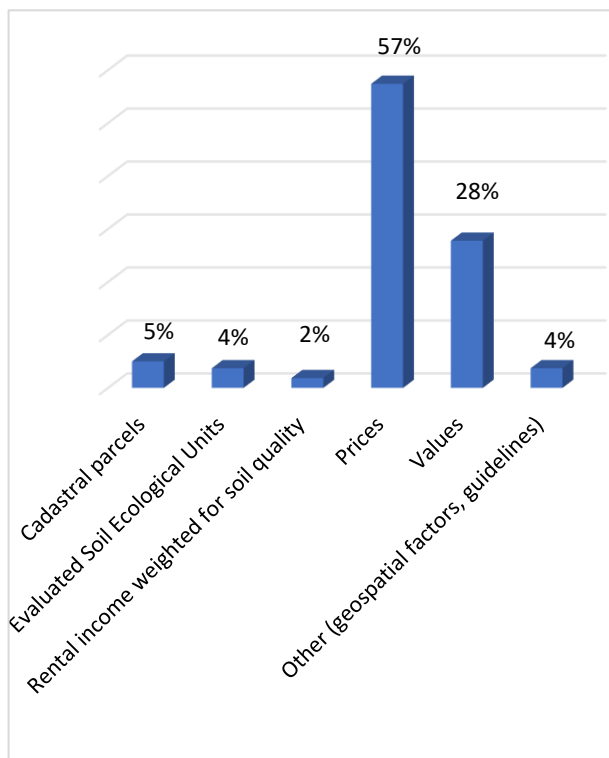
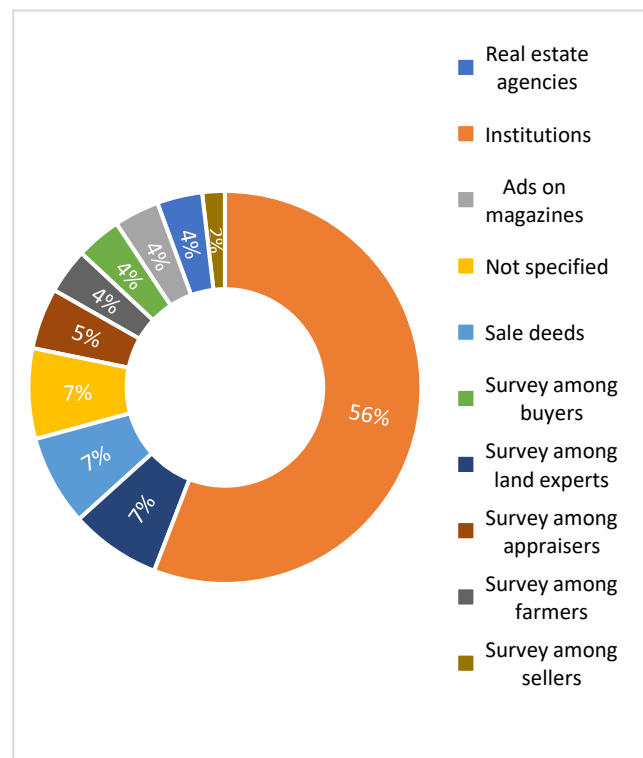


Figure 4b. Data source



3.6 Methodology

Among the methodological approaches used in the studies included in the SLR, the quantitative approach is prevalent: about 85% of the studies used econometric models and 2% statistical coefficients. In these cases, econometric models are suitable for understanding the variables, and the relative complex relationships among these ones, affecting land prices or values. An analysis of these models can provide crucial information on the key variables driving the land market.

However, there is also a diversification in the methodology adopted. Studies using algorithms account for about 4%, indicating an alternative approach to analyse complex data efficiently (Naudé et al., 2012; Ertunç et al., 2021). At the same time, the use of methods such as fuzzy logic (Kilić et al., 2019) and multicriteria analysis (Tezcan et al., 2020; Bencure et al., 2021; Ertunç and Uyan, 2022) suggests on the one hand an approach that can handle uncertainty and nuance in the involved variables, particularly useful with ambiguous or not fully defined data, and on the other a technique that

considers and weighs multiple criteria in the valuation, especially in situations where the decision involves multiple perspectives and objectives.

It is also noteworthy to include the method of standardized capitalized rental income (Pichura et al., 2021), a traditional approach based on the capitalization of income generated by property rents.

In summary, the diversity in methodology reflects the breadth and complexity of real estate research, with scholars approaching the topic with a varied range of analytical tools. This eclectic approach enriches the understanding of the real estate sector, offering not only a quantitative perspective but also computational considerations, fuzzy logic, and multicriteria analysis, thus contributing to a more comprehensive view of market dynamics and the key factors driving changes.

Considering that the majority of the studies (85%) employed econometric models, it seems appropriate to delve deeper into this topic. To this purpose, from the full-text analysis on 46 of the 54 studies at issue relevant information was extracted, primarily related to functional forms and estimation methods.

Regarding functional forms, the most frequently used were linear and log-linear (semi-logarithmic) models. Several authors included both linear and semi-logarithmic forms in their studies and employed statistical tests (such as the Box-Cox test) to determine which one offered the best fit (e.g., Coelli et al., 1991; Vural and Fidan, 2009; Samarasinghe and Greenhalgh, 2013; Ali et al., 2018; Wineman and Jayne, 2018). Nevertheless, in many cases, the semi-logarithmic form was chosen to mitigate heteroscedasticity problems among land values (Peterson, 1985; Curtiss et al., 2013; Samarasinghe and Greenhalgh, 2013; Sklenicka et al., 2013; Ismail et al., 2016; Ritter et al., 2020), setting unit land price as the dependent variable (Tempesta et al., 2021). Maddison (2000) used a linear-log form, specifying that some independent variables had been transformed, as did Warmann et al. (1985), who applied quadratic and square root transformations to the independent variables to analyse non-linear relationships with the dependent variable. The double-log transformation was preferred over other functional forms in six studies (Coelli et al., 1991; Patton and McErlean, 2003; Gracia et al., 2007; Tsoodle et al., 2007; Borchers et al., 2014; Delbecq et al., 2014).

Among estimation methods, the most commonly used include classical techniques such as Ordinary Least Squares (OLS) and more sophisticated approaches like General Linear Modeling (GLM) (Sklenicka et al., 2013), Generalized Least Squares (GLS) (Donoso et al., 2013), Stepwise regression (Warmann et al., 1985), Truncated Regression Model (Xu et al., 1991; Torell et al., 2005), and Maximum Likelihood Method (MLM) (Cavailhes et al., 2003; Czyzewski et al., 2017). Some authors (Uematsu et al., 2013; Chen et al., 2018; Lehn and Bahrs, 2018) opted for quantile regression as it is less sensitive to outliers and allows for exploring the heterogeneity of the effects of explanatory variables across different levels of the land value distribution (Uematsu et al., 2013).

A Difference in Difference (DiD) approach was employed by Lee et al. (2021) to understand the effect of solar power promotion policies on farmland prices.

To address problems related to the geographical distribution of phenomena such as spatial autocorrelation and spatial heterogeneity, spatial econometric models were employed. These models incorporate a spatial weight matrix to capture correlations between geographically proximate observations (Samarasinghe and Greenhalgh, 2013; De Noni et al., 2019; Giuffrida et al., 2023). Before using spatial econometric models, the Moran's I test is typically applied to verify the presence of spatial autocorrelation (Demetriou, 2016; De Noni et al., 2019; Giuffrida et al., 2023).

For instance, Demetriou (2016) initially used OLS, but the estimates showed spatial autocorrelation in the residuals. This prompted the choice to employ a Geographically Weighted Regression (GWR) to model spatial variation in coefficients. Patton and McErlean (2003), after conducting a Lagrange Multiplier test to identify spatial dependencies, addressed them using the Spatial Lag Model (SAR) and the Spatial Error Model (SEM). Both models were estimated using Heteroskedastic-Robust

Instrumental Variables to ensure consistent estimates in the presence of heteroscedastic errors. In the SEM, spatial dependence is modeled in the errors, while in the SAR, it is modeled by including a spatially lagged dependent variable as a regressor.

Delbecq et al. (2014) modeled spatial heterogeneity using the Smooth Transition Spatial Error Model, employing a logistic function to represent the transition from urban to rural regimes. Lehn and Bahrs (2018) incorporated a spatially lagged variable into the model using a weight matrix based on the Queen contiguity criterion. The spatial component was modeled using a SAR, including spatiotemporal lag variables as exogenous factors.

A more advanced approach was recently proposed by Giuffrida et al. (2023), who employed a spatial lag of X (SLX) model estimated using the Generalized Spatial Two-Stage Least-Squares method.

3.7 Characteristics

The characteristics found in studies included in the SLR were subdivided into two broad categories: parcel-level characteristics and macro-level characteristics. Despite, as above said, the focus of this work is the study of parcel-level characteristics, most of the papers analysed include also macro-level characteristics in their analyses. For the authors, these macro-level factors should be part of the assessment process since they contribute to the price formation of agricultural land in combination with the parcel-level characteristics.

3.7.1 Parcel-level characteristics

The SLR on the characteristics influencing the value or price of agricultural land provides a comprehensive insight into the complexity of this valuation process. The frequency with which these characteristics have been included in the studies is below described and represented in figure 5.

The most thoroughly examined characteristic was the **parcel area**. Its importance is clear with thirty-eight studies dedicated to exploring the relationship between the size of agricultural properties and their economic value. This result highlights the broad interest in understanding how the size of a piece of land may influence its economic valuation.

Alongside this factor, the **distance from the city or infrastructure** has been the subject of an equal amount of attention (included in thirty-eight studies), underlining how proximity to urban areas and infrastructure networks seems to play a significant role in determining land prices. Among positional characteristics, the **distance from the trade centre** (nine studies), **road network** (sixteen studies), **water resources** (thirteen studies), **sea view** (one study), **proximity to the coastline** (one study), and the **distance between the parcel and buyer's residence** (three studies) were also considered. Additionally, seven publications have included the **way of access** to the parcel (road frontage, by asphalt road, by dirt road, etc.).

Soil **fertility** and **yield**, investigated in thirty-two and ten studies respectively, are useful for assessing land suitability for agricultural production. In addition, **land use** in terms of **cultivated crops**¹ (twenty-four studies) can be an important indicator of its versatility and potential as is the **water availability for irrigation** purposes (presence of wells, connection to scheme water, water market rights, etc.) have been enclosed in fifteen cases.

For several studies, it is important to assess the contribution of topographic factors on land prices or values. The **slope** is the most considered factor (eighteen studies), followed by the **altitude** (ten studies) and the **shape** and **exposure**, mentioned in ten and seven studies respectively. Only one study decided to consider the effect of **erosion control practices**.

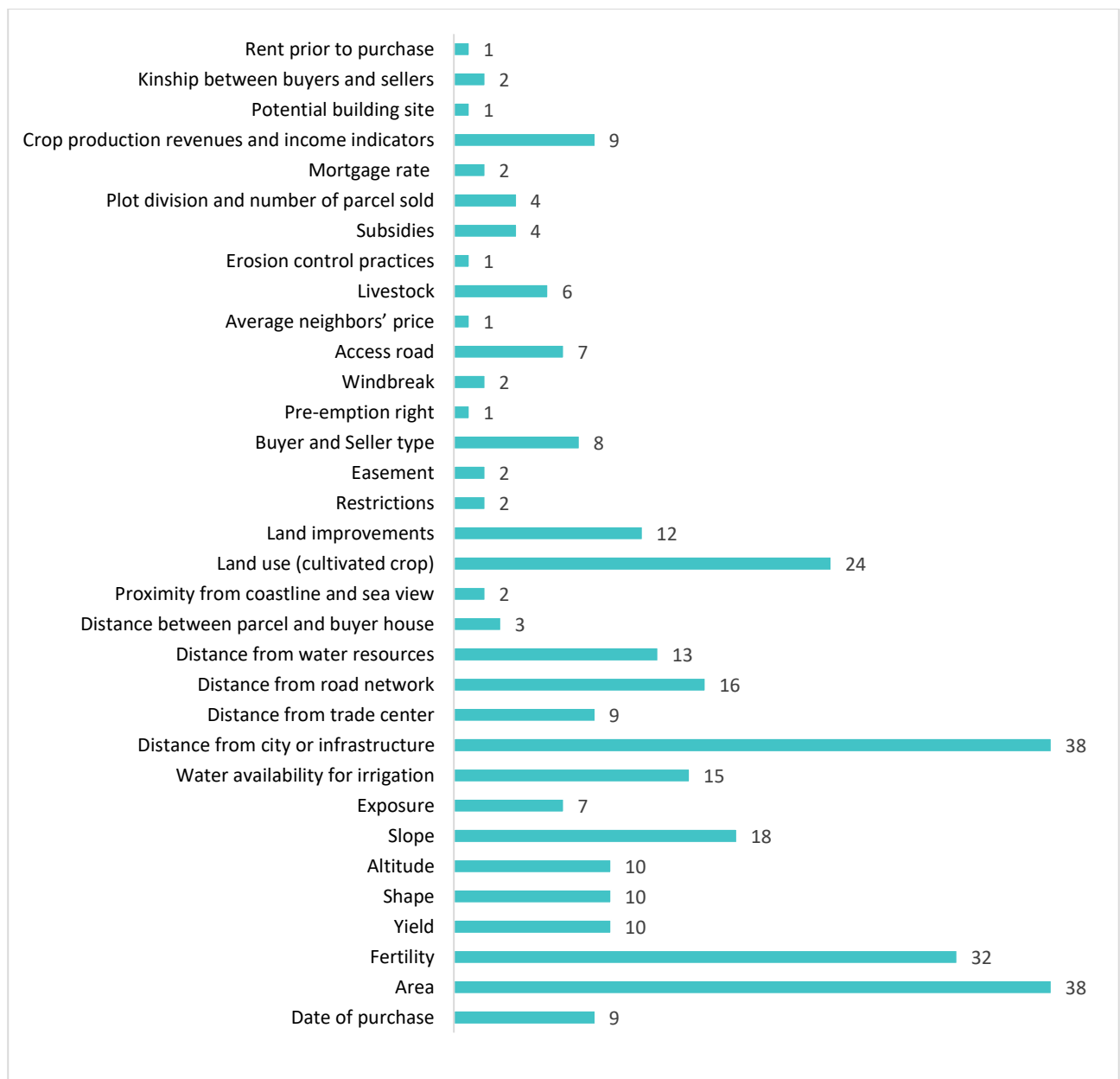
¹ In some of the 54 papers analysed, land use in terms of cultivated crop is not considered because the surveys are focused on the same crop type (arable land, vineyard, pastureland, etc.).

Moreover, there are other characteristics which can be an added value for agricultural lands such as **land improvements (buildings and number of bedrooms in dwellings, structures, fences, drainage systems**, and so on) included in twelve studies or other factors less cited as the presence of **livestock, windbreak, restrictions and easement**, the **number of plots** in which the land is fragmented and sold, or if the land is a **potential building site**.

For some authors, the **date of purchase**, the **buyer and seller type**, the **pre-emption right**, the **average neighbours' price**, and **kinship between buyers and sellers** may affect the price of land. The **rent prior to purchase** is a practice that might indicate how individuals assess the value of the land before committing to a purchase, reflecting the perceived value of the land.

Economic features related to the figure of the agricultural entrepreneur such as **mortgage rate**, **income indicators**, **crop production revenues**, and **subsidies** were also considered in some studies.

Figure 5. Frequency of parcel-level characteristics included in the studies



3.7.2 *Macro-level characteristics*

In analysing the characteristics which influence the price of agricultural land, it is crucial to consider a wide range of macro-level factors (Fig.6). At the core of this assessment, there are demographic dynamics, with **population**, **population density**, and **population development** (sixteen studies) playing a crucial role in shaping the demand for agricultural land. A **growing population** can increase the demand for agricultural products, directly impacting the value of the land as well as the **education level** and the **GDP per capita**. Another important territorial indicator is the **human development index (HDI)** which is a measure of social welfare based on income, life expectancy, and education level.

Besides, the geographic **zone** (sixteen studies) in which land is located is pivotal in the appraisal process for understanding the vocation for agricultural activity in the area, the closeness to **agro-ecological zones** or **natural amenities**, the **share of protected areas** or the spread of **hunting activity** in the area. Lands located in high-demand zones may be sold at higher prices.

Climatic data (eleven studies) assume fundamental relevance, as factors such as temperature and precipitation impact agricultural productivity, and consequently, land value. Indeed, when lands are in **wetlands** or phenomena like **floods** occur, they can cause a decrease in land values.

Similarly, the impact of fiscal policies, reflected in **fiscal values**, can influence the buying and selling of agricultural land, adding complexity to the market.

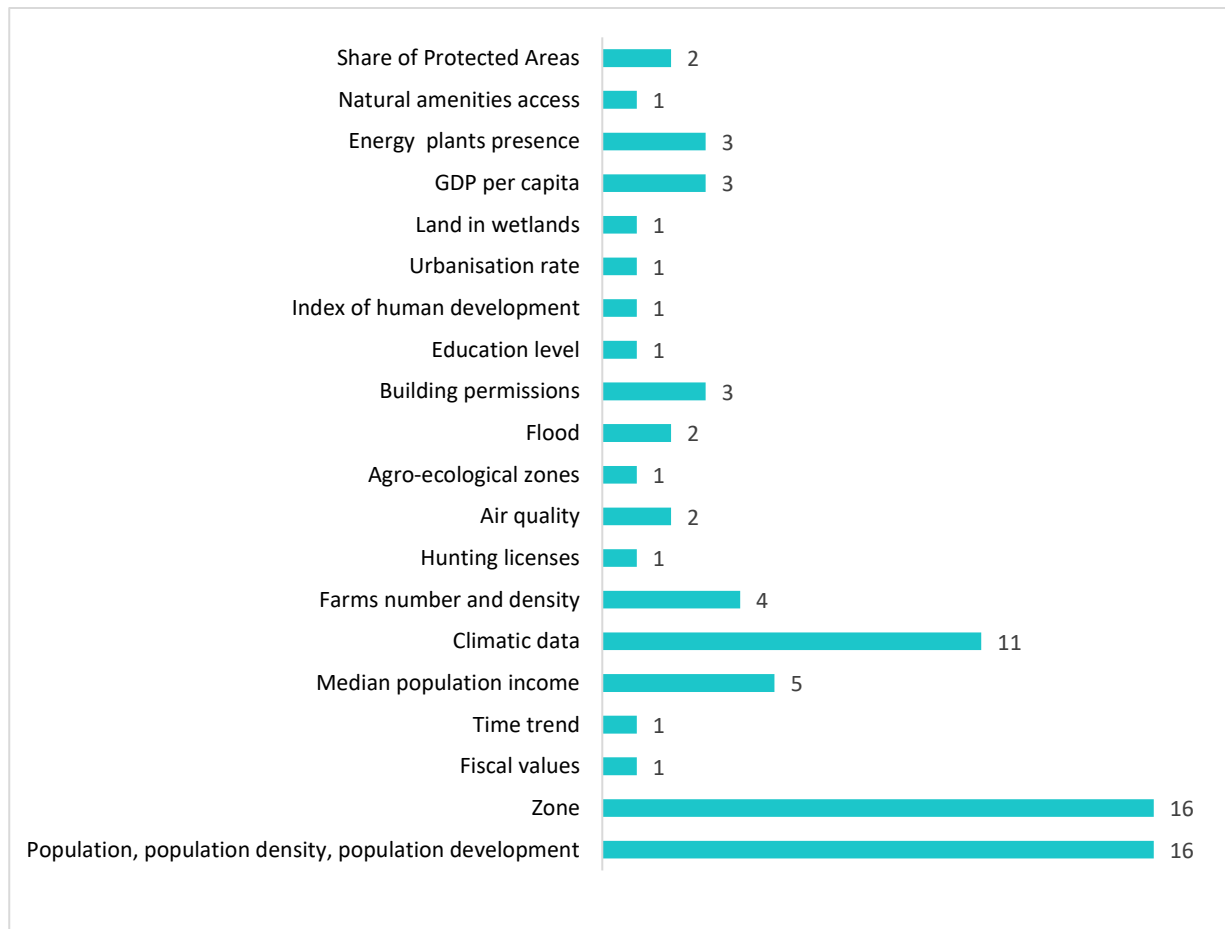
Furthermore, the **time trend** provides a clear indication of how price trends evolve, revealing stability or variations that can influence investor decisions.

The **median population income**, together with **the number and density of farms**, creates an economic environment in which the purchasing power of land can also depend on the financial situation of individuals and competition between farmers.

The **building permits** have a weight in determining the value of the land. Restrictions or building permits can alter the designated use of the land, thereby influencing the price. Also the **urbanisation rate**, which reflects the degree of urban development in the region, potentially influences the supply and demand for agricultural land, especially for people seeking more rural environments, for whom also **air quality** counts.

The presence of **energy plants** can influence the overall attractiveness of the region and, consequently, the demand for agricultural land, depending on the nature of the energy infrastructure.

Figure 6. Frequency of macro-level characteristics included in the studies



4. DISCUSSION

The review identified a notable gap in the transparency and availability of data, which is crucial for accurate land valuation. As stated by Jafary et al. (2024): “Access to accurate land prices is crucial for various aspects such as taxation, land resource allocation, real estate market management and urban development and planning”.

Improved data accessibility and transparency are essential for enhancing the reliability of valuation processes and for fostering greater market efficiency. Some authors as Maasikamäe et al. (2015) underline the importance of data quality and not aggregated data in research studies on land price formation mechanisms.

Analysing various studies reveals that evaluating agricultural lands is complex, requiring the examination of numerous factors that often vary according to the market segments analysed.

As reported by Xu et al. (1991): “It is difficult to determine the value of parcel characteristics embedded in agricultural land since such characteristics are not directly traded and priced in explicit markets”.

It is intriguing to understand the effects captured through specific variables or their proxies.

Soil fertility is one of the most important aspects in agricultural land evaluation as it represents a soil quality index and reflects land productivity. For instance, results obtained by Vasquez et al. (2002) indicate that farmland values are largely determined by agricultural productivity-related factors. However, soil fertility is a complex measure involving several characteristics (Peterson, 1986).

In this regard, Naudé et al. (2012) attempted to develop a simple measure able to reflect soil quality through an algorithm integrating soil-specific data, including effective soil depth, texture, and a combination of soil series attributes to generate a soil-type fitness index. This index reveals the agricultural suitability of different land types for various crops.

Sufyan Ali et al. (2018), combined soil texture, fertility, water for irrigation, land surface, salinity, and waterlogging into a single dummy variable (fertile or unfertile land) which positively and significantly influences prices, highlighting the importance of soil quality for agricultural productivity. The study suggests policy interventions to protect fertile agricultural lands from urban encroachment and pollution.

Vural and Fidan (2009) applied the hedonic price method inserting several soil quality characteristics obtained from the farmland records, finding out that the pH, saturated water, potassium and organic matter positively affect land values.

Peterson (1986) identified organic matter as a key indicator of soil health closing correlating with soil fertility. However, nationwide data on the organic matter content of soils in their so-called natural state – i.e. without fertilisers – are lacking. Therefore, Peterson (1986) measured fertility by the average pounds of nitrogen per acre in the upper 40 inches of soil, as nitrogen closely correlates with organic matter. The results showed that soil nitrogen content explains land price variation, somewhat surprising given the increased use of commercial fertilizers.

Soil quality adds value to the land (Xu et al., 1993; Ritter et al., 2020; Ertunç and Uyan, 2022).

Slaboch and Čechura (2020) and Slaboch and Malý (2022) suggest that climate, slope, exposure, skeletonization, and soil profile depth mainly influence the Evaluated Soil Ecological Unit price in the Czech Republic.

In addition, soil quality could include other variables such as moisture, indicators of agrochemical soil properties, groundwater level, and soil salinization type (Pichura et al., 2021).

Research carried out by Gebeltová and Malec (2018) highlighted that water erosion and anthropogenic factors negatively affect land prices.

Giuffrida et al. (2023) find out that land with low permeability is more expensive probably it is related to the lower costs for irrigation and soil tillage. Moreover, it could be an index of good agronomic characteristics of the soil which reflect a higher productivity.

Land productivity has a positive impact on the sale price per acre (Warmann et al., 1985; Jenkins et al., 2007; Tsoodle et al., 2007; Curtiss et al., 2013; Demetriou, 2016) contributing to the model explanatory power (Sills & Caviglia-Harris, 2009) and suggesting higher values for land with better soils (Wineman & Jayne, 2018). Moreover, soil quality positively influences land consolidation project success (Tezcan et al., 2020) as the fragmentation phenomenon reduces price (Tempesta et al., 2021). Uematsu et al. (2013) found that soil productivity is negatively correlated with land value in lower quantiles, possibly because owners might not fully exploit its potential due to they are off-farm workers. However, soil productivity is positively correlated with land value in higher quantiles, where more productive lands are more expensive. Similar results were reached by Sklenicka et al. (2013) who discovered an increase in farmland prices only in the most fertile land mirroring the demand from farmers.

Maasikamäe et al. (2015) observed multicollinearity between arable land ratio and soil productivity noting that: “the arable land fields are bigger if the soil productivity is higher”.

Boisvert et al. (1997) added that soil productivity, measured by crop yields such as maize, positively affects market values and rental rates with rental rates being a more precise agricultural productivity indicator due to their higher elasticity compared to price elasticity. This discrepancy could partly be attributed to the inclusion of a speculative component in total land value estimates, reflecting the

potential for non-agricultural uses since residential and commercial potential drives up land prices (Sufyan Ali et al., 2018).

Delbecq et al. (2014) found that soil quality - seen as a crop productivity index - has a positive and greater impact in urban fringe areas than in rural areas, indicating that land near cities is valued for both agricultural productivity and potential urban development.

The slope of the land has a negative relationship with land prices, indicating that less sloped lands tend to have higher values (Demetriou, 2016; Wineman & Jayne, 2018; Tempesta et al., 2021). "Slope can modify microclimate and positively influence grape quality" (Tempesta et al., 2021).

Samarasinghe and Greenhalgh (2013) found that steep and very steep slopes being valued about 37% and 52% less, respectively, than similar land in flatter areas. In Lehn and Bahrs (2018), terrain slope showed more pronounced negative effects in the lower part of the distribution, suggesting that this factor limits the prices of less expensive land more significantly.

Uematsu et al. (2013) found that plains are negatively correlated with farmland values at all quantiles, while tablelands are negatively correlated only at lower quantiles. Plains with hills or mountains have no significant impact, but hills or mountains are positively correlated with farmland values at all quantiles. Maddison (2000) finds out that the average elevation of farmland has a highly negative effect on its prices, a consistent finding in other hedonic studies. Higher elevations are associated with greater diurnal temperature variations, which negatively affect agricultural productivity. The shape of the parcel has a modest effect (Czyżewski et al., 2017), while Tempesta et al. (2021) found that shape does not have a significant effect, likely because its role is less important for small plots.

However, small and deformed parcels may affect agricultural productivity according to Ertunç et al. (2021). It is in line with Lee et al. (2021) for whom "top-quality farmland is larger and more uniformly shaped". Water source as a well or in general irrigation availability is an added value for agricultural land (Xu et al., 1991; Reynolds and Regalado, 2002; Demetriou, 2016; Ertunç et al. 2021). Their presence enhances model explanatory power (Sills & Caviglia-Harris, 2009) and adds significant value across various crops (Gracia et al., 2007) even if depending on regional agricultural needs (Tezcan et al., 2020). Xu et al. (1991 and 1993) noted that, in increasing order, centre pivot, sprinkler and rill irrigation systems contribute to increase land values.

Coelli et al., (1991) estimated the implicit marginal value of water provided through the "Scheme" in rural areas using the hedonic pricing technique. The aim was to understand how the availability of a water Scheme affects agricultural land prices.

The results show that water Scheme has significant market value, with a positive impact on agricultural land prices. Unsurprisingly, Scheme connection is valued more highly in areas without suitable groundwater. Water marketing rights have shown a positive and significant impact also in Jenkins et al. (2007) and in Karakayaci (2024), confirming the importance of these rights in the context of irrigation and land value.

Ismail et al. (2016) explored the impact of floods on land property values in Malaysia using their duration, with a specific focus on distinguishing between urban and rural areas. The study reveals that prolonged floods significantly lower land values due to crop damage and reduced productivity, leading to a decreased demand. Besides, land located near rivers tends to have lower market values due to an increased flood risk associated with river proximity.

Samarasinghe and Greenhalgh (2013) found that moderate flood risks increase land value by 5%, while severe risks decrease it by 10%. Their study also indicated that plant-available water increases land value when rooting depth is less than one meter. Rooting depth alone does not impact significantly land value; its effect depends on drainage and water availability. Slightly gravelly soils are valued higher than non-gravelly soils if the rooting depth is over 0.8 meters, otherwise, non-gravelly soils are more valuable. Reynolds and Regalado (2002) outcomes showed that different types

of wetlands can have different effects on land prices. In particular, on the one hand wetlands can make agricultural production unfeasible without a drainage system; on the other hand, the presence of wetlands could be seen as an aesthetic attribute by some individuals who might be willing to pay a higher unitary price. The authors outline that probably their study underestimates the social benefits of wetlands since this component is not captured by property sales prices.

Land prices decrease in zones where the hydraulic risk is low avoiding flood phenomena (Giuffrida et al., 2023). Land use plays a key role in determining land values (Bencure et al., 2021) since "the ability of a land to support diversified activities makes it more versatile and, therefore, more valuable" (Torell et al., 2005).

The interaction between land use and the territorial zone in which the farm is located influences land values (Samarasinghe and Greenhalgh, 2013). Fallow lands are assessed at lower per-acre values compared to cultivated lands, potentially reflecting reverse causality if less productive lands are those left fallow (Wineman & Jayne, 2018).

Prices for grassland are generally lower than arable land prices by about 26% (Ritter et al., 2020), suggesting that pastureland values might better reflect natural and recreational amenities (Borchers et al., 2014). The production of high-value crops such as fruits and vegetables is a luxury attribute to farmland values with an effect that is higher at higher quantiles (Uematsu et al., 2013), as well as the Designation of Origin certification (Gracia et al., 2007) and an intensive use of land might reflect larger future income flows (Reynolds and Regalado, 2002).

An element that emerged in Tempesta et al. (2021) is the effect of the planting expectations of a vineyard on the price of arable land and woods.

Instead, surprising results come from Warmann et al. (1985) where land cover type variables had not a significant relationship with farmland price per acre, suggesting that buyers prioritize soil productivity over land cover information.

An increase in farm size positively influences land prices (Ismail et al., 2016; Lehn & Bahrs, 2018) and the per-acre value (Samarasinghe & Greenhalgh, 2013) and it is one of the main factors which increases the value of (Torell et al., 2005), probably due to their ease of farming (Boisvert et al., 1997).

A study conducted by Uematsu et al., (2013) used the value of production per owned acre, as a proxy of farm size, finding a positive correlation with farmland values at all examined quantiles.

Xu et al. (1991), Xu et al. (1993), Reynolds and Regalado (2002), Tsoodle et al., (2007), Curtiss et al. (2013), Copenheaver et al. (2014) and Demetriou (2016) found that the larger plots tend to have a lower value per unit area.

The analysis of Wineman & Jayne (2018) reveals that plot size has a convex effect on unitary land values. This means that intermediate-sized plots tend to be more valuable per unit area compared to very small or very large plots. Also, in Sills & Caviglia-Harris (2009) and Ritter et al. (2020), the lot size initially has a positive coefficient, but this effect is attenuated by a negative coefficient on the quadratic term, indicating diseconomies of scale.

Ritter et al. (2020) incorporated both the inverse and linear terms of size into their model, obtaining the expected positive signs. This supports the notion that very small plots have a price premium, and there is a linear price increase for intermediate plot sizes, as "it cannot be expected that the price per unit of land is independent of the transaction volume" (Ritter et al., 2020).

Ritter et al. (2020) further demonstrate that for arable land, both the linear and quadratic terms are statistically significant, with the linear term showing a positive sign and the quadratic term showing a negative sign, as anticipated. However, for grassland, these relationships are reversed, with a negative linear term and a positive quadratic term. These results indicate a significant difference in the functional form when analysing grassland prices.

Differently, in Warmann et al. (1985) the farm size and the relative squared term have negative and positive signs respectively.

A different perspective is furnished by Lehn and Bahrs (2018) who found out that changes in population and Utilised Agricultural Area (UAA) negatively influence land prices, with more pronounced effects in the upper quantiles, maybe due to greater speculation and conversion of agricultural land in urban areas.

Conversely, Delbecq et al. (2014) outcomes showed a negative effect of parcel size both in urban fringe areas and rural areas.

Czyżewski et al. (2017) highlighted that under the Single Area Payment Scheme system, Common Agriculture Payment support can still act as a stimulus to increase farm size since on a larger scale of agricultural activity, these incentives programs become more effective.

The presence of buildings and other improvements such as barns, windbreaks, milking parlors has a positive and significant effect (Xu et al., 1991; Xu et al., 1993; Reynolds and Regalado, 2002; Delbecq et al., 2014; Cavailhè & Wavresky, 2003) as well as building permission (Czyżewski et al., 2017). Even if Reynolds and Regalado (2002) found a small effect size of the building value on farmland price.

The livestock rate is positively correlated with farm values, suggesting that it is an indicator of soil and/or pasture quality (Sills & Caviglia-Harris, 2009). It has a stronger positive effect in the upper quantiles, reflecting the higher demand for agricultural land in regions with high livestock density (Lehn & Bahrs, 2018). A farm specializing in livestock production negatively impact on farmland values and the impact is stronger at lower price ranges (Uematsu et al., 2013).

A particular study comes from Maddison (2000) who considered variables such as milk production quota per acre, cottages per acre, and number of bedrooms per acre. The paper shows that professional valuations are a biased indicator of sale prices because surveyors overvalue the number of bedrooms and undervalue other characteristics.

Nevertheless, since the advent of urbanisation, additional factors have begun to influence land value (Chen et al., 2018) and soil quality became irrelevant to lands used for residential, commercial and industrial purposes (Naudé et al., 2012; Sklenicka et al., 2013). Indeed, Borchers et al. (2014) and Vasquez et al. (2002) found that multiple non-agricultural attributes of farmland contribute to the market value and more in-depth the development potential represents an important determinant of market values.

In this regard, Cavailhè & Wavresky, (2003) argued that agricultural land prices are influenced by potential future residential rent and anticipated conversion dates.

Among the non-agricultural factors, positional characteristics play a central role in the valuation of agricultural land (Sklenicka et al., 2013). Several studies found negative relationships between land prices and distance from residential zones (Demetriou, 2016; Sufyan Ali et al., 2018), trade centers (Torell et al., 2005; Sufyan Ali et al., 2018; Wineman & Jayne, 2018), road network and infrastructure (Vasquez et al., 2002; Ismail et al., 2016; Czyżewski et al., 2017; Sufyan Ali et al., 2018; Wineman & Jayne, 2018; Ertunç et al. 2021; Bencure et al., 2021; Tempesta et al., 2021; Giuffrida et al., 2023; Karakayaci, 2024), coastline (Bencure et al., 2021), nearest city center (Warmann et al., 1985; Xu et al., 1991; Xu et al., 1993; Reynolds and Regalado, 2002; Sills & Caviglia-Harris, 2009; Cavailhè & Wavresky, 2003; Delbecq et al., 2014; Curtiss et al., 2013; Uematsu et al., 2013; Ismail et al., 2016; Sufyan Ali et al., 2018; Wineman & Jayne, 2018; Giuffrida et al., 2023) or from the built-up area could be a more accurate variable according to Sklenicka et al. (2013).

Nevertheless, the impact of positional factors also depends on where buyers and sellers reside, which could affect their willingness to pay and be paid respectively (Giuffrida et al., 2023).

In the temporal analysis carried out by Donoso et al. (2013), the distance between the farm and the city center is the most important characteristic for both examined historical periods.

However, lands near airports in both urban and rural areas tend to have higher value due to strategic location benefits facilitating industrial management, production, and export activities via air transportation (Ismail et al., 2016).

On the contrary, according to the results obtained by Giuffrida et al. (2023), proximity to airports has a strong negative effect on land prices as it affects the building susceptibility of soils. These results show, on the one hand, that transportation and management costs are relevant factors in determining the value of agricultural land (Vural & Fidan, 2009) on the other hand, the higher market value of land closer to city centres is due to positive impacts on surrounding land activities and development opportunities (Ismail et al., 2016). Moreover, the proximity to another farm might drive up bids for smaller land parcels, as farmers seek to expand their holdings in a specific area (Boisvert et al., 1997). Sklenicka et al. (2013) discovered that the most influential factor affecting the spatial variability of farmland prices is the closeness to a settlement area. This can theoretically be explained by the willingness of buyers to pay more for land adjacent to a village and bordering their existing parcels, as land fragmentation near villages tends to be higher. Nonetheless, the authors concluded that the primary driver for the significant rise in farmland prices is speculative interest, in relation to the potential for converting farmland and later selling it for non-agricultural purposes.

Sufyan Ali et al. (2018) used the distance from a sugar mill as a proxy for air pollution showing decreased land prices due to pollution concerns.

A comparison between rural areas and urban fringe was made by Delbecq et al. (2014) and Cavailhè & Wavresky, (2003). The former show that the distance from the nearest urban centre is not significant in urban fringe areas but has a significant negative impact in rural areas. The latter find out that agricultural land prices near the city centre are three times higher than those in remote rural areas, and small residential lots are nine times more expensive than large development lots far from the city. In addition, Czyżewski et al., (2017) aim to determine how policy affects the prices of land under the Single Area Payment Scheme. Their outcomes highlight that land properties in peripheral and city-integrated areas have lower prices compared to agricultural areas, whereas agrotouristic areas have higher prices, especially when considering prices per hectare.

Moreover, Maddison (2000) pointed out that land values are artificially influenced by the Common Agricultural Policy. Direct payments to specific farms may be capitalized into land values. These payments should ideally be treated as land characteristics and included in the hedonic price equation (see, e.g., Barnard et al., 1997). This means that some characteristics identified as important by the analysis may only seem productive because they attract direct payments.

Besides, Uematsu et al. (2013) found that direct payments positively affect land values increasing their magnitude across quantiles. Another characteristic potentially relevant is the access to land via a registered road or path (Reynolds and Regalado, 2022; Demetriou, 2016; Bencure et al., 2021), the presence of paved roads (Tsoodle et al., 2007). Sklenicka et al. (2013) demonstrated an unwillingness to pay higher prices for inaccessible land, possibly due to the risk of future negotiation failures with neighbouring landowners for access.

The population density is positively correlated with land prices and may reflect both the scarcity of available land and the urban development pressure (Sklenicka et al., 2013; Uematsu et al., 2013; Wineman and Jayne, 2018). It could be used as a proxy of accessibility and proximity to urban areas and the positive correlation with land values might signify the expected rise in land prices due to heightened demand for non-agricultural purposes (Boisvert et al., 1997).

The population density of the county where the farm is located is statistically significant in Maddison (2000). This supports the hypothesis that proximity to the market is a crucial characteristic of farmland. Alternatively, it might suggest that farmland is being purchased with the expectation that

housing construction will be permitted, with population density serving as a proxy for potential development profits. It could also be that population density reflects the influence of unmeasured amenities such as proximity to local schools or off-farm employment opportunities for the farmer's family.

Changes in population positively influences land prices, with more pronounced effects in the upper quantiles, indicating greater speculation and conversion of agricultural land in urban areas (Lehn & Bahrs, 2018). Population growth has a significant impact only in urban fringe areas and not in rural areas, supporting the idea that proximity to urban areas increases the value of agricultural land due to expectations of future development (Delbecq et al., 2014). Also, the zone and the number of farms per km² has a significant effect on land prices (Warmann et al., 1985; Curtiss et al. 2013).

The presence of a sea view is one of the eight significant variables in the land valuation process that increases the land value in Cyprus (Demetriou, 2016).

Coastal areas and areas with lakes can be more scenic and pleasing can be a luxury attribute of land affecting farmland values only at higher quantiles (Uematsu et al., 2013).

As Uematsu et al. (2013) expected, natural amenity is more “luxury” than “necessity” and it has a larger impact on farmland values at a higher value range. Furthermore, recreational activities such as fishing and hunting, have a positive impact on farmland values, but only at higher quantiles.

Instead, Lehn and Bahrs (2018) discovered that the percentage of nature reserves limits the prices of less expensive land.

Socioeconomic characteristics of the family, such as education, age, and origin, are not statistically significant individually or jointly. This suggests that family characteristics do not influence farm prices in the Brazilian land market under study (Sills & Caviglia-Harris, 2009). Instead, Boisvert et al. (1997) found out that land values are also positively related to the operators with a college education that lead them to manage farm better.

Kostov (2010) explored how personal relationships and buyer characteristics can modify the implicit prices of land characteristics. The results support the hypothesis that social capital, represented by personal relationship characteristics, affects the terms of exchange in the agricultural land market. This implies that personal relationships between buyer and seller can lead to preferential treatments that influence the final price of the land. Additionally, buyer and personal relationship characteristics appear less relevant in markets of homogeneous products with many buyers and sellers. However, the price is 19% lower when buyers and sellers are relatives (Giuffrida et al., 2023).

Curtiss et al. (2013) deepened how the changes in farmland prices are also affected by buyer typologies. In particular, they found that non-agricultural buyers, on average, pay significantly higher unit prices for farmland with the same characteristics, valuing parcels closer to towns more highly. These buyers also tend to purchase land in municipalities experiencing significantly higher population growth and lower unemployment rates, likely because these areas are more attractive for living. These findings support the hypothesis that non-agricultural land investors have intentions related to land development and speculation. Additionally, cooperatives are found to pay significantly higher prices for land located farther from district towns and in areas experiencing negative demographic trends. Non-farm companies as buyers increase the price (Cavailh  & Wavresky, 2003). Instead, according to Tempesta et al. (2021) and Giuffrida et al. (2023) when the buyer is a company, the unit price is on average higher. More in detail, Giuffrida et al. (2023) explain that when buyers are direct farmers or professional agricultural entrepreneurs the price is higher and one of the reasons could be that they pay registration fees in a fixed amount and not proportional to the declared value of the real estate.

Finally, another aspect to consider is the discrepancies between estimated values and market prices which may influence the formation of prices at a local level. In certain contexts, it can be extremely complex to identify the factors that contribute to price formation (Tempesta et al., 2021).

Average rainfall is positively correlated, while temperature has a negative relationship with land prices (Wineman & Jayne, 2018). This indicates that favourable climatic conditions increase agricultural land value. Instead, Samarasinghe and Greenhalgh (2013) find that increased total rainfall tends to reduce agricultural land values.

In Maddison (2000) three climate variables significantly impact farm prices: the number of frost days in winter, summer temperatures, and summer relative humidity. The increase in land values with more frost days in winter can be explained by the beneficial effect of cold snaps killing pests and vermin, which aids agricultural production. Conversely, high relative humidity negatively impacts land prices by promoting diseases such as mildew. Average wind speed in winter and the number of frost days in summer are also statistically significant.

Uematsu et al. (2013) showed that the mean temperature in July has a positive impact at a 0.25 quantile while, at the highest quantile, it has a negative impact. It is conceivable that a high average temperature in summer—perhaps indicative of drought condition that can result in crop loss and hence lower income from farming—can be detrimental to farmland values at the very high price range. Average relative humidity has no impact on farmland values except at the lowest quantile (0.10) where it has a positive and significant impact on farmland values. This may indicate the importance of humidity for agricultural production as a basic necessity for land parcels at the very low-price range.

5. CONCLUSIONS

The analysis carried out on the 54 papers shows that most of the studies has utilised stochastic approaches, only few authors have resorted to other analytical tools but there is not any paper which has carried out a Systematic Literature Review. From the results obtained, it is evident that a series of parcel-level characteristics play a significant role in quantifying the economic value and in determining the price of agricultural land. Among these ones, parcel area, distance from urban centres and infrastructures, soil fertility, and topography have a major influence and therefore should be considered within any valuation process. Furthermore, SLR also highlights the importance of macro-level characteristics, such as demographic dynamics, economic and climatic indicators, fiscal policies, and other territorial variables. These factors not only influence the demand and supply of agricultural land but can also provide crucial insights into long-term market trends and market segments.

The complexity of the agricultural land valuation process requires a thorough and multidisciplinary analysis that considers a wide range of quantitative and qualitative factors (for which the effect is often difficult to be quantified) and their interactions.

Accurate and reliable assessments can provide valuable information for investors, farmers, and real estate operators who are involved in land management and operate in various capacities in this market.

The results of the research show the importance of an integrated and multidisciplinary approach to assess the value of agricultural land, involving experts from fields such as agriculture, economics, urban planning, and environment. Only through such a network it might be possible to obtain a comprehensive and accurate view of the agricultural land market and to develop effective strategies to promote the sustainability and prosperity of rural and agricultural communities.

In conclusion, this SLR points out the wide degree of diversity of the characteristics considered, underlining a multidimensional approach in the studies included in the review.

Land assessment extends beyond physical dimensions, embracing cultural, environmental, and economic elements, contributing to a more comprehensive understanding of the dynamics involved in agricultural land valuation.

The relatively low number of the citations obtained by the 54 papers here analysed is the clear evidence that the price-discovery mechanism of agricultural land is a topic studied only by a small part of the international academic community.

Nevertheless, it is hoped that this work helps arise interest and awareness in the crucial role the land market currently plays and will play in the coming years due to its practical relevance for food security, financial, fiscal, credit, social, urban, environmental purposes.

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Appendix I. Data extracted from 54 studies included in the review

Authors	Year	Paper type	Journal	Journal Ranking	Citations in Scopus	Citations in WoS	Publisher	Country	Research objective	Data type	Data source	Sample size	Methodology
Sklenicka et al.	2013	Research paper	Land Use Policy	Q1	73	63	Elsevier	Czech Republic	Identify the characteristics which affect agricultural land prices or values	Prices	Real estate agencies	286	Econometric model
Dirgasovà et al.	2017	Research paper	Journal of Central European Agriculture	Q4	8	8	University of Agricultural Sciences and Veterinary Medicine	Slovakia	Identify the characteristics which affect agricultural land prices or values	Supply prices	Institutions	5,811	Econometric model
Donoso et al.	2013	Research paper	Ciencia e Investigación Agraria	Q3	1	2	Pontificia Universidad Catolica de Chile, Facultad de Agronomia e Ingenieria Forestal	Chile	Identify the characteristics which affect agricultural land prices or values	Asking prices	Ads on journals	2,073	Econometric model
Xu et al.	1991	Conference paper	Agricultural and Applied Economics Association (AAEA) Conferences	Not available	-	-	University of Wisconsin Press	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Survey among buyers	906	Econometric model
Vasquez et al.	2002	Working paper	Agricultural & Applied Economics Association - Western Agricultural Economics Association Annual Meeting	Not available	-	-	University of Idaho	USA	Identify the characteristics which affect irrigated farmland prices or values	Prices	Institutions	453	Econometric model
Rakhmatulloh et al.	2021	Research paper	International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies	Q4	-	-	TUENGR GROUP	Indonesia	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	Undefined	Econometric model
Maasikamäe et al.	2015	Conference paper	Proceedings of the 2015 International Conference “ECONOMIC SCIENCE FOR RURAL DEVELOPMENT”	Not available	0	2	LLU ESAF	Estonia	Identify the characteristics which affect arable land prices or values	Prices	Institutions	Undefined	Econometric model
Copenheaver et al.	2014	Research paper	Mountain Research and Development	Q1	4	3	International Mountain Society	USA	Identify the characteristics which affect hystorical agricultural land prices or values	Prices	Deeds	528	Econometric model
Xu et al.	1993	Research paper	Land Economics	Not available	0	62	University of Wisconsin Press	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	905	Econometric model

Tempesta et al.	2021	Research paper	Aestimum	Q2	1	1	Firenze University Press	Italy	Identify the characteristics which affect agricultural land prices or values	Prices	Deeds	653	Econometric model
Gebeltová and Malec	2018	Conference paper	Agrarian Perspectives XXVII. Food Safety-Food Security, Proceedings of the 27th International Scientific Conference.	Not available	0	3	Czech University of Life Sciences Prague	Czech Republic	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	Undefined	Econometric model
Warmann et al.	1985	Working paper	Research report Agricultural Experiment Station, Oklahoma State University.	Not available	-	-	University of Idaho	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	Undefined	Econometric model
Bencure et al.	2022	Research paper	International Journal of Housing Markets and Analysis	Q2	7	0	Emerald Group Publishing Ltd	Philippines	Identify the characteristics which affect agricultural land prices or values	Respondents opinions on geospatial factors affecting value	Survey among land experts	67	MultiCriteria Analysis
Reynolds and Regalado	2002	Research paper	The Appraisal Journal	Not available	-	-	Not found	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	212	Econometric model
Slaboch and Malý	2022	Research paper	Agriculture	Q2	1	1	Multidisciplinary Digital Publishing Institute (MDPI)	Czech Republic	Identify the characteristics which affect official agricultural land prices or values (ESEU)	Evaluated Soil Ecological Units (ESEUs)	Institutions	2,172	Econometric model
Slaboch and Čechura	2020	Research paper	Agris On-line Papers in Economics and Informatics	Q3	1	1	Faculty of Economics and Management CULS Prague	Czech Republic	Identify the characteristics which affect official agricultural land prices or values (ESEU)	Evaluated Soil Ecological Units (ESEUs)	Institutions	2,172	Econometric model
Curtiss et al.	2013	Research paper	German Journal of Agricultural Economics	Q3	17	16	Deutscher Fachverlag GmbH	Czech Republic	Identify the characteristics which affect agricultural land prices or values	Prices	Deeds	579	Econometric model
Borchers et al.	2014	Research paper	American Journal of Agricultural Economics	Q1	58	70	John Wiley & Sons Inc.	USA	Identify the characteristics which affect cropland and pastureland prices or values	Values	Institutions	3,370	Econometric model
Ertunç and Uyan	2022	Research paper	Land Use Policy	Q1	11	11	Elsevier	Turkey	Agricultural land grading for fair assignments in land consolidation projects	Cadastral parcels	Survey among land experts	77	MultiCriteria Analysis

Lee et al.	2021	Research paper	Energy Economics	Q1	5	5	Elsevier	Taiwan	Evaluation of solar power promotion plans on farmland prices before and after the liberalization of the energy market	Prices	Institutions	595	Econometric model
Ertunç et al.	2021	Research paper	Land Use Policy	Q1	7	5	Elsevier	Turkey	Agricultural land grading for fair assignments in land consolidation projects	Prices	Not specified	375	Algorithm
Tezcan et al.	2020	Research paper	Land Use Policy	Q1	27	25	Elsevier	Turkey	Agricultural land grading for fair assignments in land consolidation projects	Cadastral parcels	Not specified	645	MultiCriteria Analysis
Gdakowicz and Putek-Szelag	2020	Research paper	Real Estate Management and Valuation	Q3	1	2	De Gruyter Open Ltd.	Poland	Identify the characteristics which affect agricultural land prices or values	Values	Survey among appraisers	405	Statistical coefficients
Ritter et al.	2020	Research paper	Land Use Policy	Q1	30	31	Elsevier	Germany	Identify the characteristics which affect agricultural land prices or values	Values	Institutions	82,650	Econometric model
Pichura et al.	2021	Research paper	Journal of Water and Land Development	Q2	12	-	Polish Academy of Sciences	Ukraine	Influence of soil quality classes on land prices or values	Capitalized rental income and soil quality class	Institutions	296	Standard Capitalized Rental Income
De Noni et al.	2019	Research paper	Aestimum	Q3	6	4	Firenze University Press	Italy and Germany	Identify the characteristics which affect hystorical agricultural land prices or values	Values	Institutions	509	Econometric model
Demetriou	2016	Research paper	Land Use Policy	Q1	75	68	Elsevier	Greece	Identify characteristics and analyse agricultural land valuation process in land consolidation scheme	Values	Institutions	488	Econometric model
Kilić et al.	2019	Research paper	Croatian Operational Research Review	Q4	17	7	Croatian Operational Research Society	Croatia	Identify characteristics and analyse agricultural land valuation process in land consolidation scheme	Cadastral parcels	Not specified	243	Fuzzy Logic Method

Ali et al.	2018	Research paper	Sarhad Journal of Agriculture	Q3	1	-	Researcher's Links Ltd	Pakistan	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	90	Econometric model
Wineman and Jayne	2018	Research paper	Applied Economic Perspectives and Policy	Q2	33	31	John Wiley & Sons Inc.	Tanzania	Identify the characteristics which affect agricultural land prices or values	Asking prices	Survey among farmers	5,152	Econometric model
Lehn and Bahrs	2018	Research paper	Journal of Agricultural & Applied Economics	Q2	8	-	Cambridge University Press	Germany	Identify the characteristics which affect agricultural land prices or values	Values	Survey among appraisers	1,416	Econometric model
Ismail et al.	2016	Research paper	Asian Social Science	Q2	15	-	Canadian Center of Science and Education	Malaysia	Measure the effect of flood on land values	Prices	Institutions	410	Econometric model
Czyzewski et al.	2017	Research paper	Land Use Policy	Q1	14	13	Elsevier	Poland	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	653	Econometric model
Jenkins et al.	2007	Research paper	Great Plains Research	Q2	3	-	Center for Great Plains Studies	USA	Analyse the effect of water rights on agricultural land prices	Prices	Not specified	51	Econometric model
Patton and McErlean	2003	Research paper	Journal of Agricultural Economics	Q1	58	55	Wiley-Blackwell	Ireland	Identify the characteristics which affect agricultural land prices or values	Prices	Real estate agencies	197	Econometric model
Uematsu et al.	2013	Research paper	Land Use Policy	Q1	39	39	Elsevier	USA	Identify the characteristics which affect agricultural land prices or values and the relative impact of natural amenities	Values	Institutions	15,108	Econometric model
Tsoodle et al.	2007	Research paper	Agricultural Finance Review	Q2	12	-	Emerald Group Publishing Ltd.	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	23,436	Econometric model
Samarasinghe and Greenhalgh	2013	Research paper	Soil Research	Q1	7	8	CSIRO	New Zealand	Identify the characteristics which affect agricultural land prices or values	Values	Institutions	4,477	Econometric model

Gracia et al.	2007	Research paper	International Journal of Agricultural Resources, Governance and Ecology	Q3	4	-	Inderscience Enterprises Ltd	Spain	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	450	Econometric model
Naudé et al.	2012	Research paper	Land Use Policy	Q1	3	2	Elsevier	South Africa	Develop a farm valuation support system that assists appraisers in their application of the comparable sales method	Respondents opinions on a new land appraisal system	Survey among appraisers	96	Algorithm
Peterson	1986	Research paper	American Journal of Agricultural Economics	Not available	21	10	John Wiley & Sons Inc.	USA	Construct a quality constant land price index for use in long-run agricultural profit or cost functions.	Prices	Institutions	Undefined	Econometric model
Boisvert et al.	1997	Research paper	American Journal of Agricultural Economics	Not available	15	15	John Wiley & Sons Inc.	USA	Detect what portions of farmland value are due to productivity, location, and the land's potential for environmental contamination.	Values	Survey among land experts	Undefined	Econometric model
Sills and Caviglia-Harris	2007	Research paper	Land Use Policy	Q1	43	37	Elsevier	Brasil	Identify the characteristics which affect agricultural land prices or values	Values	Survey among farmers	163	Econometric model
Vural and Fidan	2009	Research paper	African Journal of Agricultural Research	Not available	8	5	Academic Journals	Turkey	Identify the characteristics which affect agricultural land prices or values	Prices	Survey among sellers	54	Econometric model
Delbecq et al.	2014	Research paper	Land Economics	Q1	50	44	University of Wisconsin Press	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	10,317	Econometric model
Maddison	2000	Research paper	European Review of Agricultural Economics	Q2	84	78	Oxford University Press	England and Wales	Identify the characteristics which affect agricultural land prices or values	Prices	Journal	400	Econometric model
Cavailhes et al.	2003	Research paper	European Review of Agricultural Economics	Q1	82	69	Oxford University Press	France	Assess how the vicinity of the towns affect periurban land prices and the decrease of these with	Prices	Institutions	1,060	Econometric model

									increasing of distance from the city				
Chen et al.	2018	Research paper	Sustainability	Q2	11	11	MDPI AG	Taiwan	Identify factors driving distortion of farmland prices	Prices	Institutions	Undefined	Econometric model
Coelli et al.	1991	Research paper	The Australian Journal of Agricultural Economics	Not available	4	5	Wiley-Blackwell Publishing Ltd	Australia	Determine the marginal price of a comprehensive water supply scheme for valuating a its expansion	Prices	Institutions	129	Econometric model
Kostov	2010	Research paper	Land Economics	Q1	19	17	University of Wisconsin Press	Ireland	The influence of buyer and personal relationship characteristics on agricultural land prices	Prices	Survey among buyers	235	Econometric model
Torell et al.	2005	Research paper	Journal of Agricultural and Resource Economics	Q2	41	36	Colorado State University	USA	Identify the characteristics which affect agricultural land prices or values	Prices	Institutions	492	Econometric model
Karakayaci	2024	Research paper	Pakistan Journal of Agricultural Sciences	Q3	0	0	Pakistan Association of Advancement in Agricultural Sciences	Turkey	Identify the characteristics which affect agricultural land prices or values	Values	Survey among land experts	900	Econometric model
Jafary et al.	2024	Research paper	Cities	Q1	2	2	Elsevier	Australia	Identify the characteristics which affect agricultural land prices or values	Values	Institutions	26,700	Econometric model
Giuffrida et al.	2023	Research paper	Aestimium	Q3	2	2	Firenze University Press	Italy	Identify the characteristics which affect agricultural land prices or values	Prices	Deeds	225	Econometric model

CHAPTER 2

Analysis of the initial steps of the Market Comparison Approach (MCA) for its application to agricultural land: parameters of the market segment and real estate data

Based on the **published** paper:

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Analysis of the initial steps of the Market Comparison Approach (MCA) for its application to agricultural land: parameters of the market segment and real estate data

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Abstract. In the current Italian real estate market, estimates of the market value of rural properties are carried out by appraisers mainly using the single-parameter comparison procedure and, less frequently, the income capitalization method. To overcome problems of appraiser subjectivity and other issues related to these methods, and to gradually comply with real estate appraisal standards, this research paper aims to develop and validate a scientifically rigorous method. This article carries out a first attempt to apply the mixed approach based on the integration of Market Comparison Approach (MCA) and General Assessment System (GAS) to agricultural land, currently used only in the field of urban real estate appraisal. The study focuses on the first steps of this valuation procedure: choice of the parameters which characterise the market segment and identification of the land characteristics to be included in the procedure. These two steps are preparatory to the following phase concerning the estimate of marginal prices, which represents the core of the whole valuation procedure.

Keywords: valuation standards, market-oriented method, land values, land prices, real estate appraisal.

JEL codes: C81, O18, Q1, R3.

1. INTRODUCTION

The 17 Sustainable development goals set by the European Union with Agenda 2030 include goal 2, which aims to end hunger, achieve food security, and promote sustainable agriculture that helps maintain the planet's ecosystem and contrasts the growing phenomenon of soil degradation and desertification; additionally, it aims to assure secure and equal access to land for all.

Until recently, the agricultural sector has seen little interest from those responsible for property appraisals. This is because the land market has a

marginal economic importance compared to urban real estate, which is more closely linked to the financial and investment sectors.

The land market is characterized by a particular good, soil, which has a limited and extremely rigid supply that has been exacerbated by its drastic consumption during the last few decades due to the land transition from agricultural to non-agricultural uses, and finally by land abandonment and movement of investments elsewhere.

However, it seems that a reversal in this trend may be underway, shown by increasing interest from analysts stimulated by greater public interest towards environmental sustainability and land consumption (Munafò, 2021).

An analysis of the land market requires transparent data collected with scientific rigor. However, up until now, precise information is still lacking on agricultural land trading activities (Festa et al., 2021).

Thus, there seems to be an unmet need on one side to have easily available sales databases and on the other to be equipped with a valuation tool complying with real estate appraisal standards in order to provide reliable estimates.

Today in Italy, the unreliability of land appraisal results is mainly due to the fact that information is obtained in a market that is scarcely active and rather opaque, making it difficult to implement market-oriented estimates and almost impossible to conduct large-scale valuations (e.g. Mass Appraisals). To overcome these obstacles, estimates are often based on the personal knowledge of the appraiser rather than on recorded and traceable data, thus becoming true “expertise” (Ciuna et al., 2014; Ciuna et al., 2015; Simonotti, 2003).

Up until now, the scientific community has concentrated its attention on urban real estate markets, and has refined tools and methodologies both for the measurement and data collection phase as well as for the valuation phase itself.

Thus, the introduction of these more advanced market-oriented procedures into the agricultural land market sector should be favoured, where the most used method in professional practice is still the single parameter comparative procedure.

The whole valuation discipline, especially that belonging to the Italian school (Brizi, 1946; Medici, 1972; Michieli, 1993), in dealing with the monoparametric appraisal procedure, makes a distinction between comparative estimates based on technical (or physical) parameters and those ones based on economic parameters.

Within the first category, the parameter that is most commonly cited in the literature and used in profes-

sional practice is the surface, a parameter that is easy to quantify because it can be detected with a very high degree of precision, depending on the measurement tool adopted.

Among those ones with economic parameters (gross saleable production, net product, landlord income, rent) the rent is the element most taken into consideration both by the literature and by the category of real estate appraisers in the field of agricultural land.

Within the first category, the estimates can be easily applied only when the goods have a high degree of homogeneity (“deep analogy” condition). Therefore, according to the appraisal theory, this parameter is difficult to use with land properties as the market value of this category of assets is attributable to a large variety of intrinsic and extrinsic characteristics and is not exclusively correlated to their surface area. The use of this parameter is therefore possible only if there is a high degree of homogeneity between the land being valued and the similar used for comparison, a situation which rarely occurs in the actual market.

In the case of economic parameters, the rent is applicable only following the occurrence of the two conditions illustrated below. The first one is that it must be determined by the effective interaction between land market demand and supply (pursuant to article 45 of Law no. 203 of May, 3rd, 1982) and the second condition is that land management of the specific market segment must ordinarily be rent-based.

This appraisal procedure may be strongly influenced by discretionary decisions made by the appraiser, who has the delicate task of identifying comparable properties that are similar in everything except the parameter chosen as the discriminant under a condition of “deep analogy” (Simonotti, 2002).

The absence of such a condition leads to a sample selection that is not consistent with the methodological assumptions of the valuation procedure. The distortion of the resulting appraisal valuation can be attributed to a lack of consideration of certain characteristics that significantly contribute to the market price but are operationally difficult to quantify, as well as to the low activity of the agricultural land market that does not easily allow for the identification of bought and sold properties that are only dissimilar from the one being appraised in a single characteristic.

Based on the situation discussed above, it seems evident that a procedure is needed that is multiparametric but also parsimonious, such as the Market Comparison Approach (MCA), which can make systematic adjustments of detected prices. These price corrections make it possible to: a) not have to identify comparable goods

that fit the “deep analogy” conditions; b) to decode otherwise omitted variables influencing market price into economic terms.

Currently, applications of MCA in the literature exclusively regard urban real estate markets (Simonotti et al., 2016; Simonotti, 2003; 2006; 2011; 2019) and to the authors’ knowledge the only attempt to implement the MCA for agricultural land is that of Berloco (2012), who proposes using MCA as an instrument that can assure accurate and robust valuations of agricultural land, even in the presence of a land market that is notoriously stagnant and opaque.

First, Berloco (2012) emphasises the importance of carefully identifying the market segment to be studied due to the extreme complexity of agricultural holdings. The collection of property data comes next, which should be carried out by using ad hoc survey forms. In the absence of a set of universally shared agricultural land property characteristics, the Author presents a wide variety to stimulate a discussion with appraisal professionals to identify the current “best practices” that can be used as the foundations for agricultural property appraisal standards¹. To this end, he proposes an illustrative case-study where an integrated MCA-General Assessment System (GAS) is applied to an agricultural property producing cereal and forage crops.

Besides, MCA and GAS in relation to agricultural land can be found in Italian Property Valuation Standard (Tecnoborsa, 2005; 2018) and in Simonotti (2011). The latter proposes three examples of application of the MCA and the GAS for educational purposes; the former, aims to provide professionals with the guidelines for the appraisal of agricultural assets and to indicate their operative field. Therefore, the Code mentions MCA and GAS, among others, in the more general context of the Market Approach Method for the evaluation of agricultural land.

In the light of the above, there is the actual risk that professional estimates are carried out on the basis of real estate characteristics just described and not developed from the methodological point of view.

The GAS is a mathematical procedure based on comparison. By starting with two or more properties with one or more characteristics that are usually qualitative, this process makes it possible to determine the marginal prices of said characteristics and the value of the subject through matrix calculus techniques (Simonotti, 2011). It can be used both autonomously

and in combination with the MCA when the marginal prices of qualitative characteristics need to be estimated. Since its resolution requires the use of matrix calculus, its main limitation is that the number of comparables must be equal to the number of qualitative characteristics involved plus one.

A didactic example of the application of this method to agricultural land can be traced in a quite old study by Simonotti (1985), where the author deals with it from a theoretical point of view while making in the closing part of the paper a mere exemplification concerning an agricultural piece of land.

However, no further developments have followed this pioneering study in investigating appraisal methodologies for agricultural properties.

The objective of the present study is to obtain estimates that are rigorous in terms of both property data collection and valuation analysis, even under the condition of a scarcely active market².

This study discusses the following first two steps of the research that has been carried out so far:

1. Choice of parameters to implement the segmentation of the agricultural land market (market segmentation data collection form);
2. Identification of the characteristics to be included in the procedure determining the relative marginal prices (property data collection form).

2. CHOICE OF PARAMETERS TO IMPLEMENT THE SEGMENTATION OF THE AGRICULTURAL LAND MARKET (MARKET SEGMENTATION DATA COLLECTION FORM)

Like the urban real estate market, the agricultural land market is also divided into segments that can be identified through a process of segmentation.

The parameters that characterize a segment show both how each segment differs from the others and also identifies unifying properties with common technical and economic parameters (Simonotti, 2011).

Furthermore, as defined by Simonotti (2011), the market segment is the basic unit of economic and estimative analysis for the real estate market that cannot be further divided.

In Simonotti (2011), as regards the definition of the market segment, some parameters are already reported

¹ To the best of our knowledge, the second edition of Tecnoborsa (2005) already included a chapter exclusively addressing agricultural properties in its third edition of the *Codice delle Valutazioni Immobiliari* (Real Estate Valuation Code).

² Recently Festa et al. (2021) and Povellato (2022) reported data on bought and sold surface areas. Using ISTAT calculations based on annual surveys of notary activities, they estimated the approximate annual percentage of agricultural and forest land that is bought and sold in Italy to be about 1% of the total agriculture and forest surface area.

such as: Description; Location; Type of contract; Destination; Real Estate Typology; Size; Characteristics of supply and demand; Market form; Price level.

In Italian Property Valuation Standard (Tecnoborsa, 2018), there is just a list of parameters (location; form of contract; agricultural production destination; type of land investments and other fixed endowments; size; characteristics of supply and demand; market regime; price level) which define the market segment of an agricultural company (page 234).

In this regard, a new market segment survey form has been developed to carry out this first phase. It is based on the already tested and widely used survey form for urban real estate valuation proposed by Simonotti (2011) and reported in Tecnoborsa (2018), within which the parameters that characterize a given market segment are contained. For these parameters to be translated into economic-estimative indicators, they must be measured and recorded, as suggested by Simonotti (2011).

Below, potential parameters that characterize rural property market segments are discussed.

The *type of contract* indicates a sale, rental, or other relationship (donation, exchange, “rent to buy”, etc.).

Location refers to the geographic and economic position (presence of infrastructure, public services, etc.) of an immovable property, taking into consideration the *General Regulatory Plan* (Piano Regolatore Generale, PRG, in Italian), which is an urban planning instrument that classifies land areas based on their construction potential and eventual planning and protection restrictions.

Current use indicates whether the land making up a certain segment is used for agricultural production or for other uses³. The type of use (agricultural or not agricultural) serves as a discriminant to determine if additional parameters characterizing the market segment apply. Indeed, if the current use of a property is “agricultural”, then the following additional parameters should be considered:

- The *altitude range* indicating the altitude, in terms of meters above sea level (MASL) of the considered area. For this purpose, a classification into “agricultural regions” is used, i.e., portions of land made up of “groups of municipalities according to rules of homogeneous territorial continuity in relation to certain natural and agricultural characteristics

and, subsequently, aggregated by altimetric zone”⁴ (ISTAT, 1958). According to this classification, the following altimetric zones will be identified for the practical definition of the market segment: internal mountains and coastal mountains; internal hills and coastal hills; lowlands.

- The *climate data* relating to average annual temperature and precipitation values and their distribution are essential as they guide crop choices. Furthermore, living in the era of climate change, these values can be subject to varying fluctuations over the short term. Thus, satellite-based remote sensing tools such as the Climatic Research Unit Gridded Time Series v. 4.06 (CRU TS) (Harris et al., 2020) can be helpful since they provide a continuous monitoring of data made available through open access platforms such as Google Earth;
- The *size class* refers to the order of magnitude, expressed in hectares (ha), of the rural property that characterizes a given segment for a certain type of contract. The various size classes could go hand in hand with the Utilized Agricultural Area (UAA) (or *Superficie Agricola Utilizzata*, SAU, in Italian) classes adopted by ISTAT (2012) for data collection for the General Agriculture Census. In this way, appraisers could have a reference point to compare with his or her own knowledge of the market. Following this reasoning, the dimensional classes could be ≤ 0.99 ha, from 1.00 to 1.99 ha, from 2.00 to 4.99 ha, from 5.00 to 9.99 ha, from 10.00 to 19.99 ha, from 20.00 to 49.99 ha and ≥ 50.00 ha;
- *characteristics* refer to all the rural characteristics to be considered within the procedure that potentially contribute to the formation of each given segment and therefore positively or negatively influence the market;
- *supply and demand agents* describe the kinds of figures operating in the market and the motivations that drive them to act. The principal actors within the rural land market can be classified as physical or legal persons. The first group generally include those involved in the agricultural sector as professional farmers, direct cultivators, and field workers or non-agricultural workers for whom farming is a hobby and not an income source. The physical persons category also includes private individuals who operate in the rural land market for investment purposes. The legal persons category includes corpora-

³ Given the complexity of the subject, this first exploration only considers cases where the land is used for purely agricultural purposes (including the uncultivated land at the service of the productive agricultural area, called tare) and momentarily excludes land used for other purposes.

⁴ Translated into English by authors. Original text: “gruppi di comuni secondo regole di continuità territoriale omogenee in relazione a determinate caratteristiche naturali ed agrarie e, successivamente, aggregati per zona altimetrica”.

- tions, cooperatives, public entities, and the Church;
- the *market form* is established based on the degree of competition between supply and demand for a property belonging to a given segment. The rural land market can be defined as “imperfect” because of the varying nature and behaviour of the agents that locally influence the supply and demand of land, and the relative high transaction cost involved. This is proven by the fact that there are actually many different markets for land, both in terms of time and space as well as in relation to its alternative uses. In this sense, the Italian rural land market takes on a bilateral oligopoly (Antonietti, 1976; Magri, 1985, Bazzani, 1987; Grillenzoni and Grittani, 1994; Schimmenti et al., 2013);
 - the *market ratios*, which are mainly used for the calculation of marginal prices/rents of characteristics per surface area in the context of the urban real estate market. In this moment, it is not possible to say which agricultural land characteristics are actually connected, nor to describe the possible ways of determining their value. The eventual detection of these relationships will depend on how the calculation of the marginal prices of certain characteristics will be developed;
 - the *indicative price* regards the sales price, the rent, etc. The trend of increasing, decreasing or steady prices and the number of sales in a given time frame (market cycles) characterize individual market segments;
 - the *attachments* are generally satellite images or urban planning documents (*Piano Regolatore Generale*, PRG), that refer to the geographic location of the identified market segment.

In Figure 1 a scheme of market segmentation parameters is reported.

3. IDENTIFICATION OF THE CHARACTERISTICS NEEDED FOR MARGINAL PRICES DETERMINATION

The fundamental contribution made by this line of research is the determination of marginal prices for all the characteristics that potentially influence the value of agricultural land, including those that are intrinsic and extrinsic, qualitative and quantitative.

Thus, first it is necessary to identify all these characteristics, analyse their advantages and disadvantages, eventual correlations or interactions with other characteristics and choose the most functional ways to express them, establishing nomenclature, measurement scales and economic criteria. For qualitative characteristics, the marginal price is estimated using the GAS.

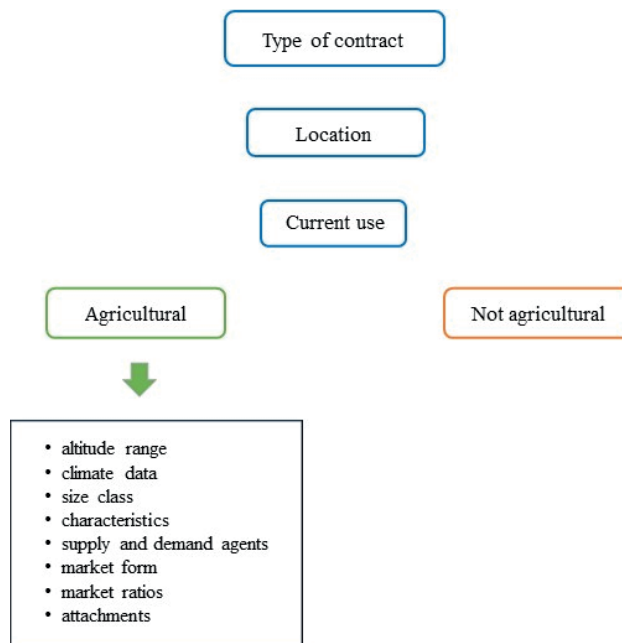


Figure 1. Parameters for the identification of agricultural land market segments.

Already Grillenzoni and Grittani (1994, p. 412) and Gallerani et al. (2011, p. 28) in their textbooks and, more recently, Tecnoborsa (2018, p. 235) provide a list of the main characteristics which are most likely to affect the market price of a land asset.

The characteristics listed and described in this study take the cue from the relevant white and grey literature on the topic.

The first characteristic, of extrinsic nature, is the *date*, which refers to the moment in which the sales contract is stipulated for comparable properties. The estimate of its marginal price is for the purpose of the adjustment of the comparables' prices to the moment of appraisal. A discrete cardinal scale is used, with months as the measurement unit (Simonotti, 2011). The marginal price can be calculated in a similar way to urban real estate estimates, i.e., through the monthly change rate of the considered market segments (Simonotti, 2011) or for a similar market segment (Tecnoborsa, 2018; Simonotti, 2019). This variation rate is finally multiplied by the comparable market price.

However, despite there being an analogy with the urban real estate market in terms of the formula to be applied for calculating the marginal price, it may be necessary to change the time frame considered for the selection of comparables given the different level of the rural land market's activity compared to that of urban real estate.

The *surface area* is an intrinsic characteristic, its measurement scale is cardinal and refers to the Utilized Agricultural Area (UAA) and Uncultivated Land Area (Tare). According to the definition of the Italian *Network of Agricultural Accounting Information* (Rete di Informazione Contabile Agricola, RICA, in Italian), the UAA represents the surface area used for agricultural production and thus occupied by agricultural crops. According to RICA, in Italian *tare* are those land areas that are not directly used for production but are in any case necessary for farming, such as areas occupied by buildings, country roads, or any other non-agricultural use. The urban real estate method for calculating marginal prices was also thought to be the best choice in this case. Thus, the UAA is the main surface area, and the *tare* may be considered as the secondary surfaces. The marginal price would then be the lowest⁵ of the average prices calculated by the ratio between the total price of the comparable properties and the *commercial surface area*⁶ (Equation 1). The market ratio of tare refers to the ratio between the marginal prices of tare and UAA and its value is likely to be obtained directly through official and unofficial market sources (i.e., estate agents, consultants, ecc.) or by means of data inferred from notarial deeds.

$$\bar{p} = \frac{P}{UAA + TARE \cdot \pi} \quad (1)$$

In (1) $\bar{p}$ is the average price (€/m² or €/ha); P is the market price paid for comparable land (€); UAA is the utilized agricultural area (ha or m²); $TARE$ is the unproductive land according to the definition cited above (ha or m²); π is the market ratio of the uncultivated surface area.

Regarding the $TARE$, the marginal price (p_{TARE}) can be determined as the product of the UAA's marginal price (p_{UAA}) and the relative market ratio (π_{TARE}) (Equation 2).

$$p_{TARE} = p_{UAA} \times \pi_{TARE} \quad (2)$$

The *crop type* indicates the crop (herbaceous or orchard) present in the subject and in the comparables with reference to the moment of valuation for the for-

mer and at the time of sale for comparables. For herbaceous crops⁷ no other details are necessary. For orchard crops, the tree variety should be recorded, as well as the planting distance (between the rows and within the rows) to know the planting density (i.e., the number of trees per hectare), pruning shape (i.e., the form used to manage the vegetative growth of a tree for both technical and economic ends), the age of the orchard to identify what stage of the production cycle the orchard in question is in: planting and establishment, growth and maturity, peak production, decline (Gallerani et al., 2011; pages 67-68-74-75). This intrinsic characteristic due to its nature is to be expressed in a nominal scale, by distinguishing as a first step among herbaceous crops and orchards and if necessary, by describing the cultivated plant species and varieties.

Regarding the economic criteria, the cost value and the capitalization value are believed to be the best choices to determine the marginal prices of the crop types, especially in the case of tree orchards.

The first of the two economic criteria mentioned above – the cost value – can always be used to estimate the value of the topsoil of a tree crop land. Regardless of the specific context, it is always possible to proceed with the preparation of a metric estimate (Computo Metrico Estimativo in Italian, CME) – current or referring to a certain year (by consulting the Regional Agricultural Price Lists or carrying out any analyses of unit prices) – based on technical nature (use of factors and means of production) and economic nature (average unit prices by type of intervention), in order to arrive at the total cost of planting a specialized topsoil. In this way, the planting cost would correspond to the marginal price for the transition from the value of bare land (e.g. arable land) to that of land containing a given tree crop plantation. In summary, it would be the amount of money necessary for the transition from the market value of arable land to that of tree crop land.

The second economic criterion that is proposed here is the capitalization value, applicable to the estimate of equal in age tree crop lands that are renewed on themselves at the end of the economic cycle of the crop in progress. The mechanism by which the quantification of the marginal price for the type of crop is reached is the determination of the difference between the estimated value in an intermediate year (V_m) of the economic cycle and that of bare land (V_0). However, this criterion is excessively complicated having in mind the objective of using it in a “thrifty” estimating procedure, as it would be necessary to carry out a double estimate by

⁵ As for the MCA used for urban real estate appraisal, the choice to use the lower of the average unit prices of comparable properties is due to the difficulty in determining the relationship between the average price and the marginal price trend. There may not be enough real estate transactions to create a curve of the average and marginal prices based on the total market prices to compare to the traded areas.

⁶ The term “commercial”, taken from the urban real estate sector, simply means that the different weight of productive and unproductive areas is directly considered in terms of economic value – at least for agricultural production.

⁷ Herbaceous crops can be cereals, leguminous plants, vegetable crops, forage crops, etc.

capitalization, first applied to the bare land, then to the land considered already planted with trees, for the sole purpose of gathering the variation in the total price of a land property after the change in land use from arable to orchard or vice versa.

The *exposition* represents the capacity of the land to receive sunlight, in relation to its orientation in respect to the four cardinal points and the potential presence of mountains, or to be influenced by negative phenomena that exclude the possibility of cultivation, such as exposure to wind (EXEO, 2023). The angle of incidence of sun rays on the earth's surface influences the microclimate in terms of humidity and temperature. Obviously, the best definition of exposition depends on the cultivated crop. Furthermore, since this is an intrinsic qualitative characteristic, its measurement scale could be ordinal – with points attributed in terms of preferences (1 poor, 2 medium, 3 excellent) – or dichotomous – i.e., in relation to the type of crop grown on the subject, the comparable and whether the same subject receives an optimal sun exposition (presence = 1/ absence = 0). In both cases the relative marginal price could be determined with the GAS.

The *land improvements* regard investments made to construct immovable goods that aim to improve the land's productivity and attractiveness. These improvements entail both an increase of income as well as the value of the property where they are built since they become an integral part of the land's capital (Medici, 1972; Michieli, 1993). The following is included in the category of land improvements:

- the rural buildings that contribute to farming, such as the farmer's home, barns to shelter animals, to store machinery and equipment and agricultural products;
- hydraulic improvements are interventions to regulate excess water on farmland caused by precipitation and/or runoff phenomena. Excess water inflows/outflows can severely damage crops, causing water stagnation on flat lands (killing plants via root asphyxiation, nutrient leaching, soil structure destruction, etc.) and of erosion on sloping lands (topsoil removal, i.e. the soil layer with the highest level of biological activity and of organic substances, causing a consequent reduction of the soil's infiltration and thus water retention capacity). Furthermore, the construction of drainage infrastructure, channels, terracing, etc. can help mitigate these phenomena, which would permanently compromise the fertility of agricultural soil;
- the farm's wells, artificial lakes and water supply from irrigation consortia as sources of irrigation water;

- irrigation systems, which transform a farm from a dry system to an irrigated one. In this way, the farmer can establish the times and methods of irrigation/ other interventions to better satisfy the water needs of crops;
- internal roads within the farm facilitate the movement of people and agricultural machinery without affecting the area where crops are grown (i.e., the UAA);
- fencing provides security for the farmer, who needs to protect his or her land from possible damage caused by the intrusion of animals or people.

This characteristic is cardinal and its unit of measurement depends on the nature of the land improvement (linear, square or cubic metre) since the characteristic is manifold.

The most appropriate economic criterion for the marginal price of land improvements is the cost value, depreciated according to the age, state of maintenance and economic life of the built structure involved.

The *layout* represents the shape of the land parcel. This parameter is important because it can determine whether production limits or advantages are present in terms of the agricultural surface area suitable for farming. If the parcel is rectangular or square, it can be defined as regular; instead, if its geometric shape diverges from the above-mentioned ones, it is defined as irregular (EXEO, 2023). Thus, this intrinsic characteristic lends itself to being expressed as a dichotomous variable in terms of absence/presence of regularity and the relative marginal price is estimated through the GAS.

The *degree of consolidation and fragmentation* tells us if the cadastral units that make up the entire real estate property are connected or split into two or more parts. The more fragmented (i.e., the number of parts) the property is, the more difficult it is for the landowner to manage it. It is an extrinsic qualitative characteristic which can be expressed on an ordinal scale according to the number of parts the property is composed of, and its marginal price can be quantified using the GAS.

The presence of *planning and protection restrictions* on the property, identifiable through the urban zoning certification (known as Certificato di Destinazione Urbanistica, CDU, in Italian), which entail a depreciating factor on the property. From a legal point of view, these can be grouped into three large categories: building restrictions; building codes and land use regulations.

The first are enforced by laws governing the entire category of properties that are recognized as worthy of protection because they possess public good qualities. These include hydrological restrictions, forest restrictions and environmental restrictions. Building codes are

enforced on a property so that it does not compromise the ability of another property to serve public interests. These include access and buffer requirements (regarding roads, cemeteries, public land, railroads, electric lines, aqueducts, methane pipelines, airports, public maritime property, public waters, etc.). Finally, land use regulations include the limits imposed by the territory governance plan (Piano di Governo del Territorio, PGT, an Italian regional planning instrument), which governs land transformations, building density, urban attractiveness and even the use-destinations of private properties involved in expropriations.

Regardless of restriction type, they all partially or entirely limit an owner's potential to develop land. The more restrictions exist on a property, the less attractive it will be to the market. This extrinsic characteristic can be expressed by a dichotomous scale (presence/ absence of restriction) and its marginal price quantified using the GAS.

The *type of access to the property* is an intrinsic characteristic and indicates ease of access. In fact, a property can be accessed by public roads (such as highways, principal and secondary extra-urban roads and local roads in order of importance) or be interlocked, i.e. surrounded by other properties without the possibility of being accessed from a public road. By law, the owners of interlocked properties have easement rights, and the owners of neighbouring plots must grant them passage. However, clearly access through an easement is not the same as direct access from a public road. This is a qualitative characteristic measured through a dichotomous scale (0 = interlocked land; 1 = land with front-road access) and the procedure for identifying its marginal price is the GAS.

Furthermore, the *distance from the public road network* is important for all properties that are accessed through private inter-property roads, which is considered equal to the sometimes-winding route that must be taken to access these properties. These roads are often unpaved, and difficult or impossible to travel on with cars or farm vehicles. This extrinsic variable can be expressed on an ordinal scale according to the distance and the upkeep condition of the roads involved and the marginal price can be estimated with the GAS.

One of the most important characteristics of rural land, especially in market segments where the buyer is a farmer, direct grower or field worker, is *soil fertility*⁸.

In fact, characteristics directly connected to land productivity are of particular interest to an agricultural buyer, who shows a willingness to pay during negotiations that is directly proportional to the property's expected profitability (Grillenzoni and Grittani, 1994; Grittani, 1994).

Fertility is perhaps the most relevant intrinsic characteristic of land, yet it is also the most complex and articulated because it is divided amongst three components: physical fertility, chemical fertility and biological fertility.

The first is related to soil structure and grain size. The second is connected to soil's cation exchange capacity, electrical conductivity and pH. Finally, biological fertility is linked to the presence of organic matter and to the activity of beneficial microorganisms in the surface layer of the soil, which in turn influence the other two previously mentioned components of fertility.

Thus, overall soil fertility is the product of these three components. In turn, each one is also influenced by various endogenous factors, including anthropic activity.

Thus, the overall valuation of fertility is quite complex and cannot be carried out in a synthetic way by professional appraisers without the support of the costly laboratory analyses necessary to measure the different indicators involved.

In addition, some intrinsic characteristics of soil (slope, rockiness, stoniness, etc.) influence soil fertility. A separate assessment of such characteristics could result in an over-estimation of the fertility marginal price due to their conjoint influence on a land property's market value.

A solution to the above problem might be to separately analyse the characteristics which mainly contribute to the overall level of soil fertility. Despite the existence of several intrinsic characteristics affecting soil fertility, at this very early stage of the research it seems appropriate to describe only those ones reported by Costantini (2006), based on the Land Capability Classification System⁹.

Stoniness and *rockiness* characteristics influence soil properties and consequentially farm management. In general terms, areas with a strong presence of these factors are difficult to work mechanically, require frequent irrigation, and repeated fertilizing.

Stoniness indicates the presence of stones (classified as gravel, pebbles, stones, and boulders according to

⁸ Here we report as an example one of the numerous definitions of soil fertility present in the field literature (Violante, 2013): "It defines the ability of the soil, used for agronomic purposes, to allow abundant plant production. More precisely, fertility is expressed by the maximum yield that can be obtained from a soil cultivated with the plant species most suitable for the climatic conditions of a specific environment. Therefore, the propensity to produce is not a function of the only characteristics

of the soil but represents the productive potential of a complex pedoclimatic system".

⁹ The Land Capability Classification System was established in 1961 in the United States of America by the Department of Agriculture's Soil Conservation Service.

their size) on and below the soil surface that can impede farming activities. The following classes regarding surface stoniness are proposed:

- not stony: absence or almost absence (up to 3% of the UAA) of stones on the surface, for which no intervention is necessary;
- slightly stony: when up to 15% of the UAA is covered with stones;
- moderately stony: when up to 50% of the UAA is covered with stones;
- very stony: presence of stones for over 50% of the UAA.

Thus, the measurement scale is ordinal and the economic criteria to be used is the cost value. The marginal price can be determined based on the cost of the stone clearing necessary for a property to move up one category.

Rockiness indicates the presence of bedrock near the soil surface, or of rocky outcrops above the surface. The following classes indicate the different percentage frequencies of rockiness present in an area:

- non-rocky: absence or near absence (up to 2% of UAA) of rocks;
- slightly rocky: when up to 10% of UAA is covered by rocks;
- moderately rocky: when up to 25% of UAA is covered by rocks;
- very rocky: when up to 50% of UAA is covered by rocks;
- extremely rocky: presence of rocks for over 50% of UAA.

Unlike stoniness, rockiness indicates actual layers of rocks on the ground that are difficult if not impossible to remove. For this reason, it is appropriate to consider it as a surface subtracted from agricultural production and therefore to be included in the unproductive surface area present on the land. Thus, this characteristic is included in the MCA as a non-productive area and its marginal price is calculated by referring to the Equation 2 described at the beginning of this section.

Slope, intended as the relationship between the difference in elevation and the distance between two known points, can significantly affect agricultural productivity and management costs.

The steeper the slope, the more difficult farming will be. Furthermore, slope directly affects soil fertility due to erosion. Erosion is a naturally occurring phenomenon where soil surface particles are detached and transported by precipitation, which can significantly reduce soil fertility. The rate of erosion is positively correlated with the slope: the greater the slope, the more intense the erosion will be, with consequent negative repercussions for the soil productivity.

The following four distinct slope classes are proposed:

- flat: up to 13%;
- gentle slope: up to 20%;
- moderate slope: up to 35%;
- steep slope: up to 60%.

Land with a grade of over 60% and up to 90% is defined as excessively steep, and a slope over 90% is defined as precipitous. Such high slope values preclude any kind of cultivation and so land or portions of land with these features can be classified as unproductive areas. Thus, for *slope*, an ordinal measurement scale is used.

However, like fertility, slope is a complex characteristic due to the various collateral effects it causes, such as impeding mechanized farming operations, and causing hydrogeological instability, i.e., landslide risk. For these reasons, an economic criterion to calculate the marginal price of slope is not easily definable and it will be identified in a further development of the study.

Praedial servitudes, are easement rights where one property (the servient tenement) must bear a property burden favouring another property (the dominant tenement) belonging to a different owner (Art. 1027 c.c.).

According to the Italian Civil Code, they can be instated voluntarily with an *inter vivos* act (with a contract) or a *mortis causa* act (with a will). The acts must be put in writing by law otherwise they are null and void.

The legislation automatically provides for a small number of easements (right of way easements, aqueduct easements, power line easements, irrigation easements) in the absence of explicit agreements between parties, which can be established coactively, through a judicial ruling or through an administrative act from the public administration.

In both cases (with or without a contract), the property owner of the dominant tenement must pay an indemnity in favour of the owner of the servient tenement, which is indispensable for the holder of the servitude to start exercising his or her right.

A property bearing a servitude burden is less attractive to the market than one that is free of encumbrances, as for all economic burdens.

Servitude burdens on properties are usually indicated in notary deeds of sale, even if the description is rarely precise enough to allow an appraiser to assess its importance in economic terms. In the map sheets the presence of servitudes could be found.

A dichotomic scale is used to express this extrinsic characteristic (0 = presence, 1 = absence), while the quantification of the marginal price is based on the monetary sum (the indemnity) due the owner of the servient tenement to compensate for the burden imposed

on the property. If this should be impossible to determine, even though it remains a dichotomous characteristic, its marginal price should be calculated with the aid of the GAS.

Usufruct is a real right to enjoy another owner's property, which is regulated by the Italian Civil Code (art. 978-1020).

The two legal subjects involved in the institution of usufruct are:

- the legal owner loses property rights, while remaining formally the owner of the asset;
- the usufructuary holds the rights to enjoy the “fruits” of the property, i.e., to benefit from the property and use it as if he or she were the owner, with the exception that the usufructuary cannot change its economic destination.

Usufructuary rights can last up to a maximum of 30 years for legal persons and for the natural life of physical persons.

The presence of usufruct is transcribed in both the cadastral register and in the deed of sale, specifying the parties involved (usufructuary and legal owner).

The same right can also be transferred. Rural properties with the burden of total or partial usufruct are less attractive to the market since the buyer cannot use the asset until the usufruct expires (potentially until the death of the usufructuary).

As for the characteristics preceding it, the usufruct is an extrinsic one, is measured with a dichotomic scale (0 = presence, 1 = absence) and the economic criterion used to quantify its marginal price is the discounting of the future income annuities that have still to be gained by the usufructuary for the residual period of the usufruct.

In case of a “life-long” usufruct contract, the number of residual years can be quantified through the statistical data produced by ISTAT and freely accessible from the ISTAT website. They provide the life expectancy of an individual in a certain territorial area by age and gender. These data correspond to the second quartile of a statistical sample, in other words to the median of the distribution curve.

The annual income of an usufructuary can be approximately traced back to the Land Benefit, which represents the reward due to the landowner, that is the price paid for the use of real estate capital. The average annual income of the land owner can be obtained following two methodological procedures. The first one is based on the annual farm balance by which Land Benefit is quantified by subtracting all the farming cost items (various expenses, wages, salaries, taxes, interests on agricultural capital and maintenance, insurance and depreciation quotas) from the Saleable Gross Product (SGP).

Alternatively, the adjustment for the presence of a life-long usufruct right might take place by applying the coefficients of the usufruct right used by law for tax purposes. These coefficients allow to derive the value of bare ownership (that is, the property subject to usufruct) by subtracting the monetary value of the usufruct right, as obtained above, from the observed sale price of land.

One of the most important financial characteristics to be included in the collection of agricultural land real estate data is the presence of an *ongoing loan or mortgage*, which constitutes an additional financial burden in its sale.

This situation is always described in particular detail in the notary deed, thus appraisers should not have any difficulties quantifying this important monetary sum.

The economic criterion used to assess the marginal price of this extrinsic characteristic is the discounting, i.e., accumulating all the remaining future loan or mortgage payments to the present moment of appraisal by applying a commercial interest rate. In other terms, the economic criterion to be adopted is to discount all the remaining loan instalments at the time of the valuation and then to subtract their present value from the estimated land market value.

In this case, the marginal price will differ from comparable to comparable, depending on single instalment amounts, the number of remaining payments and the applied interest rate.

Regarding *property tax*¹⁰, in Italy, the Unified Municipal Tax (Imposta Municipale Unica, IMU) is applied to all real estates, and therefore in this specific study on agricultural properties. Nevertheless, to date the latter are exempted¹¹ when they are situated in minor islands (Law No. 448/2001) or in mountain or hill areas (Legislative Decree No. 504/1992). The characteristic is extrinsic and can be expressed through a dichotomic scale (1-present; 0-absent). Its marginal price has a negative sign and is calculated by the discounted present value of the unlimited annual tax fees saved by the landowner in case of IMU exemption.

Entitlements connected to European grants for farmers must also be considered. These entitlements represent the right to obtain monetary aid to cultivate a given area

¹⁰ As to tax benefits, the new 2023 Italian finance law (L. 197/2022) states that registration and mortgage taxes for professional farmers and direct cultivators holding small farm and mountain properties are to be paid at a fixed rate (200 euros) and a cadastral tax equivalent to 1% of the land's sale price. Agricultural cooperatives that directly manage land receive the same benefits. Although tax benefits might affect land purchase propensity by the above-listed categories, they have not been included among the characteristics since they are not directly linked to the value of land capital but to the typologies of buyers.

¹¹ Stability Law 2016 – Law No. 208/2015.

of land. In addition to receiving these incentives, a farmer can obtain entitlements by buying them. Since they are an object of transfer, it would be possible to retrace the price paid for them using notarial deeds and to use it to appropriately adjust the purchase price of the land upwards or downwards.

The National Strategic Plan of the Common Agricultural Policy (CAP) has stated that entitlements will be abolished starting from 2028 and that in the meanwhile their values will be gradually lowered. Therefore, they are not considered in the present study.

EU income support represents the amount of money granted to farmers through the CAP. These economic supports are allocated in relation to the crops and to the cultivation area. The scale of measurement of this extrinsic characteristic is cardinal. The marginal price can be calculated by discounting the future grants based on the of National Strategic Plan period (2023-2027).

Distance to population centres or product processing/commercialization centres is an important characteristic that strongly influences a property's attractiveness to market agents. The traveling time from the closest population centre and/or processing/commercialization centre of the farm's products can, in fact, significantly influence a property owner's management costs. Furthermore, a potential buyer usually pays just as much attention to the property's location compared to population and processing/commercialization centres as to other aspects.

A cardinal scale in kilometres seems the best way to measure this extrinsic characteristic. The economic criterion for the quantification of the marginal price is that of the cost value. The marginal price is linked to the unit cost of the fuel necessary to cover a kilometre of distance between the reference population centre and the rural property. Assuming an average fuel consumption and a given standard fuel price, the marginal price is obtained by multiplying the two factors. Due to the nature of the characteristic, its marginal price is negative since there is a proportionally inverse relationship between market value and distance.

For the sake of clarity, we are going to describe all the steps from the determination of the marginal price to the quantification of the price delta related to the characteristic within the evaluation table.

The marginal price is obtained by multiplying the kilometre consumption by the unit price of the fuel (petrol or diesel) and is expressed in €/Km. In order to obtain the price adjustment, the round-trip distance travelled daily between the land property and the nearest inhabited centre (subject minus the comparable one) is firstly multiplied by 365 (in order to pass from

daily to annual distance) and then the result is to be divided by an adequate commercial rate to capitalize the annual figure.

Alternatively, its marginal price could be calculated as the relationship between the opportunity cost and the possible income the property owner waives by traveling to and from the centre. As per the previous calculations, appropriate adjustments need to be made in the valuation table and the obtained result needs to be capitalized to a single moment in time with a given commercial rate.

The main information concerning the characteristics dealt with in this section are summarized in table 1, reported below.

4. DISCUSSION AND FIRST REMARKS

This paper has described an initial attempt to utilize the mixed approach MCA and GAS for the agricultural land assessment, dealing in particular with the choice of the market segment parameters and with the identification of the relevant land characteristics. Therefore, it serves an exploratory purpose, providing an initial overview of the potential for further methodological developments.

Such a research need arises since in the literature there are just documents reporting a list of land characteristics (Tecnoborsa, 2018) and some illustrative efforts for educational/professional goals (Simonotti, 2011) or for a scientific purpose (Berloco, 2012).

It is believed that this line of investigation could produce a breakthrough in terms of both scientific research and professional practice. Not only would it provide a more transparent and objective method for appraising land through the development of a modified MCA, but it would standardize parameters and features of real estate, create a database of land prices, as well as a database of the marginal price of land features.

Should this research continue to be developed, it would contribute to increasing the knowledge of free-lance appraisers and to diversifying appraisal methodologies, with market-oriented methods currently limited to just the single parameter procedure. Thus, appraisers could have a practical land appraisal tool based on scientific principles and not on subjective judgements.

This would significantly help appraisers to overcome the known difficulties they encounter when valuing land, which are principally caused by the land market's low level of activity and its opacity. These drawbacks strongly impact on the search of sales deeds and on the identification of comparables characterized by an adequate level of homogeneity.

Table 1. Characteristics analysed for the inclusion in the MCA procedure.

Characteristics	Nature (intrinsic or extrinsic)	Type (quantitative or qualitative)	Measurement scale (dichotomic, cardinal, ordinal, nominal)	Economic criterion or procedure
<i>Date of sale</i>	Extrinsic	Quantitative	Cardinal	-
<i>Surface area</i>	Intrinsic	Quantitative	Cardinal	Market value
<i>Tare</i>	Intrinsic	Quantitative	Cardinal	Market value
<i>Crop type</i>	Intrinsic	Qualitative	Nominal	Cost and capitalization value
<i>Exposition</i>	Intrinsic	Qualitative	Ordinal or dichotomic	GAS
<i>Land improvements</i>	Intrinsic	Quantitative	Cardinal	Cost value
<i>Layout</i>	Intrinsic	Qualitative	Dichotomic	GAS
<i>Degree of consolidation and fragmentation</i>	Extrinsic	Qualitative	Ordinal	GAS
<i>Planning and protection restrictions</i>	Extrinsic	Qualitative	Dichotomic	GAS
<i>Type of access to the property</i>	Extrinsic	Qualitative	Dichotomic	GAS
<i>Distance from the public road network</i>	Extrinsic	Quantitative	Cardinal	GAS
<i>Stoniness</i>	Intrinsic	Quantitative	Ordinal	Cost value
<i>Rockiness</i>	Intrinsic	Quantitative	Ordinal	Cost value
<i>Slope</i>	Intrinsic	Quantitative	Ordinal	Not defined
<i>Praedial servitudes</i>	Extrinsic	Qualitative	Dichotomic	Benefit calculated in compliance with the normative in force
<i>Usufruct</i>	Extrinsic	Qualitative	Dichotomic	Discounting
<i>Ongoing loan or mortgage</i>	Extrinsic	Quantitative	Dichotomic	Discounting
<i>Property Tax</i>	Extrinsic	Quantitative	Dichotomic	Discounting
<i>Entitlements</i>	Extrinsic	Quantitative	-	Not applicable
<i>EU income support</i>	Extrinsic	Quantitative	Cardinal	Discounting
<i>Distance to population centres or product processing/ commercialization centres</i>	Extrinsic	Quantitative	Cardinal	Capitalization of a cost value

The greatest limit to the practical application of the MCA lies in the nature of agricultural land characteristics, which are generally more qualitative and less technical than those of urban real estate. This makes them harder to standardize and measure, entailing fewer possibilities to use the MCA.

In fact, as seen above, nominal or dichotomic scales are advisable for a great part of the variables involved in rural land appraisal. Consequentially, marginal prices need to be estimated through the GAS. Since it is based on mathematical and matrix calculations, its use requires a number of comparables equal to the number of qualitative characteristics involved, plus one. For example, in the case of six qualitative characteristics (a plausible hypothesis, at least in this initial analysis of the characteristics involved), at least seven comparables are needed to use the GAS. This number would cause the MCA-GAS to no longer be a parsimonious method, and thus it would lose its advantage over single parameter

and multiparameter methods based on Multiple Regression Analysis.

As this paper shows, the same progress has not been made for all the characteristics analysed. While for some of them it has been possible to hypothesize ways of estimating their marginal price, for others their complexity and the multiple interactions that a single characteristic can have with other ones casts doubts on their ability to be used in the approach at all.

Indeed, given the experimental nature of this investigation, an alternative method for calculating the marginal price could be found for one or more of the characteristics for which the adoption of GAS is currently suggested.

Nevertheless, the results of this research project could be practically useful for those operating in land real estate and credit (notaries, judges, professional appraisers, those involved in real estate court disputes, real estate agents, credit institutions, etc.), as well as for the academic community.

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CHAPTER 3

A wall between real estate valuation standards and professional appraisal practice: A focus on Italian market

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Article

A wall between real estate valuation standards and professional appraisal practice: A focus on Italian market

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Abstract: Real estate appraisal standards provide guidelines for the preparation of reliable valuations. These standards emphasize the central role of market data collection in market-oriented valuation methodologies such as the Market Comparison Approach (MCA), which is the most commonly used. The objective of this study is to highlight the difficulties in data finding, as well as the gap between the standards and the actual appraisal practices in Italy. Thus, a detailed comparison was made between the real estate data considered necessary by the standards and those ones reasonably detectable by appraisers, showing that some important market information is not reachable due to legal, technical and economic factors. Finally, a case study is presented in which the actual appraisal of a residential property is schematically described to support what is claimed with the research question and thus the degree of uncertainty around an estimate judgment.

Keywords: market transparency; real estate appraisal; market data collection; property characteristics

1. Introduction

Until recently, both the rural and the urban Italian appraisal scenarios were characterized by an almost exclusive reliance on “expertise” which was more or less cleverly disguised as an estimate. Single-parameter or income capitalization valuation procedures were applied by an “appraiser” in a way that was easily open to the subjective interpretations of professional users (Ciuna et al., 2014; Ciuna et al., 2015; Simonotti, 2003).

In fact, appraisers are quite often criticized for the superficiality of their property valuation reports when applying single parameter procedures, or for the false sense of rationality they convey in the balance sheets and income capitalization estimates they produce for agricultural land valuations. However, the economic context and peculiar conditions of the Italian market, which is characterized by a general lack of transparency—meant as an extreme difficulty in the collection of reliable property transaction data—justifies their *modus operandi* (Ciuna et al., 2015).

In Italy, during the past fifteen to twenty years there has been some development of new appraisal methodologies which make use of market-oriented (Simonotti, 2011) and income-based approaches (D’Amato, 2015; Simonotti, 2011), applied to the urban market. These Italian academics have been stimulated in their studies by the increasing awareness of the problems with the widespread dependence on “expertise” in real estate appraisal, including serious repercussions with such delicate areas as real estate foreclosures and credit risk exposure checks.

At this regard, Simonotti was one of the first scholars to identify the urgency of adopting real estate valuation standards in Italy (1998; 2008; 2009), followed by other scholars (Ciuna et al., 2015; Manganelli, 2017; Salvo and De Ruggiero, 2012).

Real estate appraisal standards, like all standards in general, come about and evolve over time through a combination between innovations in research of the real estate sector and the professional best practices implemented in each country (Michieli and Cipolotti, 2018) to prepare reliable and scientifically correct estimates. Furthermore, they represent guidelines, i.e., references for those working in the real estate appraisal field, which provide the operational protocols necessary to carry out valid and scientifically sound appraisal processes.

Most recently, during the last few years, various organizations dedicated to appraisal have been established in Italy, including various professional associations.

Thanks to these ones, various initiatives (including seminars, conferences, training and professional refresher courses) are designed, promoted and implemented to spread knowledge of real estate appraisal standards and the most innovative valuation methodologies recognized by them, in order to keep seasoned professional appraisers up to date and to train new generations of appraisers who are more aware of the limitations of the methodologies that have been used, with the main objective of improving the overall quality of real estate appraisals, bringing it closer to that of other countries (Simonotti, 2009).

Nonetheless, the overall quality of real estate appraisals is not yet at the long-desired levels. This situation can be attributed to two categories of causes, which are somewhat connected.

The first one is strictly connected to individual professional behaviour and concerns an insufficient qualitative level of the adopted appraisal methodologies. This issue can be referable either to a lack of professional training or to the fact that valuers are not willing to use the most appropriate appraisal tools because of purely economic reasons. It is rather unlikely to obtain reliable results without incurring in high costs for data search and data collection. In fact, professional fees for appraisal services in Italy are not proportionate to the efforts needed to comply with real estate appraisal standards, especially during the delicate phases of search and subsequent data collection, and of the market analysis, contradicting what is clearly stated in the UNI 11558/2014 Norm¹.

The second critical aspect is related to the lack of transparency conditions of the Italian real estate market (Curto and Fregonara, 2019; Gabrielli et al., 2021; Gabrielli et al., 2022; Grillenzoni, 1970; Manganelli et al., 2022). Indeed, in a given market there is transparency when information is promptly available to all the market participants (supply and demand). On the opposite, a market with lack of transparency is defined as an opaque one and produces an information asymmetry of market participants (Schulte et al., 2005).

Compared to other real estate markets, the complexity of the Italian bureaucratic system can slow down sales transactions and result in uncertainties. The procedures for acquiring, selling, and registering properties are often lengthy and complicated. Additionally, real estate information is often scattered across different sources and not centralized in a single accessible database. This is further compounded by the “culture of secrecy,” where many sellers and buyers prefer to

keep confidential the terms of their transactions.

This dense opacity of information on real estate transactions prevents the availability of reliable, complete data, obtainable in a timely manner (as required for appraisals) and at reasonable costs, which are essential for the operation of market-oriented procedures such as the MCA. This happened despite several editions of the Tecnoborsa Code were published for about twenty years (2000, 2002, 2005, 2011 and 2017).

The importance of obtaining value estimates as close as possible to the market price is often neglected, especially in matters concerning the legal and financial fields in which any distortions in the values estimated by professionals can produce significant repercussions on the real estate supply chain.

In light of the above constraints, the research question of the present study is the following: “In Italy are nowadays professionals in the position of correctly operating in their valuations to obtain precise, reliable, objective and scientifically valid estimates as outlined by valuation standards? Or is the issue of the market opacity still affecting their work?”

To date, the existing literature concerns the issue of lack of market transparency and its consequences but does not analyse what is requested by the evaluation standards compared to what surveyors can actually implement. This study is therefore aimed at highlighting the perspective gap between the operating real estate valuation standards and the appraisal practices of freelance professionals in Italy for urban properties. This is carried out through a detailed analysis of the economic, technical and legal constraints affecting the collection of real estate data essential for the application of market-oriented valuation methods such as the Market Comparison Approach (MCA) and the Multiple Regression Analysis (ARM), in accordance with the real estate valuation standards, and in particular with the Italian Property Valuation Standard (Tecnoborsa, 2018). We actually focused on MCA, presenting an illustrative case study of its application and related constraints in section 4, as it is one of the most widely used appraisal models in Italy nowadays for two main reasons: i) it does not require a large amount of data; ii) its application does not involve statistical knowledge that could pose difficulties for an average-skilled surveyors.

2. A brief literature review on the Italian real estate market

As above mentioned, the low quality of real estate appraisals is attributable to the lack of transparency of the Italian real estate market, noted in the literature since the mid-twentieth century.

Based on his assertion that a country is as economically developed as its ability to make the market of exchangeable goods transparent, Grillenzoni (1970)—regarding the farmland market—proposes the institution of a bank of rural land prices. Thus, the same professionals involved would provide current data in real time.

Well ahead of his time, the same author argues that the establishment of this price bank would avoid arbitrary value attributions and allow for the use of reliable data, something that has not happened to date in the Italian market.

Decades after Grillenzoni's (1970) work, various appraisal scholars are still addressing the lack of transparency in the Italian real estate market.

Among these authors, Simonotti (1998) affirms that the lack of surveys and systematic and comprehensive data and real estate market information collection can be attributed to: the real estate market's lack of transparency; a strong segmentation of the same; the rudimentary administrative objectives of the surveys conducted by the public administration. To improve the level of real estate estimates, he therefore advocates the creation of an information base of reliable, detailed, and objective data related to the various market segments.

D'Amato (2010) affirms that in the Italian real estate market, both properties' real prices and characteristics are not clearly indicated in legal documents and data is often missing.

In another work, Simonotti (2009) observes how the Italian real estate market's lack of transparency is connected to the widespread behaviour of contracting parties as well as the excessive complexity of juridic-administrative procedures. In turn, these cause heavy inefficiencies in the real estate market that impact professional activity and strongly limit the breadth of the available market data observations, which are necessary for the execution of accurate valuations.

In a study regarding mass appraisals, the same Simonotti (2002) laments the evident constraints imposed on the Italian real estate market by the lack of transparency in sale prices, which cause consequent problems for appraisers seeking to use valuation procedures based on the systematic collection of real estate data. These procedures are commonly used in foreign countries, where real estate data is either recorded directly or acquired from private companies or cadastral databases.

To improve the transparency of the specific market of auctioned properties, Guerrieri (2010) stresses the need for a comprehensive knowledge of each item, including their legal, urban planning, technical and economic aspects. All of these are rather underdeveloped in Italy.

Guerrieri (2010) also sustains that while the economic importance of the role played by real estate appraisals has clearly grown over time, the level of knowledge and transparency of the real estate market has not changed as profoundly. It makes valuations less accurate and also impedes buyers from exercising any control over the price-quality ratio of the asset under consideration (Guerrieri, 2012).

More recently, Curto and Fregonara (2019) highlight the obstacles in using transaction prices due to the difficulties in the extraction of data from the deeds of sale, causing a low-quality level in the valuation reports.

Gabrielli et al. (2021) carry on stating that in an opaque market such property data are either not available or they may be purchased only at a very high cost, therefore professionals are practically obliged to refer to other sources of information, which in a transparent market would be classified as inadequate. Then they consider that transparency is an undeniable problem of the Italian real estate market, where transaction data of sales are not directly and easily available for valuers. A direct consequence is that most professionals count on the asking prices of the selling advertisements; these ones are often incomplete and inaccurate in the data they include, thus worsening the reliability of the appraisal reports.

Gabrielli et al. (2022) and Manganelli et al. (2022) directly address the lack of

transparency of the Italian real estate market, which often leads appraisers to use asking prices as proxies for market prices in the selection of comparable properties, resulting in substantially lower quality valuation reports.

Gabrielli et al. (2022) seek to verify how information opacity still represents a crucial problem in the Italian real estate market, focusing on the information employed during the process of estimating the market value of real estate. Instead, Manganelli et al. (2022) try to directly measure the lack of transparency (opacity) of the Italian real estate market as the gap between the asking price and the (future) market price by using a multiparameter statistical analysis model, concentrating on the marginal influence of the principal macroeconomic and microeconomic variables on the spread. The microeconomic variables are mostly related to the comparable extrinsic and intrinsic property characteristics.

3. Real estate appraisal standards

In this section, a description of the principles on which the most important global and European real estate valuation standards are based is first provided, followed by a description of the main Italian standards created in response to the International Valuation Standards (IVS) and European Valuation Standards (EVS). In particular, an analysis of some fundamental points outlined by the Tecnoborsa Code is conducted to understand the steps that an appraiser is supposed to follow in the context of a valuation assignment.

3.1. Main international and European real estate valuation standards

Among the internationally recognized standards, the (IVS) are the longest standing, having been first published in 1981 by a few British and American valuation associations that came together to promote global real estate standards and a common valuation vision among different countries.

They represent the general guidelines for worldwide appraisals and are composed of a few commonly shared principles that can be applicable by different national or regional standards. In the field of valuation, they are published in what is commonly known as the “White Book” including a proposal for worldwide standardizing some concepts and terms in the field of real estate appraisal.

The approaches considered by the IVS to estimate market value include: the Sales Comparison Approach, to be applied by comparing prices adjustments for similar properties based on their different comparable attributes; the Income approach, based on the premise that the value of a property is determined by the income it generates; the Cost approach values a property in terms of replacement costs and is related to the economic principles of market price, discounting of future benefits and substitutability between different goods.

In addition, the IVS require that the final valuation report should provide, among other information, a description of any limiting or particular assumptions required for the valuation assignment, and a statement of compliance with the standard.

In summary, the objective of the IVS is to establish transparent and coherent valuation practices and thus to increase users’ trust in appraisers and in the discipline

of Appraisal.

Another important appraisal standard is the “Red Book”, instituted by the Royal Institution of Chartered Surveyors (RICS), a global accreditation organization for professionals in the real estate appraisal field, that is fully in line with the IVS.

At the European level, the EVS were created in compliance with the IVS and are published in the “Blue Book”. In accordance with the IVS, they propose the same valuation methods with a preference for the Sales Comparison Approach compared to the other two since it is directly linked to real market dynamics. The EVS standards also require appraisers to specify that the standards will be applied in their letter of appointment. Should this not occur, appraisers must give explanation why their application is impossible.

3.2. Italian real estate valuation standards

The principal standards in Italy are those of the Associazione Bancaria Italiana (ABI, Italian Banking Association), the “Linee guida per la valutazione degli immobili in garanzia delle esposizioni creditizie” (Guidelines for the valuation of real estate as collateral for credit exposure), and the “Codice delle Valutazioni Immobiliari” (Code of Real Estate Valuations).

The ABI guidelines are principally based on the following European regulatory and normative sources for real estate valuations for credit exposures:

- Regulation EU No. 575/2013 on requirements for credit institutions and investment firms.
- Directive 2013/36/EU on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms.
- Directive 2014/17/EU on credit agreements for consumers relating to residential immovable property.
- The European Banking Authority (EBA) Guidelines in loan origination and monitoring published on 29 May 2020 (EBA/GL/2020/06).

The Directive 2014/17/EU was implemented in Italy by Decreto Legislativo no. 72/2016, which introduced article 120 to Decreto Legislativo no. 385/1993 (Testo Unico Bancario–TUB).

The goal of the ABI Guidelines is to promote maximum transparency and fairness in real estate appraisals, and to ultimately ensure the greater stability of banks in their credit operations and in the issue and acquisition of securities and of covered bank bonds.

Tecnoborsa Code (henceforth referred to as the Code) is considered as the main real estate valuation standard to be referred to in professional practice in Italy.

This standard, unlike its predecessors, has been designed based on the international standards it takes inspiration from. It has been partially modified and integrated with additional rules for adapting it to the Italian real estate market.

According to the Code, market analysis is essential for the reliable performance of market-oriented appraisals and a fundamental prerequisite for the identification of Highest and Best Use (HBU). Indeed, it is indispensable for obtaining all the elements necessary for the estimate, i.e., the quantitative and qualitative characteristics of a real estate asset.

For this purpose, the Code lists the property features, according to different classification criteria, including those that are intrinsic and extrinsic, quantitative and qualitative, positional, environmental, typological, institutional and economic.

3.2.1. Tecnoborsa code

The Code for real estate appraisal² (2018) states that the survey and collection of actual prices and rents is the only reliable approach (1.1), useful for market transparency and equity in the order to curb distortive effects and make real estate appraisals more efficient (1.2).

Regarding the data concerning the price, only people directly involved in the transactions—such as construction company technicians, real estate agents, buyers and sellers, tenants, notaries, etc.—can have full knowledge of the facts, and thus of the actual data.

Furthermore, a correct collection of real estate market data must be carried out according to principles of validity, reliability, and representativeness (1.7) through survey forms to collect and analyse both the market segment and real estate data (1.8).

The investigation of the segment parameters must be carried out in the field, collecting relevant information from industry operators. Where conditions allow, this should also include collections of the sector's trade uses and customs (2.6).

Market segments need to be identified and described for various reasons. These range from appraising a single property, to performing mass appraisals of part or all the properties in each segment, to mapping all the market segments present in a particular geographical area (e.g., municipality, district, block, etc.), to constructing a database (2.7).

In the second case regarding the market value of real estate, surveys should look at the segment of the property to be valued as well as comparable market segments (if they fall in a different segment than that of the property being estimated) (2.8). The real estate survey form is designed to collect information on market prices or rents and the technical-economic characteristics of the real estate in question (2.9). This real estate data is used in professional appraisals, mass appraisal and in the development of sample statistics, indices and coefficients used for real estate valuation (2.9.1).

Finally, the market segment survey form of the property to be appraised, the survey forms of the market segments of comparable properties, as well as the real estate data survey forms (including attachments) of all the properties used for the valuation must be included in the final appraisal report (4.1).

In addition, the Code presents some advice for appraisers regarding the phases of detection, storage, and exchange of data and information related to the real estate market.

It discusses the quantitative-qualitative nature of data and the use of nominal, ordinal and cardinal scales to describe the quantitative characteristics (1.5), and the use of nomenclatures for qualitative characteristics (1.7).

The next point regards primary sources (2.1) for sales, lease or rent data, i.e., property transfer documents (notary deeds), or the sellers, buyers and third parties involved (tax consultants, notaries, accountants, mortgage credit bankers,

construction company technicians, freelance professionals, condominium administrators, and real estate agents).

Other information (3.1) that can be used to verify sale and rental or lease data include the registry data of the parties, the family or data derived from corporate relationships between buyer and seller, marketing of the property (real estate agency, direct sale, sale via internet, newspaper ads, word of mouth), time of marketing, rights and encumbrances on the property, and type of financing.

The Code also offers some issues to keep in mind when implementing survey instruments such as the questionnaire (4.2), the phone interview (4.3) and the personal interview (4.4) in relationships with the concerned parties in instances when sales or rent/lease data is not available within official documents (sales deeds) or is incomplete.

Furthermore, the Code warns appraisers that some data sources should not be considered in the data collection phase, identified as “invalid data”. These include some types of sales or rentals such as those to public administrations or to charitable entities, voluntary transfers and expropriation indemnities, sales and rentals between close relatives or between affiliated companies. Other situations in which one must not rely on the relative data are sales made under special conditions, such as those of judicial auctions or those in which the purchaser is the owner of an adjacent property to the one to be valued.

It should be noted that the above chapter is largely inspired by the document published in 2020 by the International Association of Assessing Officers (IAAO), whose main theme is the identification of methods for verification and adjustment of real estate transaction data, according to a specific valuation standard.

In the relevant chapter, the Code describes the MCA in detail, noting that it is the most widely used real estate valuation procedure worldwide. It also emphasizes that the assessment system and allocation system are complementary to the MCA and can be used in combination with it to determine the marginal prices of qualitative property characteristics.

However, the guidelines by the Tecnoborsa Code do not seem to effectively take into account the conditions of the Italian real estate market, characterized by a lack of transparency in information. The code tries to propose alternative ways (i.e., points no. 4.2, 4.3, and 4.4) to obtain the missing data, but these seem quite convoluted and difficult to follow. It is true, though, that the standards express what is necessary to carry out valuations in the most objective, reliable and transparent way, and it is unthinkable that this will be radically changed or that the standards will be entirely adapted to the conditions of a specific market like the Italian one.

4. Collection of market data and the unavailable information

In this section, an examination of the constraints that limit the effectiveness of market value estimates in Italy is conducted, taking into account the innovative processes as MCA, General Assessment System, etc.

As already mentioned, for these appraisal procedures to work and provide reliable results, it is necessary to know not only the characteristics of the property being appraised but also those of the properties used for comparison, known as

“comparables”. While the characteristics of the property being appraised are easily obtained through the information and documentation provided by the property owners or clients of the appraisal, this is not the case for comparables. There are countries where information on real estate transactions is collected in public databases or is accessible upon request. Among these, United States has platforms like Zillow, Redfin, and Realtor that offer an easy way to identify recently sold homes quickly, showing both current prices and historical transaction prices, as well as other property-related information. These are useful for finding comparables and making comparisons to estimate market value.

This analysis is carried out by comparing the theoretical level to be reached in the data and market information collection phase—the standard—and the operational level for an appraiser aiming for full compliance with real estate valuation standards. In order to carry out a detailed analysis of what can be detected with a good operating margin, a verification is conducted of the useful information contained in property transfer documents, which are primary sources of purchase and sale data, as indicated in the Code.

The most reliable source of real estate data, such as sales or rentals, is the notarial deed but often the market information and real estate data contained in these documents are not detailed enough.

In order to carry out a correct market survey it is necessary to analyse in detail real estate purchase and sale deeds.

Starting with the real estate data collection form, a systematic verification of the presence in a generic notarial deed of sale is carried out for all the locational and typological characteristics.

The characteristics relevant to the building where the real estate unit chosen for appraisal is located, such as the number of floors above ground level and the construction date, can usually be obtained from the notarial deed. This information can also be easily obtained through the Google Maps Street View tool or even through a simple site visit. The construction date is not always specified in the deed. Finally, location data of the property, such as municipality, fraction, district, address, house number, interior, etc., are always indicated in the notarial deeds.

Notaries rarely include information about the main surface area (the interior area) and any secondary surface areas of a real estate unit in purchase and sale agreements. These could include ancillary areas (balconies, terraces, verandas, porticoes, etc.) as well as connected surfaces (cellars, attics, garages, etc.). This data may be extracted from measurements taken by professional technicians before the agreement is signed, used to survey the property’s cadastral and urban state.

The cadastral data are essential in any deed of sale because this information is mandatory by law and notaries must indicate them as they identify the property that is the object of the transaction, and they are usually provided to the notary directly by the seller or obtained from the current (or historical) cadastral survey.

In addition to other features which can be inferred from the deed text, such as the level or floor above ground, there are others which are usually not included in the body of the deed, such as the predominant exposure of the real estate unit, the view, the panorama, the brightness, the presence and conservation status of technological systems (plumbing, heating and cooling, electrical, etc.), the general state of

maintenance (including any partial or total renovations carried out and the corresponding completion date) and the quality level of the finishes present in an apartment at the time of the deed's signing.

According to Tecnoborsa, relevant subjective characteristics are rarely explicitly stated in the deed, such as the professional condition and occupation of the contracting parties, unless they are legal persons (corporations, cooperatives, etc.), in which case the notary is obliged to verify the name and status of the activity (active, ceased or in liquidation) by requesting a business search at the Chamber of Commerce. On the other hand, the data of buyers and sellers are always available, such as name, surname, tax code, date and place of birth and residence, otherwise the deed is null and void.

The motivation to sell and the motivation to buy the property in question are also rarely mentioned characteristics.

The economic characteristics, as well as any protection or planning restrictions on the property, are usually stated in the deed. Among these, the rental situation of the property (flat occupied or free of people) and the presence of usufructuary, use or habitation rights, as well as easements, are specified in the deed.

Financial characteristics, such as the presence of a mortgage or other form of financing, are also always reported in the deed.

The urban and cadastral conformity of the property must be indicated in the deed of sale, although this almost never occurs through a compliance and cadastral conformity report, which is a certification provided by the seller and transcribed into the deed of sale in which a qualified technician must confirm that the state of the property is in accordance with the documents deposited at the cadastre and the Municipality, and must verify that the property is certified for occupancy.

Finally, the real estate data collection form (Simonotti, 2011; Tecnoborsa, 2018) includes attachments such as architectural plans of the area, the building and the single real estate unit, as well as detailed photographic documentation.

The architectural plans of the area and of the building (in the case of condominiums) are not included as attachments to a notarial deed for obvious reasons. However, it is not as obvious why the floor plan of the real estate unit is not required to be attached to the notarial deed according to Decreto Legislativo No. 78/2010. Furthermore, the notary does not need to include the description of the verifications carried out in this regard in the deed; in fact, a brief indication that they have been carried out is sufficient, including when they took place and their results.

Without a doubt, the absence of a survey plan poses significant issues for appraisers, as this is essential for obtaining data related to surface area, such as the main Net Internal Area and Gross Internal Area as well as any secondary surfaces of the real estate unit (e.g., balconies, terraces, porches, carports, parking spaces, garages). This data is important for the implementation of processes such as the MCA for calculating the marginal prices of the surface characteristics.

Given that notarial deeds are public acts, one would think that the architectural plans, when attached, would also be public. Apparently, the "Agenzia delle Entrate" (the Italian Revenue Agency) is not of the same opinion in this regard.

In fact, according to the Italian Revenue Agency notice no. 9 from 25 November 2003, for a professional to request a copy of the architectural plans of a

property, he or she must first obtain a delegation signed by the current owner since by the notice states that architectural plans “take on a strong aspect of confidentiality” in according to the privacy law protecting personal data (Codice in materia di protezione dei dati personali, issued with Decreto legislativo 30 June 2003, n. 196).

However, it is easy for appraisers to follow the indications of the Code to obtain photographs of the area’s building types and of the property in question; on the contrary, it is impossible to reproduce a photographic documentation representing the interior of the real estate unit which is not included in the deeds. Therefore, the only description available for appraisers is the extremely concise one reported in the deed, describing the property’s number of floors, the number and types of main and accessory rooms and the number of bathrooms.

After examining the real estate property characteristics that an appraiser is expected to collect to fill out the form, it becomes clear that some of these cannot actually be obtained from the sales deed.

In accordance with the Code’s proposed methodology, appraisers seeking to fulfil the requirements of the data collection phase should look for an alternative approach for any features that cannot be discerned from reading the notarial deed.

To summarize, some of the most significant characteristics of the real estate property for the purposes of an appraisal cannot be found directly from the property transfer documents such as surface area (main and secondary), condition of technological installations (plumbing, heating and cooling, electrical, etc.), general state of maintenance (specifying any partial or total renovation work carried out and the corresponding date of completion), panoramic view, lighting and the overall quality of the finishes in the apartment at the time of the deed.

Clearly, when using market comparison-based approaches to appraise properties, this is only a problem for those properties chosen as comparables. In fact, the appraiser will have direct knowledge of the evaluated elements for the property being appraised but will have problems acquiring the same information for the comparable properties without conducting an on-site visit (Guerrieri, 2010).

In this situation, the appraiser can determine all these characteristics by resorting to alternative methods suggested by Tecnoborsa. However, these methods entail all the operational difficulties involved with these kinds of investigations, coming from the automatic distrust these subjects have for appraisers and their work, which is still not well known or appreciated.

At this point, appraisers can only rely on themselves, attributing amounts to unknown characteristics based on their own potentially strongly tainted judgment, which can emerge as expertise.

For exactly this reason, Italian valuation practices have historically been based on appraisers’ knowledge of the region and economic market, using expertise to overcome the lack of objective, organized and accessible technical and economic information (Simonotti, 2003).

The difficulties that arise during the collection of real estate data can also be sought in the parameters of the market segment, especially in the market ratios.

As already noted, these could be calculated from data collected from sales deeds when the deed refers to individual portions of a property, and not to the whole

property. If only the total price for the whole property is reported, a direct detection of market ratios cannot take place (Simonotti, 1998). In such cases, experts often turn to the use of indices reported in public administration operating manuals and notices (Ciuna and Simonotti, 2014).

In well-developed real estate markets that are efficient and transparent, market ratios are widely available as market data (Simonotti, 2008). On the contrary, undeveloped real estate markets, such as the Italian one, compromise the accuracy of market-oriented procedures because they lack the very data those approaches are founded on.

5. An illustrative case of the difficulties in applying real estate valuation standards: The appraisal of the market value of a house in a seaside area

For illustrative purposes, a case study is briefly described using data from a real professional situation in which the valuer tried to adhere as closely as possible to appraisal standards.

In particular, the appraisal was carried out at the specific request of a private client, during which surveys were conducted on all elements of the residential structure. Simultaneously, three sale deeds of similar properties belonging to the same market segment, were obtained from some notary offices³. Physical access to the three comparables was not possible due to privacy concerns, but observations were made from the outside and based on the real estate data from the aforementioned deeds, supplemented by aerial images from Google Earth and Google Maps.

This approach is consistent with what is typically done by most appraisers during their professional activities.

This example regards the appraisal of the most likely market value of a villa built in 1958 belonging to the A/7 (villino, i.e., small homes with gardens) cadastral category. The property, which is accessed directly from the public road, is laid out on four floors: two above ground (ground floor and 1st floor) and two below the street level (S1 and S2). On the ground floor, there is the actual residential space with four bedrooms, a kitchen, the living room and two bathrooms, while on the first floor there is a terrace. The floors below are occupied by a large room, two storage rooms and a bathroom (S1 floor) and by three rooms, a storage room, and a bathroom (S2 floor).

The property main area and balconies respectively cover 348 m² and 38 m², an external storage area has a usable floor area of about 60 m², and there is 3256 m² of outdoor space with a possible private access to the sea. The area's population density is not very high, since all the surrounding villas include large areas of appurtenant land.

Table 1 shows the market ratios for the identified market segment, extracted from the relative survey form filled out by the appraiser.

After having identified 3 comparable properties and having chosen the characteristics to include in the procedure, the following data table was elaborated (**Table 2**).

Table 1. Segment market ratios.

Indicator	Value
Surface area of garage—storage areas	0.25
Secondary surface area (balconies and terraces)	0.25
Annual price change rate	0.03
Complementary ratio	0.15

Table 2. Property data.

Property characteristics	Comparable 1	Comparable 2	Comparable 3	Subject property
Main area (m ²)	387.00	201.00	274.00	348.00
Balcony area (m ²)	45.00	30.00	12.00	38.00
Garage—storage areas (m ²)	54.00	25.00	0.00	60.00
External area (m ²)	7083.0	1223.0	1267.75	3256.0
Bathrooms (no.)	4	2	3	4
Date (month)	12	12	1	0
Pool + poolside area (presence/absence)	1	0	0	0
Ceteris paribus				
Waterfront access				
External and internal upkeep conditions				

The above-mentioned table reports the real estate property characteristics and relative quantities, as well as those characteristics considered *coeteris paribus*, i.e., waterfront access, and external and internal upkeep conditions.

For the comparables, waterfront access was personally ascertained by the appraiser; on the contrary, upkeep condition is considered *cœteris paribus* because it was impossible to verify both at the time of the sale and at the time of the appraisal.

At this point, the appraiser proceeded to estimate the marginal prices (**Table 3**) and successively completed the valuation table⁴ (**Table 4**).

Table 3. Marginal prices.

Property characteristics	Marginal price Comparable 1	Marginal price Comparable 2	Marginal price Comparable 3
Main area (€/mq)	2301.44	2301.44	2301.44
Balcony area (€/m ²)	575.36	575.36	575.36
Garage—storage areas (€/m ²)	575.36	575.36	575.36
External area (€/m ²)	31.77	31.77	31.77
Bathrooms (€/n)	1500.00	1500.00	1500.00
Date (€/month)	3750.00	2358.38	1875.00
Pool + poolside area (€/n)	15,000.00	15,000.00	15,000.00

Table 4. Appraisal table.

Property characteristic	Comparable 1	Comparable 2	Comparable 3
Sale price	€1,500,000.00	€943,350.00	€750,000.00
Main area	−€89,756.32	+€338,312.27	+€170,306.86
Balcony area	−€4027.53	+€4602.89	+€14,959.39
Garage – storage areas	+€3452.17	+€20,137.64	+€34,521.66
External area	−€121,569.25	+€64,580.69	+€63,159.15
Bathrooms	€0.00	+€3,000.00	+€1500.00
Date	−€45,000.00	−€28,300.50	−€22,500.00
Pool + poolside area	−€15,000.00	€0.00	€0.00
Adjusted price	€1,228,099.07	€1,345,682.98	€1,011,947.05
Absolute percentage divergence ⁵	32.98%		

As shown by **Table 4**, the absolute percentage divergence is equal to 32.98%. Such a high value did not allow the appraiser to continue with the valuation synthesis by estimating the market value of the property. The literature only considers the test passed if the value does not exceed 3%–5%, while in professional practice the maximum threshold rises to 10%. If the MCA has been correctly set up and carried out in its previous phases, this difference can be attributed to some important qualitative characteristic that has not been considered by the expert.

If this were the case, this could mean that the adjusted prices of the comparable properties differ because of the remaining qualitative characteristics (Simonotti, 2011, p. 161). Following this hypothesis, the appraiser identified two inestimabilis characteristics (zone and urban planning compliance) that were used in the General Assessment System⁶. This procedure, separating the effects of the aforementioned qualitative characteristics, has made it possible to estimate the marginal prices and simultaneously to obtain the market value of the property being estimated.

However, it is not at all certain that the divergence between the adjusted prices is solely due to the omission of one or more qualitative features. In fact, this divergence could be the result of a series of approximations accumulated throughout the process. In the present case, the appraiser resorted to a series of assumptions ranging from the quantification of the market segment's market ratios (surface area ratios, complementary ratio, annual rate of price variation) to the inclusion of the “upkeep condition” under the “coeteris paribus” condition.

Regarding this last point, the unavailability of third parties (notaries, real estate agents, construction companies, etc.) and the impossibility of verifying the actual conditions of the comparables with a site visit or through photographic documentation, implicitly “forced” the appraiser to renounce the inclusion of this property characteristic in the valuation process.

This situation, if the actual maintenance conditions of the comparables were significantly different from each other and from those of the subject, could lead to significant procedural biases in the valuation of the property.

What has just been written for the “upkeep condition” is nevertheless applicable to other property characteristics, such as technological systems (electric, heating, air

conditioning, water-sanitary, lift), the constructive characteristics of the building and the finishes of the interior, and to the parameters of the market segment such as market ratios (regarding both surfaces and not) and instrumental ratios, which are difficult to detect but of a great interest to valuation purposes.

In the case under consideration, regarding the determination of market ratios, in the absence of the regular sources described in the technical-valuative standards for their ascertainment, the appraiser “took refuge” in technical manuals, valuation texts, and ministerial or Italian Revenue Agency notices to get an idea of the values to be assigned to these market ratios in relation to the appraised property’s market segment.

Both in this specific case and in general terms, the professional’s work is strongly constrained by the non-transparent conditions of the real estate market in which he/she operates, notwithstanding a medium-high level of theoretical-methodological knowledge and Best Practices in the appraisal field.

In fact, professional appraisal is heavily impacted by the inadequate amount of economic information, which reduces the availability of the market data that would be necessary to carry out accurate valuations (Simonotti, 2009).

6. Conclusions and future trends

6.1. Considerations

The research question was posed whether it is currently possible to effectively apply real estate appraisal standards in the Italian urban market.

The study of the various standards has allowed us to identify the basic principles and appraisal methodologies that they have in common. Particular attention has been paid to the Tecnoborsa Real Estate Valuation Code, which was inspired by the main international standards but particularly designed for the Italian real estate market.

Given that the crux of the Italian real estate market’s problem is its lack of transparency, this study’s analysis focused on the data collection phase that represents the weak link of real estate appraisal processes.

The comparison between the appraisal forms proposed in the Tecnoborsa Real Estate Appraisal Code (for both market segment and real estate data) and the data that can be obtained from property transfer documents (sales deeds) clearly showed that in current conditions appraisers cannot complete both forms according to standards.

Paradoxically, the greatest limitation to the work of the appraiser is Italian privacy law, which prevents him/her from obtaining all the data and information that are necessary to carry out an appraisal in line with the standards. This is indeed a paradox, because the standards were created—with the contributions and collaboration of all national orders of technical professions—precisely to improve the quality of estimates in the real estate sector. On its part, the State with its legal framework on data protection (Decreto Legislativo 30 June 2003, n. 196) prevents the efficient performance of real estate appraisal, which not only plays a primary role for the interests of private citizens (Grillenzoni, 1970), but also in credit granting processes, the establishment and management of real estate funds and the

verification of the degree of coverage offered by insurance companies (Guerrieri, 2012).

The lack of transparency in the Italian market still prevents even the most experienced appraisers from fully meeting the requirements set out in the various standards, unlike in most Anglo-Saxon countries, where the appraisal activity is facilitated by a great availability of information useful for drafting an effective real estate valuation report.

Therefore, this study has outlined on the one side the ideal context and on the other side the existing constraints by identifying clearly the missing points which do not allow to bring appraisal practice closer to theory.

6.2. Future perspectives

There are various ways in which the operating conditions of appraisers can be improved to reduce the “distance” between real estate appraisal standards and valuation practices for professional freelancers in Italy.

For example, it would be desirable to set up a database of both prices and real estate characteristics of properties involved in transactions that would be regularly updated and available to professionals in the urban real estate sector through specific legislative acts.

As observed by Guerrieri (2012) and Agosta et al. (2022), public entities could play an important role in managing real estate registers and cadastral databases by reorganizing the structure of the information they possess, which is currently used for tax equalization, to supply professionals with the microeconomic data necessary for appraisals.

In the future it would be beneficial to identify the minimum levels of available information that would enable the practical application of standard valuation principles, as suggested by Guerrieri (2012).

Furthermore, the Italian Revenue service could grant working professionals' exemptions regarding the consultation of architectural plans, since they are integral parts of notary deeds, which are recognized as public acts, and furthermore constitute an important valuation instrument.

Building Information Models (BIM) are promising information technology tools that could be useful for the real time acquisition and sharing of technical information regarding both the structural and non-structural projects carried out during the life cycle of either entire buildings or individual parts.

This would presuppose the issuance of targeted regulations, as well as increased collaboration between actors operating in the real estate industry such as construction companies and appraisal professionals. Furthermore, a nationwide memorandum of understanding between appraisers, real estate agencies and notaries would be beneficial. This agreement would contribute to improving the general quality of appraisals, significantly increasing the quantity of market information available with positive repercussions for the growth and transparency of the Italian real estate market.

Before these projects are carried out, a partial revision of privacy law is necessary since some of the required information is still protected by the Codice in

materia di protezione dei dati personali in force.

Furthermore, the government could launch an informational campaign to increase private citizen's knowledge and awareness of appraisers as professional figures.

The skills and the specialist knowledge of the latter are in fact often underestimated. One of the reasons is that the Real Estate Agencies offer evaluations almost in real time and nearly for free to potential customers.

Lastly, but not least, improving coordination within each professional association and between those ones of the various technical professions would contribute to enhance the figure of the appraiser within the real estate supply chain. At the same time, it would be desirable to have a better collaboration in theoretical and applied validations, among the Professional Associations, the Scientific Societies and the Academics operating in the field of appraisal disciplines.

The practical solution to remove these constraints can come either from voluntary collaboration or through regulations on the availability and sharing of information among all stakeholders in the industry. This aims to protect and promote the improvement of the quality of real estate appraisals, recognising their delicate role.

We agree with Schulte et al. (2005) in stating that information sharing and the availability of market data can be beneficial for everyone and that “the key to more market transparency is a change in the mentality of market participants”.

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Notes

- ¹ The UNI 11558/2014 standard is an Italian technical standard that defines the competency requirements for real estate appraisers. Published by the Italian National Unification Entity (UNI), this standard establishes the criteria that professionals must meet to be considered qualified in the field of real estate valuation. This standard thus represents a fundamental tool for the professionalization of the real estate appraisal sector in Italy, promoting trust and transparency in the real estate market.
- ² Below, some key points regarding the collection of market data for a market-oriented estimation are extracted from the various articles of the Tecnoborsa Code, citing the numerical section reference at the end of each point.
- ³ Each deed of sale is registered by the notary at the time of signing with its own identification code. The deeds are public documents, but they cannot be easily found unless the evaluators interested in examining them know this numerical code. In this case they can request a copy directly from the notary upon payment of a secretarial fee.
- ⁴ The mathematical calculations carried out to determine the marginal prices (**Table 3**) and the adjusted prices (**Table 4**) are not reported here both for convenience and because the explicit description of these MCA steps is not essential to the objectives of the work.
- ⁵ The absolute percentage divergence in the MCA is calculated as the difference between the highest and the lowest of the comparables' adjusted prices, divided by the lowest adjusted price and finally multiplied by 100.
- ⁶ It was not considered convenient to report the steps taken and the results of the General Assessment System as they are irrelevant to the objectives of the present work.

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CHAPTER 4

The Land Cadastre in Italy and some fiscal implications: a case study

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The Land Cadastre in Italy and some fiscal implications: a case study

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Abstract. The Land Cadastre, as an inventory of all relevant real estate in a territory, and most importantly, as a national tax system is, or at least should be, the protagonist of fiscal, social and civil implications affecting the Italian context. According to unitary farmland incomes, the last revision dates back to 1978-1979, a period that no longer reflects the country's current socioeconomic situation and does not consider the changes the land market has undergone over the years. Through the analysis of 183 purchases and sales of agricultural land in two districts in western Sicily, this research aims at verifying the adequacy or inadequacy of the current cadastral tariffs. Based on the prices surveyed and the cadastral farmland incomes, some indicators were constructed showing, on the one hand the absence of a strict correspondence between these two values and on the other hand the actual presence of fiscal inequality for all the crop qualities examined; and, consequently, the need for revising cadastral tariffs or for reforming tax system of Italian Cadastre by replacing tariffs with market values.

Keywords: Land values, Equity, Tax policy.

JEL codes: H21, H31, R38, R51.

1. INTRODUCTION

In 1861 – at the time of the establishment of the Kingdom of Italy – 24 land registers already existed, each structured differently (Magni, 2002).

“The heterogeneity of the various land registers posed a major obstacle for a necessary and urgent reorganization of the finances by the nascent Italian government”. (Colombo, 2003, p. 11). In 1886, Law No. 3682, known as the Land Equalization Law, was passed, which resulted in the establishment of the ‘New Land Cadastre’, the first national land cadastre¹ (Zangheri, 1980).

A succession of four phases marked its establishment over 70 years: Establishment; Publication; Activation; and Management. In the first phase,

¹ At the same time the Urban Building Cadastre was established.

the operations of measurement and appraisal led to the formation of the 'New Land Cadastre'.

The appraisal procedures were distinguished as follows: qualification, classification, grading and tariff calculation. In order to determine the latter, a farm balance sheet was drawn up on typical land parcels in the municipality in question, from which the Land Cadastre Taxable Income prior to 1886 was obtained.

In later years, the Land Cadastre underwent four revisions: the first revision dates back to 1923 and updated the tariffs and the reference census time period (1904-1913); the second one took place in 1939 (R.D.L. 4 aprile 1939, n. 589) and entailed the splitting of the cadastral taxable amount into Farmland Income and Agrarian Income – quantified on the basis of balances drawn up no longer on standard plots but on actual and ordinary farms – and the updating of the census reference time period (1937-1939); the third revision concerned only the updating of tariffs to a new census time period (1978-1979), excluding any new definition or updating of crop qualities and related productivity classes. Finally, the fourth, which provided for the updating of the Farmland Income and Agrarian Income and the census period of reference to the two-year period 1988-1989, was authorized by Ministerial Decree No. 3/355 of 20 January 1990, but was never implemented.

With "old born" cadastral tariffs, the agricultural sector could only be characterized by "taxable incomes determined in a totally conventional way with values that are very far from the Italian scenario both in magnitude and in the distribution among the various crop qualities" (Cristofaro, 2015). As of now, the Italian Land Registry is not legally authoritative as it does not provide legal proof of ownership and real rights. In fact, in order to ascertain the legal ownership of a property, it is necessary to possess official documents such as sale deeds or succession deeds or to carry out a mortgage survey.

Since 2001, the Land Registry has come under the jurisdiction of the "Agenzia del Territorio" (*Land Registry Agency*) which, in turn, was merged with the "Agenzia delle Entrate"² on 1st December 2012. Currently, professionals and authorised users are able to access cadastral data via the *SISTER* online platform, which is directly connected to the "Agenzia delle Entrate" database.

Thanks to the computerisation process, cadastral document request operations have been simplified and waiting times have been significantly reduced, marking an important turning point for the cadastral system.

In addition, in accordance with the European Directive INSPIRE (INfrastructure for SPatial InfoRmation in

Europe), the "Agenzia delle Entrate" provides two services for the consultation of cadastral cartography: the cadastral cartographic consultation through the Web Map Service (WMS) and the Cadastral Cartographic Geoportal.

The process of computerisation and the use of new topographical instruments have only partially solved the problems related to measuring operations that took place many years ago and were never updated, except through the direct intervention of the professionals appointed by the owners or possessors of the real estate and through AGEA for the update of crop variations surveyed in relation to the Single Payment Scheme (SPS) (Decreto Legge 03/10/2006 n. 262).

In fact, according to a survey carried out by the "General Directorate of Cadastre" and of the "Technical Revenue Services", about a quarter of all cadastral maps (recognised as official state cartography by Law no. 68 of 2nd February 1960) show an inadequate geometric representation (Coletta et al., 2009). According to Zanchi et al. (2018), the practical use of cadastral cartography – and its continuous feedback on the territory thanks to the use of modern topographic and aero-photogrammetric techniques – has highlighted its evident inadequacy in responding to increasingly complex and operational urban planning needs (identification of individual properties on the ground). This inadequacy is due to the dated nature of the land survey, the obsolescence of the instruments used, the wear and tear on paper cadastral maps, and the deformation of maps caused by the use of scanners to digitalise them. In this regard, by way of example, the images shown in Figure 1 represent two distinct map sheets concerning the territory of Santa Flavia (PA) municipality, whose representations are doubled and shifted; hence it is impossible to obtain simple information (such as the cadastral parcel number) and, above all, reliable information.

It is necessary, therefore, to consider a revision of the Land Cadastre that concerns not only the tariffs, the classification and the grading but also the cartography aspects (Ribaud, 2001). Physical and appraisal aspects are closely linked, since having an adequate cartography makes it possible to have a suitable description of the physical base useful for assessing taxable income (Coletta et al., 2009).

It is clear that the cadastral mapping sector needs a thorough reformulation, perhaps with the help of innovative tools that can, in some way, simplify the difficulties in surveying, processing, and therefore managing, a large number of cadastral maps.

In this regard, Ferrante and Garnerò (2016) provide a new and innovative perspective on the restructuring of the cadastral mapping sector: they hypothesise the

² The Italian Internal Revenue Service.

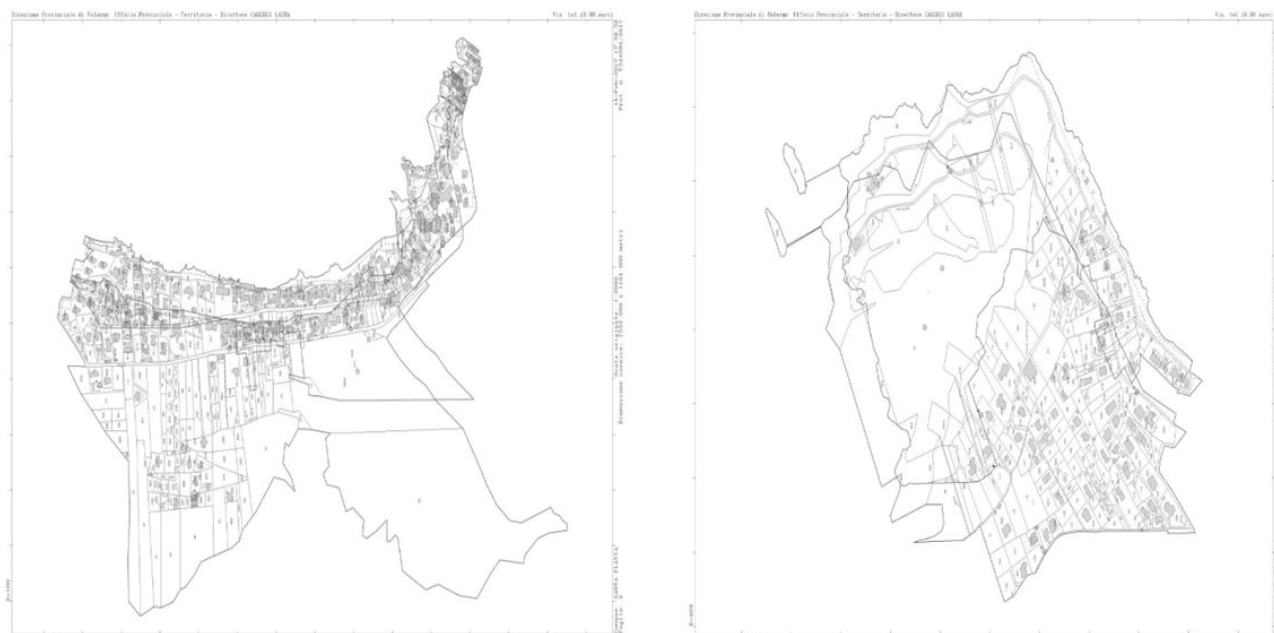


Figure 1. Map sheets of the municipality of Santa Flavia (PA) (source: Agenzia delle Entrate – SISTER).

use of innovative instrumentation such as drones for the cartographic updating of individual maps and, thus, of restricted portions of the territory.

This would allow a plano-altimetric representation capable of fully capturing the territorial geomorphologic characteristics, and therefore parcel characteristics that can influence both the value and profitability of land ownership.

With reference to the tax aspect, the last revision of the unitary farmland incomes dates back, as already pointed out, to more than 40 years ago. Since then, there has been no further change, even though Presidential Decree No. 917 of 22 December 1986 and Article 2 of Law No. 75 of 24 March 1993 establish, respectively, that every ten years there should be a revision of the tariffs and that new criteria for the classification and determination of cadastral unitary rents should be defined, considering the productive potential of the land. This shows self-awareness on the part of the State of the malfunctioning of the cadastral system as it is structured. Over the years, the only implementation intervention has concerned the revaluation of the unitary Farmland Income and the Agrarian Income, using percentage rates with no connection to the reference market trend³.

³ For IRPEF purposes, the Farmland Income and Agrarian Income have been increased by 80.0% and 70.0% respectively (since 1998, with a further increase of 15.0% since 2013 and 30.0% since 2016); for IMU (formerly ICI) purposes, the Farmland Income has been increased by 25.0%.

As also argued by Simonotti (2008), the valuation method (by classes and tariffs) of Italian Cadastre appears to be as a rigid system, which is not able to adapt to the dynamics of the real estate market, is not compliant with international valuation standards and does not have its own standard.

The problem, therefore, lies not only in the obsolescence of the cadastral farmland unitary rents but also in the procedure adopted for their determination, related to the 1939 classification, which is no longer adequate to the national socio-economic situation as it does not respond to the production systems and current structural conditions of the agricultural sector (Pierri, 2015). Moreover, changes in quality and classes do not always take place, so it is advisable to verify the actual correspondence between the cadastral certificates and the state of the places.

Furthermore, as Colombo (2003) argues, the concept of ordinariness that underlies the procedure for determining cadastral taxable incomes has long been distorted and outdated 'due' to a constantly evolving national and EU regulatory framework where entrepreneurs are constrained by the EU incentive or disincentive system that affects their production choices.

Similarly, it is important to point out that the succession over time of various changes in the economic, financial, social and environmental spheres has led to profound changes in the relationship between property and labour, in the form of tenure and land use. With

reference to the latter and as reported by Schimmenti et al. (2013), when, as a result of economic development, agriculture does not contribute substantially to the formation of national income, investors' interest in non-agricultural land uses increases. In this way, land is not only seen as a factor in agricultural production but also as a commodity to be used in different sectors such as tourism, industry and with different uses such as residential, recreational, etc. (Grillenzoni, 1970). Over the years, the guidelines of the Common Agricultural Policy (CAP), also aided by 'Climate Change', have led agricultural entrepreneurs to modify their land-use choices, favouring the concept of multifunctionality and the rapid spread of crops that were previously completely absent, and causing the sharp reduction of others that were once representative of vast rural areas of Italy (Colombo, 2003).

In this situation, the concept of ordinariness is inappropriately applied in the cadastral area, and consequently in the taxation field. In this sense, the problem of calculating tariffs does not only concern the drawing up of financial statements on ordinary farms. Indeed, once the farm balance sheet had been drawn up and the relevant tariff quantified, the appraisal procedure for typical values was applied. Following this procedure, the surveyor's task was, firstly, to assign a score to the study plot (based on its cultivation quality and relative class) and, only afterwards, he could extend the results obtained to all the other plots falling within the same municipality, by means of the so-called connecting scales. In this way, the reference parcel constituted the starting point for the determination of the scores for all the other plots (merit scales), through a comparative procedure, carried out with "empirical and subjective criteria" (Simonotti, 2002, p.576).

In fact, if a cadastral parcel was considered worse or better than the reference one then it was given a lower or higher score respectively, in comparison to the estimated score for the reference land parcel.

In this regard, it is worth recalling that in traditional valuation, the method is only one, i.e. comparison, an aspect that could, to some extent, justify the procedure adopted to calculate land rents. However, it is also true that appraisal is a discipline that tends towards objectivity without ever achieving it precisely because appraisal judgments are formulated on the basis of practical-theoretical knowledge and affected by the appraiser's discretion. The latter, as a matter of professional ethics, should implement procedures aimed at reducing the degree of subjectivity to zero. For this reason, appraisal by typical values is often a fallback to be taken into account only in the absence of market price data, while compensating for

the limitations of this procedure with excellent knowledge of the real estate market (Simonotti, 2002).

At present, therefore, the tax base provided by the cadastral system is inadequate due to the calculation system and progressive evolution of the agricultural sector (Coletta et al., 2009) and unreliable while reliability is an indispensable component of taxation (Colombo, 2003). The result is a systematic inequality in taxation due to the discrepancy between the unit incomes – actual and cadastral – of real estate in the same productivity class, which, in turn, leads to the underestimation and overestimation of the assets themselves (Simonotti, 2008).

A few research studies have showed the presence of inequality at national level (Agnoletti et al., 2020) and in a territorial context (Cenciarelli, 2006) with regard to buildings and in a specific territorial context (Asciuto et al., 2008) concerning agricultural land.

However, despite the lack of fairness mentioned above, the Italian Cadastre obtains the favour of taxpayers who, in this way, do not have additional expenses and tax inspections and the tacit approval of public institutions who are guaranteed not only simplicity in carrying out control operations but also peace of mind in their relations with taxpayers, avoiding in this way the emergence of numerous tax disputes (Coletta et al., 2009). Proposals for the reform of cadastral tariffs, so far found in the literature, are divided into two different lines of thought:

- a) maintenance of the cadastral tariffs, always determined on the basis of farm balance sheets, while proposing an appropriate and radical renewal;
- b) taxation based on market values so as to reduce the gap between cadastral and market values.

a) Maintenance, upon remodulation, of the current method by classes and tariffs

A Cadastre where fiscal system is based on tariffs is utilised, besides in Italy, in other four EU countries (Austria, Belgium, Hungary, Portugal), illustrated in section 2. Guerrieri (2003) proposes that the Land Registry be left with only its civil functions, thus making it probative, and suggests that the new tariffs (average annual farmland income per hectare) are determined from the product between average land prices, grouped by homogeneous areas and specific crop qualities, and an interest rate called 'cadastral rate', variable according to the profitability of the various crop qualities. However, the difficulty in determining an adequate capitalisation rate is now widely recognised in the valuation field and it is strongly conditioned by the appraiser's discretion.

According to Ragni and Luccarini (2003), the income values of areas characterised by productive isotentiality – called micro-zones – could be calculated on the basis of larger areas called macro-zones. Other authors (Seroglia and Tellarini, 2003; Tellarini and Seroglia, 2003) propose, on the other hand, a modification of the census areas, of the analytical crop account and above all of the crop qualities. The latter would be drastically reduced from 116 to 13 homogeneous “aggregates” from the income point of view in order to make the taxation system more adherent to the current reality of Italian agriculture and the new tariffs, in place of the Farmland Income and Agrarian Income, would be calculated analytically on the basis of data from the Agricultural Accountancy Information Network (RICA).

b) Taxation based on market values

The alternative to maintaining tariffs, albeit reformed, could be the introduction of a Cadastre with a tax system based on market values as is the case in several EU countries (Cyprus, Denmark, Estonia, France, Germany, Latvia, Lithuania, Poland, Romania, Slovenia, Spain). As early as the mid-1980s, Schifani (1985) pointed out that in Italy land taxation – based on the income parameter – did not consider two important factors (as opposed to market price). These factors are the proximity to population centres and the availability of land susceptible to be made suitable for the crops characterizing a given area. Therefore, Schifani implicitly suggested the adoption of a taxation system based on market values. In this regard, Simonotti (2008) calls for the rapid decentralisation of the valuation function to municipalities so that they entrust ‘cadastral valuers’, qualified professionals with a broad and precise knowledge of the real estate market and possessing specialist skills consistent with the Property Valuation Standards, with the delicate task of ensuring taxpayers fiscal fairness, transparency and organisational efficiency in valuations. The decentralisation of cadastral functions from the “Agenzia del Territorio” to the municipalities was sanctioned by the Ministerial Decree, on 14 June 2007⁴ (published in the Official Journal no. 154, of 5 July 2007), with the aim, among others, of carrying out a census of real estate and complete retrieval of cadastral data to be integrated into the relevant database (Asciuto et al., 2010).

⁴ The Regional Administrative Court of Latium, in its sentence no. 4259 of 15 May 2008, had censured only the part of the decree in which the municipalities were entrusted with the authoritative power to proceed with the grading and therefore with the definition of the relative cadastral income. Only this specific option should have been annulled. However, the Regional Administrative Court emphasised the need to reformulate the decree, a reformulation that never took place.

The determination of market values would be done through the application of large-scale valuation methodologies recognised by the International Valuation Standards (IVS), as is the case in modern cadastral systems. These methodologies, called “Mass Appraisal”, represent a flexible system as they allow the use of all valuation procedures: empirical and rational, single and multi-parametric, synthetic and analytical.

Considering the problems highlighted so far and the lack of response from public institutions, the aim of this research is to verify the current level of the link between market prices and farmland incomes, through the concrete case of two districts in western Sicily (South of Italy). This research also aims at verifying the fiscal equalisation or the inequality of the system of land registry tariffs in Italy, through the construction of indicators to be submitted to public decision-makers in order to verify the fulfilment of the conditions of horizontal and vertical equity⁵.

The research is composed of a preliminary analysis of the fiscal aspects adopted by EU countries for the land cadastre; a description of the study area; a description of the methodology for the analysis of the collected data; an analysis and discussion of the results obtained and some final considerations.

2. THE FISCAL FUNCTION OF THE LAND REGISTER IN EU COUNTRIES

The European Union (EU), as can be seen from its founding treaties, has no direct competence in cadastral matters. However, through the CAP, environmental policy, pre-accession programmes, etc., it has oriented its member countries to develop multi-purpose cadastral systems, given the wide availability of data and the development of information systems, which have extended the use of cadastral information also to the consolidation of the spatial data infrastructure indispensable for eGovernment in the member countries (Permanent Committee on Cadastre in the European Union, 2018).

Various cadastral models can be found in the EU countries, depending on their historical, cultural and traditional diversity, from what we can define as traditional models, developed since the late 19th century to a greater extent in Western European countries, to the more modern ones in the former communist countries

⁵ According to the principle of horizontal equity, two goods with the same market price should have the same tax value and thus the same amount of tax for taxpayers; whereas according to the principle of vertical equity, two goods with different market values should be subject to different taxes.

Table 1. Groups of EU countries according to cadastral function (Source: our elaborations).

Group I (non-fiscal function)	Group II (fiscal function)		
	Section I (area)	Section II (income)	Section III (value or price)
Bulgaria, Croatia, Finland, Greece, Ireland, Luxemburg, Malta, Netherlands, Sweden	Czech Republic, Slovakia	Austria, Belgium, Hungary, Portugal, Italy	Cyprus, Denmark, Estonia, France, Germany, Latvia, Lithuania, Poland, Romania, Slovenia, Spain

of Eastern Europe. For these latter, Osskó and Hopfer (1999), emphasise that the transition from a planned economy to a market economy made the development of modern Land Registry systems necessary to develop an active real estate market that can support sustainable development.

A comparison of national Land Registries shows, as Iovine et al. (2006) argue, that the historical origin is linked to the ascertainment of property ownership and the application of land tax; in fact, in most countries the Land Registry is directly or indirectly connected to property taxation, since it may contain the valuation of real estate and other data used by the tax authorities to calculate tax, as well as the identification of the property and the owner (legal land registries).

Therefore, taking into consideration the official documents of the Permanent Committee on Cadastre in the European Union (PCC) on the cadastral systems of the EU member states (Permanent Committee on Cadastre in the European Union-- Cadastral information system: a resource for the E.U. policies overview on the cadastral system of the E.U. member states Rome, 2008; Prague, 2009; Gävle, 2009; Sofia, 2010) the twenty-seven countries are here divided into two groups, in relation to the absence or presence (9 and 18 countries respectively) of the cadastral tax function (Tab. 1).

The first group, made up of countries where the Cadastre is not used for tax purposes, includes: the Netherlands, where the Cadastre over the years has lost importance in relation to this function but has mainly improved the technical aspects, although for statistical purposes it includes the price of the real estate transaction (Muniz Perez, 2012); Croatia, which since 1998 (Bacic, 2004), repealed the cadastral annual tax with the consequent loss of the cadastral fiscal function; Bulgaria and Finland which exempt farms and forestry from property tax; Greece where the value of a property is not stored in the cadastral database, although the price of the purchase and sale is archived and linked to the property; Luxembourg, which has not used the Land Registry for valuation and taxation since 1945; Sweden, where the Taxation Authority deals with the valuation of property; and finally Ireland and Malta which do not have a Tax Registry (Tab. 1).

The second group, which includes all countries with a tax-related cadastre, was further divided into three sections – area, income, value or price respectively – according to the data used to determine the tax base for land tax purposes.

In the Appendix 1 a brief description of the methodology adopted in the EU countries of the second group is reported.

3. MATERIALS AND METHODS

3.1 Study area

The study area (Fig. 2) includes two different districts, both located in western Sicily (in the Province of Trapani, Zone 1, and in the Province of Palermo, Zone 2, respectively). The first one includes territories of the coastal hills (Municipalities of Valderice, Erice, Custonaci, Buseto Palizzolo, San Vito Lo Capo) and of the plains (Municipalities of Paceco and Trapani). The second zone includes municipalities of the inland mountains (Godrano), the inland hills (Caccamo, Baucina, Ciminna, Bolognetta, Marineo, Mezzojuso, Villafrati, Ventimiglia di Sicilia, Cefalà Diana, Misilmeri, Campofelice di Fitalia, Santa Cristina Gela, Piana degli Albanesi), the coastal hills (Casteldaccia) and the plains (Palermo and Partinico).

The municipalities classified as “Rural Areas” or “Sparsely populated Areas”⁶ in Zone 1 represent 42.8%, while in Zone 2 they make up 58.8% of the total number.

In order to outline the structural characteristics of agriculture and the relative forms of tenure and ownership present in the two territorial areas, some data published with the 6th General Agricultural Census 2010⁷

⁶ Since 2011, Eurostat classifies municipalities according to the degree of urbanization (DEGURBA). This indicator identifies three levels of urbanisation (high, medium and low) in relation to the criteria of geographical proximity and thresholds of minimum population. The classification identifies three typologies of municipalities: 1) “Cities” or “Densely Populated Areas”; 2) “Small Cities and Suburbs” or “Medium Population Density Areas”; 3) “Rural Areas” or “Scarcely Populated Areas”.

⁷ To this day, data from the 7th Agricultural General Census are not available since ISTAT is still processing the information collected. The

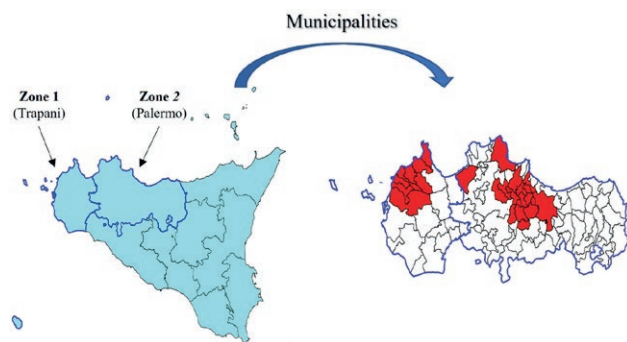


Figure 2. Study area.

were analysed, from which the indicators shown in Table 2 were extrapolated.

Zone 1 (Trapani area)

According to reports from the 6th General Census of Agriculture 2010, there are a total of 6,214 farms falling within the municipalities in the surveyed area. Total Farm Area (TFA) and Utilized Agricultural Area (UAA) occupy 56.0% and 52.6% of the total land area, respectively. Relating TFA and UAA to the number of farms, it is showed that each farm owns, on average, about 5.7 and 5.4 hectares, respectively.

With reference to the classes of UAA, as many as 31.7% of the farms have a UAA of less than 1.00 hectare; 19.8% of the farms have a UAA between 1.00 and 1.99 hectares; 11.6% between 2.00 and 2.99 hectares; 13.5% between 3.00 and 4.99 hectares; 11.4% between 5.00 and 9.99 hectares; and finally, 12.0% have a UAA of more than 10.00 hectares. The UAA of the district covers 33,397 hectares, of which 17,015 hectares are arable lands (50.9% of the total UAA). More in detail, cereals for grain production, with 7,627 hectares, represent 22.8% of the UAA; fallow lands represent 18.0% of the UAA (with 6,003 hectares), forage crops approached 4.9% (1,626 hectares), and dry legumes and vegetables occupy 2.6% and 2.4% (857 and 808 hectares), respectively.

Arable lands are followed by agricultural tree crops that occupy 37.9% of the UAA with 12,660 hectares. Among these, grapevine is the most widespread crop quality with 7,933 hectares, accounting for 23.7% of the total UAA; it is followed by olive, which represents 13.5% of the UAA with its 4,515 hectares. On the contrary, the incidence of areas with citrus and fruit trees on the UAA is barely significant (overall 0.5%). In addition,

Table 2. Main structural indicators of farms in the two districts (Source: Our data elaboration from the 6th General Agricultural Census 2010).

Indicators	Zone 1	Zone 2	
TFA/land area (%)	56.0	47.8	
TFA/no. of companies (Ha/company)	5.7	4.5	
UAA/ Territorial area (%)	52.6	44.4	
UAA /TFA (%)	94.0	92.9	
UA /no. of companies (Ha/company)	5.4	4.2	
Arable crops/UAA (%)	50.9	49.3	
Permanent crops/UAA (%)	37.9	26.9	
Vine/UAA (%)	23.7	4.5	
Olive/UAA (%)	13.5	15.6	
Other Fruit trees/UAA (%)	0.5	6.7	
Permanent grasslands and pastures /UAA (%)	9.7	23.5	
Incidence no. of owned farms (%)	76.3	80.0	
Incidence no. of individual farms (%)	99.3	99.2	
Incidence no. of farms with direct farmer management (%)	97.3	97.5	
Percentage incidence class of UAA	Ha	%	%
	Up to 0.99	31.7	41.6
	1.00-1.99	19.8	20.6
	2.00-2.99	11.6	9.8
	3.00-4.99	13.5	9.9
	≥ 5.00	23.4	18.1
Degree of farm fragmentation	No. parcels	%	%
	1	33.4	44.3
	2	24.3	26.4
	3-5	29.4	23.5
	6-10	10.4	4.8
	≥ 11	2.5	1.0

tion, permanent meadows and pastures represent 9.7% of the total UAA with an area of 3,226 hectares; family-size vegetable gardens, on the other hand, are not very widespread in the area, occupying only 0.4% (119 hectares) of the UAA.

According to the form of farm management, the gap between the various categories present is even larger, since as many as 97.3% of farms are managed directly by the farmer, 2.4% are managed by hiring outside employees, and only 0.3% are managed in another way.

In terms of legal form, the majority of farms in the district (99.3%) are sole proprietorships, while a small proportion are part of holding-groups (0.7%).

6th Census, however, is able to portray the situation of the agricultural sector in the period (2005-2017) when sample sales took place.

As for land tenure, however, 76.3% of the farms in the area are located on land owned by the entrepreneur, farms operated on land that is partly owned and partly in free use account for 13.3%, while 1.2% of the farms are conducted exclusively on land that is leased. The remaining percentage (9.2%) can be attributed to the unmentioned combinations of land tenure titles. Regarding the degree of farm fragmentation, it appears that about 33.4% of the farms consist of a single farm body. In contrast, the rest of the farms are divided into multiple bodies: 24.3% into 2 bodies; 29.4% into 3-5 bodies; 10.4% into 6-10 bodies; and 2.5% into 11 or more bodies.

Referring to the Provincial Landscape Plan of Trapani, the area was characterized according to its use (Assessorato dei Beni culturali e dell'Identità siciliana, 2010).

In the municipal areas of Trapani and Paceco, traditional agricultural crops (olive groves, vineyards and arable lands) in the peri-urban areas – where there is a fragmented agrarian-pattern – are endangered by the expansion of industrial and residential settlements and by road and rail infrastructure. The traditional agrarian landscape is more continuous in inland areas with limited scattered settlements.

In the municipality of Erice, settlement transformations have affected the coastal plain, resulting in the abandonment of traditional agro-pastoral activities on the mountain slopes and the exodus of inhabitants to the valley.

In the coastal plain between Custonaci and Valderice, vast areas of cultivated land alternate with large areas of abandoned and built-up areas. In the hilly area of Custonaci, phenomena of landscape degradation caused by intense mining activities are evident.

The open-field agricultural landscape of arable lands, vineyards, and olive groves, punctuated by cores and threadlike rural centres branching along roads, such as Buseto Palizzolo, is predominant. On the coastal area of San Vito Lo Capo, the obvious processes of degradation of the rural landscape are mainly due to the intense seasonal tourism that causes congestion and inappropriate transformations of places for second homes. Degradation factors include abandonment of agro-pastoral activities and fires that destroy the natural environment.

Zone 2 (Palermo area)

There are a total of 10,437 farms in the municipalities of Palermo zone which participate in the survey.

The TFA and the UAA account for 47.8% and 44.4% of the total land area, respectively. Relating the TFA and UAA to the number of farms, it is possible to note that each farm covers an average of about 4.5 and 4.2 hectares, respectively.

In terms of farm size, the UAA per farm is distributed as follows: 41.6% of the farms have a UAA of less than 1.00 hectare, 20.6% between 1.00 and 1.99 hectares, 9.8% between 2.00 and 2.99 hectares, and 9.9% and 9.0% fall in the classes between 3.00 and 4.99 and between 5.00 and 9.99 hectares, respectively. Farms owning UAA over 10.00 hectares are only 9.1% of the total.

The territorial UAA of the district covers 44,041 hectares: arable land is the most widespread land use, with about 21,696 hectares, accounting for 49.3% of the total UAA, followed by agricultural tree crops, covering about 11,836 hectares – corresponding to 26.9% of the UAA – and permanent meadows and pastures, which occupy 23.5% of the total UAA with their 10,359 hectares; family-size vegetable gardens (149 hectares) represent only 0.3% of the UAA.

With regard to arable lands, UAA accounts for 25.1% of cereals for grain production (with 11,052 hectares), for almost 15.6% of forage crops (6,866 hectares), for 1.6% of dry legumes and vegetables, and 1.5% of the UAA (693 and 663 hectares). In addition, fallow land, with 2,230 hectares, accounts for 5.1% of the total UAA.

In contrast, in terms of agricultural tree crops, olive is the most represented crop with 6,877 hectares, accounting for 15.6% of the total UAA. It is followed by grapevine, which accounts for 4.5% of the UAA with its 1,971 hectares; citrus and fruit-growing areas account respectively for 3.8% and 2.9% of the UAA.

In terms of farm management, 97.5% of the farms are directly managed by the farmer, while the remaining farms either use temporary employees (2.4%) or have a completely different form of management (0.1%).

From the point of view of legal form, 99.2% of the farms in the area of Palermo, are sole proprietorships, while only 0.8% are part of holding-groups.

Furthermore, 80.0% of the farms in the area are located on land owned by the entrepreneur; 7.3% of the farms are run on land that is partly owned and partly in free use; while 2.1% of farms are run exclusively on leased land. The remaining percentage (10.6%) can be accounted for the unmentioned combinations of land tenure titles. With reference to the degree of farm fragmentation, most of farms, about 44.3%, consist of a single body. Within the remaining farms, 26.4% are divided into 2 bodies; 23.5% into 3-5 bodies; 4.8% into 6-10 bodies; and only 1.0% into 11 or more bodies.

The Provincial Territorial Plan describes the area, highlighting its strong contrasts (Provincia Regionale di Palermo, 2004).

Agrarian landscape surrounding Palermo – once known as the “Conca d'Oro” – is characterized by so-called “gardens” (lemons and tangerines above all), culti-

vated on artificial terraces made on the hillsides, and by corridors from the valleys inward.

The proximity of the capital city in the past favoured the development of this type of agriculture, which, however, requires services, capital and, not least, labour. The latter contributed to its decline in recent decades. With the massive establishment of vacation housing in Palermo and the consequent loss of land used for citrus farming, the most fertile countryside close to the sea has become highly urbanized. On the other hand, agriculture in the Partinico plain is still characterized by intensive cropping systems (orchards, open fields vegetables, vineyards, etc.) despite the strong imbalances caused by uncontrolled urbanization. Away from the coast and past the hills that abut it, the landscape changes drastically, as altitude exacerbates climate conditions: barren rocky ridges dominate over hilly humps, typical of the old latifundia, now generally replaced by a fragmented ownership, where promiscuous crops are also common.

In most of this territory, which connects with the interior plateau, the cultivation of durum wheat dominates.

The area is affected by widespread hydrogeological disruption caused by adverse weather conditions, which poses a serious threat to the agricultural sector and to road infrastructure, further accentuating the isolation of rural areas. This marginalization is especially perceived due to the lack of basic services. Many outlying areas are, in fact, unreachable: they lack road infrastructure, broadband, and are often subject to critical environmental issues, such as fire risk.

3.2 Methods

The work carried out involved the use of primary data and secondary data in the two districts examined within the Zone 1 and Zone 2. The primary data, collected directly from a few notary offices, were extracted from deeds of sale signed in the period 2005-2017. The choice of considering two different spatial areas is motivated by the need to verify in both cases the current level of the link between market prices and cadastral farmland incomes, as well as the fiscal equalisation or inequality due to the calculation methods of the Farmland Income tariffs envisaged by the cadastral system of the “Agenzia delle Entrate”. The secondary data (6th General Census of Agriculture – ISTAT, 2010), described in the section 3, were used to verify the sample representativeness with reference to the structural characteristics of the farms.

In particular, the following elements were collected for each purchase and sale: date the contract was stipulated, cadastral identifiers (municipality, map sheet, parcel,

crop quality, profitability class, Farmland Income, area), sale price, presence or absence of kinship ties between buyers and sellers, ownership share and the Homogeneous Territorial Zone. At this stage, therefore, only deeds relating to agricultural land and with no kinship ties between the parties involved were taken into consideration in order to avoid sampling bias (potential outliers).

The analysis of the land market was based on a sample of 176 deeds of purchase and sale of agricultural land, distributed between Zone 1 (No. 57 deeds) and Zone 2 (No. 119 deeds). Within each deed, it was checked whether there was a single price or more than one sale price; in the latter case, the number of sales corresponded to the number of prices indicated in the deed. From this count, the sample consisted of 183 observations, of which 57 in the Trapani area and 126 in the Palermo area. The following characteristics were initially analysed, both for the entire study area as well as separately for the two study areas:

- average and median values for the total price paid, the average unit price and the land area bought and sold;
- the spatial distribution of observations by municipality in Zone 1 and Zone 2, with particular reference to their number, to total and average area bought and sold (sq. m.), and crop qualities found;
- the distribution by area classes (Ha) of land bought and sold and the corresponding average unit price paid (€/Ha) matched to each area class;
- the distribution of the number of sales and purchases according to the average unit price paid (€/Ha).

In order to determine whether the sample observations reflected actual conditions, the characteristics listed above were compared with census data.

It was, therefore, taken into account the regulatory developments for taxation purposes (Personal Income Tax “IRPEF”, Municipal Property Tax “ICI”, Municipal Single Tax “IMU” by applying to the Cadastral Farmland Income calculated for each purchase and sale the respective revaluation rates in force at the time of the signing of the deed. In this regard, it should be noted that, according to the objectives of this research, only the Farmland Income was considered within the cadastral tariffs.

To calculate the IRPEF taxable base, the Farmland Income (expressed in €/Ha) stated in each deed was revalued by 80.0% for purchases and sales between 2005 and 2011, and by 15.0% and 30.0% for purchases and sales between 2012 and 2014, and between 2015 and 2017.

Instead, for the calculation of the taxable base for ICI and IMU, the Farmland Income was revalued by 25.0 percent.

All percentages applied are consistent with the updates provided by the sector regulations.

In order to answer the research question, two groups of indicators were subsequently constructed: the first group aims to simulate the capitalization rate⁸, while the second group aims to analyse the relationship between market price and tax value for ICI and IMU purposes. With reference to the first group of indicators, the ratio of the revalued Farmland Income of the land bought and sold to the relative market price observed was calculated for each sample observation. This is used to understand whether the Farmland Income adequately performs the function that is normally a prerogative of the Land Benefit (LB) since the Farmland Income represents the pre-tax LB.

In order to estimate market value through capitalization of continuous annual average incomes, the inverse formula was applied (known as Analytical Appraisal, Eq. 1). In fact, for each surveyed trade, it is possible to derive its specific capitalization rate (r_{cap}) from the ratio of LB to market value (V) (Eq. 2).

$$V = \frac{LB}{r_{cap}} * 100 \quad (1)$$

$$r_{cap} (\%) = \frac{LB}{V} * 100 \quad (2)$$

This procedure was applied to both the Farmland Income used for calculating the IRPEF tax base (Eq. 3a) and that one adopted for calculating the tax base for ICI and IMU purposes (Eq. 3b). As a result of the considerations above, the percentage indices resulting from the application of equations (3a) and (3b) were found to be similar to r_{cap} .

$$r_{IRPEF} (\%) = \frac{F.I_{IRPEF}}{MP} * 100 \quad (3a)$$

where $F.I_{IRPEF}$ represents the Farmland Income revalued for IRPEF purposes; MP is the market price of each observation; and r_{IRPEF} is the indicator assimilated to the capitalization rate.

$$r_{ICI,IMU} (\%) = \frac{F.I_{ICI,IMU}}{MP} * 100 \quad (3b)$$

Where $F.I_{ICI,IMU}$ represents the Farmland Income revalued for ICI and IMU purposes; MP is the buying and selling price of each observation; and $r_{ICI,IMU}$ is

the indicator assimilated to the capitalization rate. The results obtained through the application of equations (3a) and (3b) were compared with what emerged from the literature review on an acceptable range of r_{cap} values for farmland, related to the economic performance of farmland. A further comparison was made with the rates of return of the Multi-Year Treasury Bonds (BTPs) net of inflation rates. For this purpose, both the average annual rates of return on 30-year BTPs and the average annual inflation rates were collected for the entire period under observation (2005 – 2017). The former were obtained from the website of the Ministero dell'Economia e delle Finanze (2022), the latter derived from the website of the Federal Reserve Economic Data (FRED) (2022).

In view of the appraisal literature (Amicabile, 2018; Gallerani, 2011; Michieli, 1993), because land assets are characterised by a different risk class than government bonds, an adjustment to net BTP rates was made, conservatively assessed at 0.5% due to the lack of specific guidelines.

The second group of indicators, on the other hand, is the ratio between the market price of a landed property and its cadastral value for ICI and IMU purposes, the latter obtained by construction by multiplying the revalued Farmland Income by a coefficient periodically set by the legislature.

The unit Farmland Income's (expressed in €/Ha) of each purchased land in the sample were revalued – in accordance with the development of tax legislation – to calculate the tax value, which is the taxable base for the payment of ICI (until 2011) and IMU (formerly ICI starting in 2012). In particular, the Farmland Incomes were revalued by 25.0%. Then, to calculate the taxable base for ICI, they were multiplied by a coefficient of 75 for all purchases and sales that occurred between 2005 and 2011. Instead, to calculate the taxable base for IMU these were multiplied by a coefficient of 110 for purchases and sales in 2012 and finally by a coefficient of 135 for those concluded between 2013 and 2017 (from 2018 to the present, the multiplier coefficient has remained unchanged and equal to 135)⁹.

Tax values were calculated with reference to both the date the purchase and sale was concluded – applying the relevant revaluation coefficients in force – and to the present day by employing the current multiplier coefficient (equal to 135) for all observations. The latter calculation was based on the assumption that the purchase

⁸ In the appraisal discipline, the capitalisation rate relates the owner's continuous average annual income (Land Benefit, LB) to the value of the land capital that generated it.

⁹ It should be noted that this paper does not consider the benefits (exemptions or reductions) provided for territories, or parts thereof, located in mountainous or hilly areas, for minor islands and for the figures of farmer and professional agricultural entrepreneur regardless of location.

and sale prices of the land in the sample (referring to the period 2005-2017) can be considered valid to date.

Including the present Tax Value was motivated by the need to determine whether or not the increased multiplier coefficient (135) has bridged the gap with the buying and selling prices. Considering a methodological perspective, we should have also updated the prices from the dates of purchase and sale to the present through the application of price variation rates. Nevertheless, due to the lack of studies on this topic, in this research prices have not been “updated” to the present day in order to avoid applying rates with no link to the real market.

From the above data, the indicators i (Eq. 4a) e i_0 (Eq. 4b) derived respectively from the ratio of purchase and sale price (MP) to tax value for ICI and IMU ($FV_{ICI,IMU}$) purposes and the ratio of MP to tax value for IMU purposes with reference to present (FV_{IMU_0}), respectively, were calculated.

$$i = \frac{MP}{FV_{ICI,IMU}} \quad (4a)$$

$$i_0 = \frac{MP}{FV_{IMU_0}} \quad (4b)$$

Through these computations it was possible to assess the extent of the variance between the two terms and to verify whether or not the cadastral values, calculated from the FIs, were connected with the trend – in the years examined – of the land market in the two case study land areas.

The indicators obtained were analysed by calculating key descriptive statistics both with reference to the entire study area and later separately for Zone 1 and Zone 2. As a result, the initial sample “ n ” of 183 trades was subdivided into two sub-samples: the first includes Zone 1 trades ($n = 57$), and the second includes Zone 2 trades ($n = 126$).

Successively within each zone, municipalities characterised by the same tariffs – crop quality and productivity class being equal – were identified.

For each sub-sample observations were divided into homogeneous groups based on the above-mentioned criterion.

Based on these groups, for each of the two sub-samples, the percentage divergence ($\Delta\%$) between the unit cadastral values for the payment of ICI and IMU referred to the date of purchase and sale (ICI and IMU Unit Tax Value) and the average unit prices observed (Average Unit Market Price) was calculated. Both are expressed in €/sq.m, in order to demonstrate the actual presence or absence of tax inequality (Eq. 5a).

$$\Delta (\%) = \frac{ICI \text{ and IMU unit tax value} - \text{Average unit market price}}{\text{Average unit market price}} * 100 \quad (5a)$$

The above procedure was repeated by substituting the unit cadastral values for ICI and IMU purposes for those in force for IMU payment (IMU₀ Unit Tax Value) by applying Eq. 5b.

$$\Delta_0 (\%) = \frac{\text{Unit tax value IMU}_0 - \text{Average unit market price}}{\text{Average unit market price}} * 100 \quad (5b)$$

The results indicate whether taxpayers own real estate with asset values greater than, less than, or equal to the cadastral value. In fact, a $\Delta\%$ result with a positive sign would mean that to date the taxpayer is being taxed more than the actual value of his/her land should suggest. On the other hand, numerical values of $\Delta\%$ with a negative sign would indicate that the taxpayer is paying less in relation to the actual value of his property.

Additionally, tax equalization was verified by comparing the market prices of land with identical fiscal values.

With reference to the two procedures described above, the crop quality most examined was arable land of Class I, II, III, IV and V, given that it represents the most frequent agricultural use for both Zone 1 and Zone 2. In addition, limited to few observations of Zone 1 the analysis was carried out for other crop qualities such as arboreal arable land, vineyards and olive groves. A significant proportion (about 35.0% of the total) of purchases and sales in our sample involved several cadastral parcels with different crop qualities but all having the same buyer, which we call “mixed crop qualities.”

As a result, the transaction involves several parcels of different cultivation systems for which a single price was paid and a single sale deed was stipulated. Since it was not possible to extrapolate the unit price paid for each crop quality involved in the transaction, the above procedure for tax equalization testing could not be applied to the above trades by adopting Equations (5a) and (5b).

4. RESULTS AND DISCUSSION

The study sample analysed, as already mentioned, consisted of 176 notarial deeds and 183 observations¹⁰ of which 57 referred to Zone 1 and 126 to Zone 2.

For Zone 1, the largest number of sales, again with reference to the sample size, refers to agricultural land

¹⁰ Although the sample is made up of 183 sales, for some calculations a smaller one ($n=179$) was used, net of 4 observations whose land sold was located in more than one municipality and for which a single price was paid.

located in the municipalities of Valderice (17.3%), Erice (7.3%) and Custonaci (6.1%). In Zone 2, the distribution of agricultural land bought and sold is most concentrated in the municipalities of Baucina and Marineo, with a percentage incidence of 17.9% and 13.4%, respectively. In other municipalities, however, the incidence of land sales is significant, especially in Villafrati (4.5%), Ciminna (3.9%) and Ventimiglia di Sicilia (3.9%).

Principal key descriptive statistics were calculated for some parameters, showing that for the entire sample size the mean (μ) and median (Me) values for the total price (€) amount to 9,816 € and 5,000 €, respectively. In the two study areas, the above central tendency indices take substantially different values (μ_{Zone1} : 11,521 €; Me_{Zone1} : 6,000 €; μ_{Zone2} : 8,899 €; Me_{Zone2} : 4,800 €). Taking into consideration the average unit price (€/sq.m), the sample μ is 3.00 €/sq.m, while the Me is 1.31 €/sq.m; again, the two areas investigated present different situations: an average price of 4.31 €/sq.m was paid for land falling in area 1, while the corresponding average price of land falling in area 2 is 2.30 €/sq.m. The median values of the two sample distributions are both significantly lower than the average values described above, and specifically 1.48 €/sq.m (Zone 1) and 0.94 €/sq.m (Zone 2). The areas being bought and sold averaged 8,955 sq.m ($n=183$) with a median value of the sample distribution of 3,340 sq.m. The average figures for the two sub-samples are again markedly different from each other: the areas bought and sold in Zone 1 are on average (5,756 sq.m) significantly smaller than those in Zone 2 (10,675 sq.m.), while the relative medians are very similar in the two distributions (3,165 sq.m and 3,573 sq.m.) and also to the sample median value 3,340 (sq.m). The total area bought and sold amounts to about 1.5 million sq.m (154 hectares), distributed at the municipal level as follows: for Zone 1, Valderice (8.4%), Erice (6.1%) and Custonaci (5.3%) are still the municipalities with significantly higher percentage values than the others in the same zone to which they belong; in Zone 2, Casteldaccia is the municipality with the highest area bought and sold (24.4%), followed by Mezzojuso (12.7%), Baucina (9.8%) and Marineo (7.1%).

The remainder of the municipalities in Zones 1 and 2 not mentioned so far have a lower incidence value in terms of number and area bought and sold of 3.5% and 4.2%, respectively. From the results obtained, the average unit area bought and sold for the entire sample is 8,611 sq.m ($n=179$). This result is in line with the census data shown in Table 3, from which it can be seen that most farms in both Zone 1 and Zone 2 have an average farm size of less than 1 hectare. Therefore, on the basis of this comparison, it can be asserted that, in terms of size, the

Table 3. Comparison of the percentage distribution by size classes between collected and census data (%).

Area class (Ha)	Collected data		Census data	
	Zone 1	Zone 2	Zone 1	Zone 2
until 0.99	79.6	82.4	31.7	41.6
From 1.00 to 1.99	17.2	13.4	19.8	20.6
From 2.00 to 2.99	1.6	0.8	11.6	9.8
From 3.00 to 4.99	1.6	0	13.5	9.9
≥ 5.00	0	3.4	23.4	18.1
Total	100	100	100	100

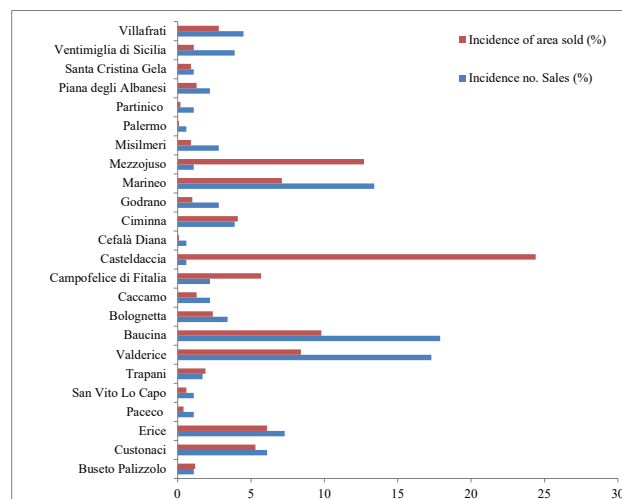


Figure 3 Incidence of area sold and no. of sales by municipality in the study area.

sample is fairly representative of the farms in the areas considered.

Due to the relatively small size of the land purchased, it seems likely that buyers are either agricultural entrepreneurs, including young ones, seeking to expand their farm base, or non-farm buyers who engage in farming for family consumption in their spare time.

The results described heretofore are reported in Figure 3 and schematised in Appendix 2 (Tab. 1a).

Figures 4 and 5 – which summarized data reported in Tab. 2a (Appendix 2) show the percentage incidences calculated as a function of the number of observations and the area bought and sold, distributed by the crop qualities found in the municipalities of both study areas. The crop qualities included are as follows: arable crops, permanent crops, permanent pastures and meadows, and mixed crop qualities.

The item “arable land” groups arable and arboreal arable land; within the item “permanent crops” olive

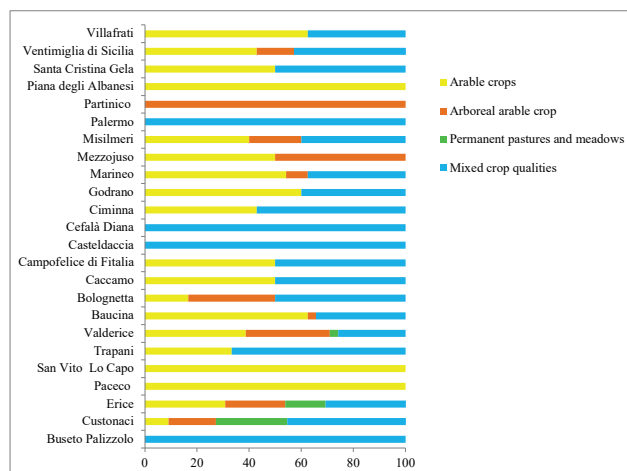


Figure 4. Number of sample sales by municipality and crop quality (%).

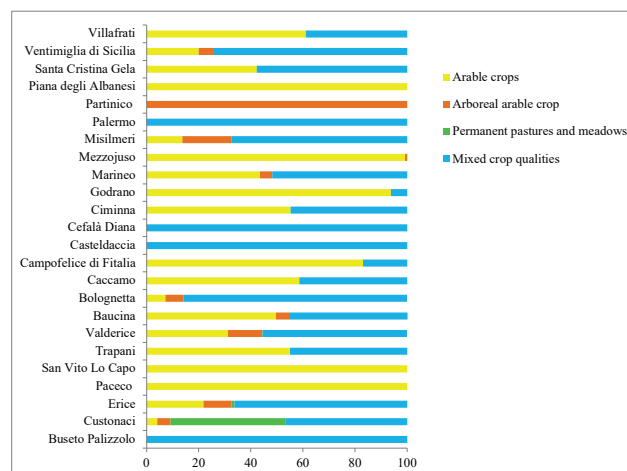


Figure 5. Area of sample sales by municipality and crop quality (%).

groves, vineyards and other fruit trees have been considered; the item “permanent pastures and meadows” encompasses pastures and arboreal pastures; finally, mixed crop qualities represent a heterogeneous item within which fall less common crop qualities and trades involving more than one crop quality and therefore not classifiable within a specific crop category.

The results obtained show that mixed crop qualities have a high percentage incidence in terms of the trades’ number (amounting to 66) and of the area bought and sold (amounting to 839,144 sq.m), since, as mentioned above, they encompass multiple crop qualities ascribable to a single selling price. It should, however, be noted that most of the plots bought and sold are arable lands.

Within the mixed crop qualities category, arable lands are the most bought and sold in the two districts (no. equal to 82), totalling 608,608 sq.m. These are followed by permanent crops, whose area purchased amounts to 56,154 sq.m for a total of 25 sample observations, and more in detail: olive groves (no. equal to 9 and 19,501 sq.m sold), vineyards (no. equal to 10 and 24,011 sq.m sold) and other fruit crops (no. equal to 6 and 12,642 sq.m sold). Permanent pastures and meadows represent, with 6 observations and 37,414 sq.m, only a small part of the sample.

Analysing and comparing the sample data and the ISTAT data, it emerges that, for both sources examined, the most bought and spread crop quality for the two study areas is arable land, which is characteristic of extensive systems such as cereal and cereal-forage, in the face of a rather limited average farm economic size in the area. This validates again the representativeness of the sample. Table 4 shows the distribution of sales by land area

classes (for Zone 1, Zone 2 and for the total of the entire study area) and the corresponding average unit price paid. The results show that 81.4% of the land sold (79.6% Zone 1 and 82.4% Zone 2) had an area of less than 1.00 hectare and were paid an average of 18,947 €/Ha; 14.7% of the sample had an area between 1.00 and 1.99 hectares (17.2% Zone 1 and 13.4% Zone 2) and an average unit price of 11,613 €/Ha; on the other hand, the presence of land from 2.00 up to 2.99 hectares (incidence of 1.1% and average unit price paid of 8,505 €/Ha), from 3.00 to 4.99 hectares (0.6%; 12,450 €/Ha) and over 5.00 hectares (2.2%; 4,993 €/Ha) is less significant. Table 4 shows that size class distribution is also consistent with the corresponding one related to census data, so the sample data reflect the agricultural situation of the surveyed areas and are representative of the statistical population of farmland.

Furthermore, Table 4 shows that average unit prices tend to decrease as the area bought and sold increases¹¹: for the smallest class (up to 0.99 Ha) the average unit price is about 19,000 €/Ha; instead, for the largest class (over 5.00 Ha) land is priced at about 5,000 €/Ha.

The assertion of Simonotti (2011) that the total price curve is increasing with the area sold, while average and marginal prices are decreasing, corroborates this trend. According to the study area, average prices for Zone 1 are higher for all acreage classes; this can be attributed to a higher incidence of non-agricultural purpose in the sample purchases of Zone 1.

¹¹ The only conflicting figure is the average unit price of 12,450 €/Ha referring to the class ranging from 3.00 to 4.99 hectares. However, the figure refers to a single observation so it was reported in the table since it is part of the sample but, for the purpose of statistical inference, it is not significant as opposed to the other values shown in Table 3.

Table 4. Area classes of land sold and relative average unit price.

Area class (Ha)	Incidence (%)			Average unit price (€/Ha)		
	Zone 1	Zone 2	Study area	Zone 1	Zone 2	Study area
until 0.99	79.6	82.4	81.4	23,274	17,061	18,947
From 1.00 to 1.99	17.2	13.4	14.7	20,626	5,399	11,613
From 2.00 to 2.99	1.6	0.8	1.1	9,256	7,815	8,505
From 3.00 to 4.99	1.6	0.0	0.6	12,450	-	12,450
≥ 5.00	0.0	3.4	2.2	-	4,993	4,993
Total	100.0	100.0	100.0			

Table 5. Classes of average unit price and percentage incidence of sales.

Class of average unit price (€/Ha)	Incidence (%)		
	Zone 1	Zone 2	Study area
until 7,500	14.1	42.0	32.2
7,501 – 17,500	37.5	23.5	28.5
17,501 – 30,000	10.9	16.0	14.2
30,001 – 50,000	23.4	7.6	13.1
> 50,000	14.1	10.9	12.0
Total	100.0	100.0	100.0

Further elaborations (Tab. 5) concerned the distribution of the number of trades in relation to the average unit price paid. This showed that for most of the plots (32.2%) an amount up to 7,500 €/Ha was paid, and only for 12.0% of the observations the price paid was greater than 50,000 €/Ha. Trapani (Zone 1) has higher unit prices on average than Palermo (Zone 2). According to Zone 2, 81.5% of sales fall into the first three price classes, with generally lower average unit prices than in Zone 1.

Through the analysis of the main descriptive statistics of the sample, the results regarding the determination of capitalization rates for each sample observation by relating the Farmland Income – revalued for IRPEF and ICI or IMU purposes – to the land sale price (eq.3a and 3b), can be summarized as follows.

With reference to r_{IRPEF} (eq.3a), the range of variation (R) was found to be between the values- minimum and maximum – of 0.0022% and 3.16%. Instead, the main measures of position, namely μ and M_e , are 0.84% and 0.73%, respectively. Among the dispersion measures, the standard deviation (σ) of the sample is 0.69%.

The results for the shape measures, kurtosis (K) (1.0088) and skewness (s) (0.9761), show that the curve of the sample rates is positively skewed (with tails on the

right-hand side) with a greater concentration of values on the left-hand side, far from the Gaussian normal distribution.

Taking a closer look at the results obtained separately for the two zones under study, it can be seen that for Zone 2, in terms of r_{IRPEF} (3a), the values of μ and M_e are quite similar. In Zone 1, μ and M_e are equal to 0.74% and 0.60%, respectively.

The coefficient of variation (CV) shows a greater distribution variability for Zone 1 than for Zone 2.

Comparing the data for both zones, a two-sample t test for the difference of means has been carried out. The null hypothesis (the means are equal) has not been rejected thus confirming that this central tendency measure of r_{IRPEF} is not statistically different for the two zones.

With reference to $r_{ICI,IMU}$ (3b), the R was found between the values of 0.002% and 2.190%. On the other hand, the main measures of position, namely μ and M_e , are 0.56% and 0.48%, respectively. Among the dispersion measures, the σ of the sample is 0.47%.

The results for the shape measures, K (1.5638) and s (1.1074), show that the curve of the sample rates is positively skewed (with tails on the right-hand side), and with a greater concentration of values on the left-hand side, far from the Gaussian normal distribution.

Zone 1 is characterized by lower μ and M_e values than Zone 2.

Differently from the previous indicator (r_{IRPEF}), from the two-sample t test for the difference of means, it comes out that the $r_{ICI,IMU}$ for two zones are characterized by statistically different means.

The calculated Coefficients of Variation (CVs) are identical to the previous ones, which means that the sample distribution of Zone 1 is more dispersed than Zone 2.

The above results were compared with the net yield rates of 30-year BTPs and with the capitalisation rates found in the appraisal literature. The former, collected for the period 2005-2017, range from a minimum of 1.8% to a maximum of 4.5%. This makes them significantly higher than the ranges of the rates obtained in this research. Just as the 3.40% average figure for the period – with the 0.50% adjustment – is far higher than those ones calculated for zones 1 (0.74% and 0.44%, respectively) and 2 (0.90% and 0.63%).

The same applies to capitalization rates that can be retracted from the appraisal literature, which vary between 1.0% and 3.0-4.0% depending on profitability, management riskiness, production system and location (Gallerani et al., 2004; Grillenzoni and Grittani, 1994; Michieli and Michieli, 2002), and can take values up to 6.0% and even more for livestock enterprises with an

Table 6. Descriptive statistics of the four indicators by Zone 1, Zone 2 and study area.

	Zone 1							Zone 2							Study area					
	R	μ	M _e	σ (%)	s	K	CV (%)	R	μ	M _e	σ (%)	s	K	CV (%)	R	μ	M _e	σ (%)	s	K
r _{IRPEF} (%)	2.4	0.7	0.6	0.6	0.7	-0.6	86.5	3.2	0.9	0.9	0.7	1.1	1.4	79.3	3.2	0.8	0.7	0.7	1.0	1.0
r _{ICI,IMU} (%)	1.6	0.4	0.3	0.4	0.9	0.3	86.4	2.2	0.6	0.6	0.5	1.1	1.4	79.3	2.2	0.6	0.5	0.5	1.1	1.6
i	246.9	14.9	2.7	37.7	4.7	24.6	252.9	864.9	13.5	2.1	79.6	10.5	113.5	589.4	864.9	14.0	2.5	67.8	11.2	138.3
i ₀	246.9	12.4	2.2	36.4	5.2	29.9	294.1	480.5	7.5	1.2	44.2	10.5	113.5	589.4	480.5	9.2	1.5	41.6	9.3	96.9

industrial configuration (Grillenzoni and Grittani, 1994).

In order to answer the research question, the other indicator adopted is the ratio of the sale price to the tax value. The latter was calculated with reference to both the transaction date, i (4a), and to present, i_0 (4b).

The results obtained for the sample ($n = 183$), related to indicator i , are reported below describing the main descriptive summary statistics. Among central tendency measures, μ of the sample stands at 14.0, M_e is 2.53. The sample variability is quite pronounced, as shown by the figure regarding σ , which was found to be 67.85. Results regarding the shape measures of the data distribution, namely K (138.26) and S (11.25) indicate substantial distance between the sample curve and the Gaussian normal curve, respectively. They also indicate the presence of a significant tail of observations in the right-hand side.

The σ is large for both territories but is far higher in Zone 2 than in Zone 1. Such high values of σ affect the CV, showing a higher dispersion of Zone 2 distribution than Zone 1, as confirmed by F test.

Regarding statistical elaborations on the ratio of price to tax value calculated with reference to present, i_0 (4b) for IMU purposes, according to the results obtained the values of μ and M_e stand at 9.21 and 1.55, respectively. The σ (41.63) indicates again a high degree of dispersion in the sample data.

In terms of shape indices, the distribution has a K index of 96.90 and a positive S index of 9.32. The values obtained indicate that the sample distribution is not Gaussian and that these data are more concentrated on the right side of the curve.

Compared with the previous situation (i), the differences in terms of i_0 (4b) between Zone 1 and Zone 2 are more pronounced, especially for the values of μ and M_e . Contrary to this, the differences between the σ calculated for the two areas are smaller and according to the F test the ratio between the variances is statistically equal to one. CVs maintain the same magnitudes and confirm that data for Zone 1 are more dispersed than those related to Zone 2.

In both cases (i and i_0), according to the two-sample t test the statistical difference between the means is equal to zero for the two zones.

All the results above mentioned are reported in Table 6.

To sum up, in relation to the evolution of tax-related revaluations, the results show that r_{IRPEF} takes on higher values than $r_{ICI,IMU}$. The same applies to the ratio of Price to Tax Value, which decreases using the tax value calculated at the present time while remaining far from equality or similarity with the Market Price. Ultimately, despite the revaluations of tax values (IMU) over the years, the spread with prices is still apparent. In addition, it is worth noting that the distance between the two magnitudes could have been even greater if prices had been updated to current time. Such a high dispersion around the mean of i and i_0 indicates how the price is dependent on countless variables, which cannot be standardized for tax purposes.

This further demonstrates the inadequacy of the tax value. This is derived from outdated incomes that are disconnected from the current scenario and is “normalized” through the application of multiplier coefficients that are the same for all land assets, regardless of the characteristics that each of them may have.

Figure 6 relates the ICI and IMU Tax Values (€) to the Sale Prices (€) of each sample observation. It shows a marked difference in non-correlation their magnitudes and a high degree of dispersion in the data. If the points were located on the line – which represents the bisector of the I quadrant ($y = x$) – then there would be a correspondence between the ICI and IMU Tax Values and the Sale Prices. In contrast, in situations where the points are above and below the bisector, the Tax Values are respectively lower and higher than the Prices. The point cloud (Fig. 6) appears to be most concentrated above the bisector, and only few points are located at or below it¹².

¹² It should be noted that in figs. 6 and 7, due to problems related to a significant difference in the intervals assumed by the two quantities (Price and Tax Value) on the two Cartesian axes, all sample observa-

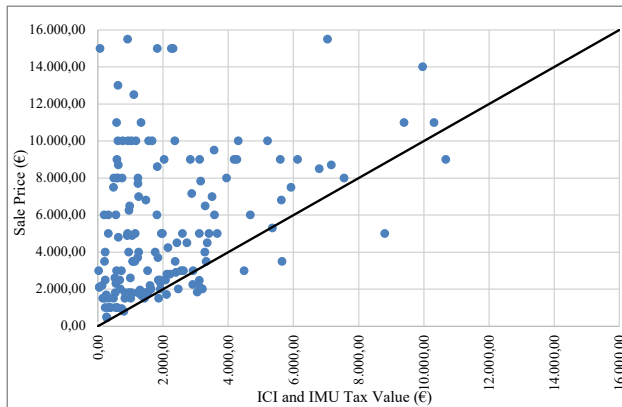


Figure 6. Comparison between Sale Prices and Tax Values (ICI and IMU) for the sample observations.

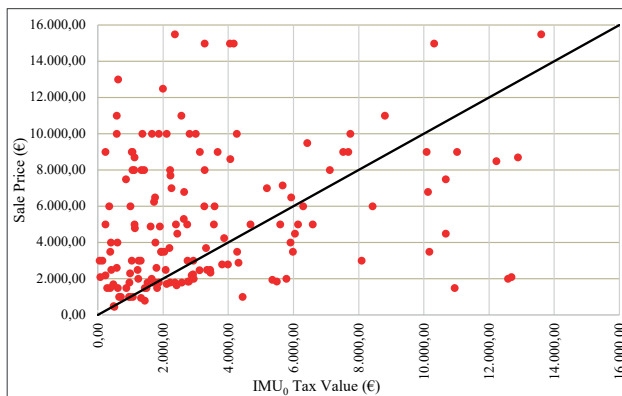


Figure 7. Comparison between Sale Prices and IMU_0 Tax Values for the sample observations.

Similarly, Figure 7 shows a comparison between IMU_0 Tax Values and Sale Prices. In fact, there is a slight improvement at the graph compared to the previous situation (Fig. 6), which is fully justified considering that IMU_0 Tax Values are, as of 2013, always higher than ICI and IMU Tax Values, due to the increase in the multiplier coefficient applied.

In Figures 6 and 7, the magnitudes of the two economic indicators on the axes do not vary proportionally because Price follows the laws of the land market instead of Tax Value which is the result of policy decisions made and adopted.

There are few studies in the appraisal literature that investigate the tax fairness of the Italian cadastral system through an examination of taxable incomes –

cadastral rent for buildings and Farmland Income for lands – which are compared with the corresponding market prices. Among them, referring to surveys conducted at the national and regional levels, the following pieces of work are worth mentioning.

In a survey conducted throughout Italy, Cenciarelli (2006) estimates a national average ratio between market values (based on data from the Osservatorio del Mercato Immobiliare, OMI) and cadastral values, equal to 2.93. At the provincial level, on the other hand, the author identified different classes (averaging data at the municipal level) of this ratio. In particular, for Trapani (covered by Zone 1) the class is between 2 and 2.5, while for the province of Palermo (reference territory for Zone 2) the range is between 3 and 3.5. In the latter case, the author points out that the figure for the provincial capital significantly influences the overall provincial result and that of the metropolitan hinterland. Although this is a survey aimed exclusively at the housing market and not at the land market, its conclusions can be considered fully consistent with the results of this paper.

Always in relation to buildings, Iommi and Marinari (2013) in Tuscany find a median value of 2.60 with a range between 1.5 and 5.7.

Agnoletti et al. (2020) in a more recent work, investigate the unresolved issue of the alignment between cadastral values, i.e., the tax base for IMU, and market values of buildings registered in the Cadastre. During their study, the authors examine vertical and horizontal equity in the Italian property taxation system. For this purpose, they resort to the ratio between OMI listings – used as a proxy for market prices – and tax values, the fiscal base subject to taxation. From their nationwide survey with data disaggregation at the municipal level, it comes to light that the actual value is on average one and a half times higher than the cadastral value. This ratio was found to be subject to significant variations rather than remaining constant in accordance with horizontal and vertical tax equity criteria.

To validate the findings of their research, the authors calculate the ratio of market value to cadastral value for typical residential properties with specific characteristics, obtaining values between 1.3 and 3.4. And they calculate it for several Italian localities. In conclusion, the study conducted by the aforementioned authors is perfectly in line with the results of the present research, albeit in different real estate fields (urban real estate versus landed property).

In the only work concerning the Italian Land Cadastre, Ascito et al. (2008), aim at verifying the reliability of the cadastral tariffs in force for some crop qualities (vineyards and olive groves), and proceed to a

tions with prices above 16,000 euros ($n = 22$) were excluded to avoid distorting effects in the graphical representations such that the trend of the analyzed phenomenon would be visually unappreciable.

comparison of the market prices of a sample of land sold in the province of Trapani with the corresponding tax values. In this way, they reach results similar to those of the present study. In fact, tax values (for ICI purposes) are consistently lower than market prices, with percentage divergences ranging from 58.0% to 71.0% for olive groves and 53.0% to 69.0% for vineyard land. However, the authors do not have punctual property data and therefore have attributed a productivity class to each observation considered, based on certain surveyed characteristics.

The last step in the present research involved checking whether tax inequality actually exists in the land fiscal system. As already anticipated, this step was found to be possible only for trades characterized by a single crop quality, which in our case are mostly arable lands, by applying equations (5a) and (5b). Sample observations were grouped according to the location of land sold. Specifically, for municipalities with equal cadastral tariffs for given crop qualities and productivity classes.

Despite the high presence of mixed crop qualities, which strongly limited the sample size on which to carry out the comparisons, the elaborations are to consider able to provide an adequate answer to the initial research question.

The comparison between prices and tax values was made on a unit basis (€/sq.m). On the contrary, it would not have been possible to identify cases where taxpayers pay IMU less or more than the asset value of the property owned. It was preferred to use the current tax value for IMU purposes for the calculations since it is obtained through a higher multiplier coefficient, in order to be in line with the current situation (year 2022). In this way, it was possible to verify whether or not the increased multiplier coefficient (135) has bridged the gap with the buying and selling prices. In Zone 1, the crop qualities analysed were as follows: arable land, arable land with permanent crops, olive grove and vineyard.

With reference to arable lands, the comparisons covered land in all existing productivity classes except the first one. In most cases there was a significant discrepancy between the tax value and the price paid. This distance is expressed with the indicator of percentage divergence (Δ_0) (whereby with positive values the tax value is higher than the market price and vice versa for negative ones). It follows that the taxable tax burden on the owner- if the land were taxed in relation to its market value instead of its tax value – would be markedly different from that calculated on its Farmland Income. The Δ_0 calculated for all arable land in Zone 1, which was 16 observations, ranged from +29.0% (tax value higher than market price) to -99.0% (market price greater than

tax value). The only exception is one observation whose market price was almost identical to the tax value.

When comparing the market prices of land with the same cadastral tariffs – which are thus matched by identical taxable income- the considerable magnitude of the variations in the prices paid (expressed in percentage terms) highlights the unequal treatment in which landowners incur. This occurs because of the marked differences in the market prices of the respective land assets.

In fact, the maximum percentage divergences within each productivity class range from +584.0% to +8,806.0%. This shows that if the current Land Cadastre were transformed into a Cadastre based on market values, the tax liabilities burdening landowners would vary between them. In particular, these would vary by the rates shown above, having taken the extreme values of each productivity class as benchmarks.

On the other hand, the observations concerning comparable arable land with permanent crops – only two 3rd class observations within the sub-sample – the Δ_0 between tax value and average unit price varies between about -43.0% and -78.0%; therefore, in a value-based cadastre the taxable income calculated on both lands would be significantly higher than at present. Alternatively, a cadastre based on market values would show a Δ_0 percentage difference of 156.0% between the two sample observations, and therefore an analogous divergence in the taxable incomes between the two owners (taxpayers), who are currently subject to the same taxable amount.

With reference to olive groves, verification was only possible on 4 sample observations of 2nd class olive groves. The calculated Δ_0 between current tax value and market price for IMU purposes was found to be between -5.0% and -61.0%, while in terms of taxpayer comparisons, the range between market prices (at the extremes) was roughly 147.0%, tax value being equal.

Finally, the vineyard lands under analysis were found to be only 4, two of which belonged to the second class and two others fell under the third class.

In the comparisons made for the second class, the Δ_0 between the current tax value for IMU purposes and the market price for each observation was not particularly high, varying between approximately -10.0% and +17.0%. In contrast, the comparison between the two observations showed a Δ_0 of approximately 31.0% between the two market prices.

For third-class vineyards, the Δ_0 between the current tax value and the market price ranged from -12.0% to +24.0%, while the prices of the two transactions diverge from each other by about 42.0%, again denoting a not insignificant tax inequality.

Ultimately, for the Trapani area, in both the inter- and intra-parcel comparisons, there is a rather significant difference for arable crops and a less marked one for tree crops.

In Zone 2, where arable crops are significantly present, it was only possible to verify them for parcels of the same productivity class (from first to fourth) in municipalities with the same Farmland Income tariff.

For first class arable crops, of which there are only three plots compared, the Δ_0 calculated between the tax value and the market price of each observation varies between +11.0% and +45.0%, while the comparison of plots with the same tax value leads to the identification of a market price variability of around 30.0%, calculated between the two extreme values of the variation interval.

Concerning the second productivity class arable crops, these were assigned to two homogeneous groups by Farmland Income; the results of the verification show for the first of the two (five plots) a wide Δ_0 between tax value and market price, ranging between +22.0% and -79.0%; while the inter-plot comparison shows a divergence between the sale prices of 604.0% – with the same tax value – which again implies a considerable inequality between plot owners. In the second group, the Δ_0 per sample observation is between approximately +31.0% and -73.0%, and the inter-parcel comparison results in a market price variability of approximately 386.0%.

There are a total of 23 observations concerning third class arable land, divided into three homogeneous groups. In particular, the first group includes 12 plots whose Δ_0 approximately varies from -84.0% to +189.0%, while the comparison of plot prices revealed a high variability of approximately 1,700%, with prices sometimes lower and sometimes higher, even by far, than the tax value.

On the other hand, the second group presents few observations (4) with a range of Δ_0 ranging from -9.0% to +43.0% and a divergence between the sale prices of 57.0%. In the third group ($n=7$) the Δ_0 is between -83.0% and -16.0%, while the comparison between the prices of the various observations – tax value being equal – showed a divergence between the sale prices of 400.0%. With regard to fourth class arable crops, only three observations were verified, showing variations in terms of Δ_0 approximately between -88.0% and -42.0% and with a percentage deviation of up to 393.0% in terms of market prices.

The last check on the potential correlation between market price and tax value was carried out with the aim to verify the vertical equity in the two areas by running the test for statistical correlation through the Pearson rank correlation coefficient. The analysis was performed on the arable lands falling into all the profitability classes, ($n_{\text{Zone1}} = 16$; $n_{\text{Zone2}} = 35$) due to a reduced sample size

of the observations concerning the other crop qualities. The results obtained ($\alpha = 5\%$) for both areas indicate an absence of statistical correlation between the two indicators (the coefficients are -0.267 for Zone 1 and +0.304 for Zone 2) and consequently the failure to comply with the vertical equity principle.

In conclusion, the analysis described above shows, for all the arable land parcels in the Palermo area, a significant level of fiscal inequality with the current Land Register tariff system in relation to both the gap between the current tax value and the unit market price, and the range between market prices when comparing parcels with equal unit farmland income and therefore with the same tax value.

Calculating both i_0 and Δ_0 further demonstrated that, although the legislator has progressively increased the multiplier coefficients over time, resulting in a reduction of the deviation between tax value and price, to date tax inequality in Italy is a widespread and undeniable phenomenon.

The findings above described cannot be extended to the other crops (e.g. permanent crops as olive trees and vineyards) due to a reduced number of sample observations in both areas which does not allow to perform a valid statistical analysis.

5. CONCLUSION

The present study highlighted, for both zones of the study area, the lack of correspondence between the revalued farmland incomes and the actual landowners' incomes (land benefit). This was highlighted by the values of the capitalisation rates calculated in the sample examined. These rates are well below the lower limit of the range indicated in the literature for agricultural land and of the values interval obtained by the indirect method.

This evidence is also confirmed by the comparison between tax values and market prices, which showed a considerable discrepancy between the two economic parameters, demonstrating the erroneous quantification of the multiplier coefficients used to calculate tax values from the revalued farmland incomes.

Both findings show that the tariff system adopted by the Italian Land Cadastre for tax purposes is obsolete and should therefore be reorganised in order to make it representative of the current agricultural scenario, in continuous and progressive evolution.

An additional objective of the research was to verify the tax fairness of the current land tax system. The data processing showed, for all crop qualities and productivi-

ty classes analysed, that the conditions of horizontal and vertical equity were not met.

In light of these findings, it is clear that the current cadastral tax system is unfair, benefiting some taxpayers to the detriment of others.

Therefore, some of the proposals for revision, already mentioned in the introductory section – including a redetermination of the unitary farmland incomes and of the classification system (the latter still standing at the 1939 revision) – should be welcomed in order to realign them to the current socio-economic conditions of agriculture. However, such a system requires a periodic updating of production factors costs and of prices regarding farm goods and services. Besides numerous farm balances are needed, whose outcomes must be extended from the reference Municipality to the entire census circle. Likewise, the cartographic part of the Land Cadastre should be improved given the close link between physical and appraisal aspects.

Another more radical proposal concerns its transformation into a Cadastre based on market values, as it is already successfully done in several EU countries. With this approach, continuous and, above all, facilitated updating over time would be ensured, as well as the possibility of using Mass Appraisal techniques to process the considerable amount of data.

As a result, it would be advisable the creation of a market prices database for cadastral purposes to be made accessible to all land market operators. This way monitoring of the land market trends would be simplified by assuring at the same time the application of innovative techniques addressed to the appraisal of market values.

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APPENDIX 1

Brief description of the methodology adopted in the EU countries of the second group (fiscal function Cadastre).

Section 1 (area)

This section includes two countries that are bound to use cadastral surface data for tax purposes. In particular, in the Czech Republic, the tax base is derived from the cadastral land area and varies depending on the quality of the land (agricultural, forest with a predominantly commercial function, etc.), while in Slovakia, the administration of the property tax system (municipalities) is obliged by law to comply with the property data in the cadastral system (common law, parcel identification number, surface area, nature, land use, location, etc.) and use the area to calculate the tax base.

Section 2 (income)

This section includes five countries (Austria, Belgium, Hungary, Portugal and Italy) that use income valuation to determine the tax base. In Austria, land taxation is based on the appraisal of the average annual yield; agricultural enterprises are assessed on the basis of their value of income capacity, which can be acquired in an average year, assuming a production capacity according to proper cultivation practices.

The main parameters for the evaluation are natural yield conditions (soil quality, topography, climate and water resources) and economic performance conditions for productivity (external and internal accessibility, farm size).

The yield value (called EMZ), resulting from the evaluation of the natural conditions of each parcel, is used to calculate for each farm the valuation index (total sum of all yield values divided by the total area), which indicates the average value for all crops.

The economic return conditions are used in the form of discounts and supplements to the valuation index. The rateable value is then derived from the farm index together with the total area.

In Belgium, property tax is based on the cadastral income, which indicates the normal average net income for a year; according to the official valuation procedure, it is assumed that the cadastral income corresponds to the income that can be obtained on average; that it is ordinary, since the highest or lowest income is not taken into account; and finally that it is net since a defined percentage can be deducted for the maintenance costs of

land improvements. The cadastral income refers to 1975 and has been indexed since 1990.

The Hungarian cadastral system contains data on property income for agricultural land only. For each property it reports the 'Gold Crown' value, which does not show the real value, but expresses the value for the quality of the land. The valuation is based on an estimate of the average annual yield considering the different cultivation uses (arable land, pastures, forests, vineyards, etc.) and quality classes (between 1 and 8); the classification procedure is supported by a network of sample areas so that the characteristics of the land to be classified are compared with the corresponding sample area. The tax base for land tax purposes is the net cadastral rent.

In Portugal, the land tax is determined on the basis of the agricultural income (tax value of the parcel), which corresponds to the balance of an annual crop account in which the asset is the total revenue and the liability is the production cost defined by law.

Italy has already been mentioned in the previous chapter.

Section 3 (value or price)

The third section includes eleven countries that use the cadastral value or market price of property to determine the tax base.

The cadastral system in Cyprus shows the estimated value and the market price of the property, which are the basis for taxation. The former, determined by the Department of Land Registry, is used in the case when the property was acquired prior to 1st January 1980 (it is based on the general valuation of all real estate on the island), while the latter, applied in the case of a property acquired subsequently, is based on the purchase price.

In Denmark, land tax is calculated for all private property, according to the concept of cadastral ownership as defined by law, based on the estimated market value of land.

Also in Estonia, the land tax is based on the estimated value of land. Since 1997, the Land Board has been collecting transaction data in a database; the last periodic valuation in 2001 was mainly based on the information collected in this database. Land valuation is a mass valuation, i.e., based on the analysis of real estate transactions and land data, using statistical analysis methods. The result of the valuation is the division of land into homogeneous zones by price level.

A new periodic evaluation started in 2021, and by 2022 the results will be made public (Estonian Land Board, 2021).

The French Land Registry provides property valuation for the purpose of determining taxable value. The valuation of land properties follows several procedures based on rental contracts, on comparison, on market value and direct appraisal.

The preferred system is valuation by leases, based on rents paid for different crops and land productivity classes. Valuation by comparison is used to a greater extent for farms subject to certain operating regimes or for land leased under extraordinary conditions, for quarries, canals, railways, etc. Market value appraisal is usually carried out for building areas by applying a percentage rate to the sale price of the property.

The direct appraisal procedure is subsidiary to the others; the appraisal procedure involves calculating the gross yield per hectare and applying to it the crop selling price at the time of appraisal, from which the discounted production costs are to be subtracted. This procedure is frequently used for the valuation of vineyards and forests, and sometimes also for orchards.

The real estate cadastre in Germany contains the results of the last official land valuation, which dates back for the former West Germany to 1964 and for the former East Germany to 1935. Property tax (*Grundsteuer*) is divided into two types: 'A' for rural land and 'B' for buildings and urban building areas. The tax is calculated on the unit values (*Einheitswert*), with reference to the type of property, through the use of a federally fixed tariff related to the type of property and a multiplier that varies according to the different geographical areas. The unit value of properties does not correspond to the market value but is generally much lower.

Cadastral valuation in Latvia is performed on the basis of information on the real estate market and on real estate data registered in the Land Registry. Cadastral valuation is a mass appraisal and is regulated by national legislation that establishes the principles and indicates the order of cadastral valuation.

The cadastral value estimate is performed automatically in the Cadastre in the valuation section. In the event of changes to the good subject to appraisal, the data is updated. The tax base for rural land, since 1998, corresponds to the cadastral value, which refers to the zoning of values (map with homogeneous zones), to the base values of land used in agriculture for each quality group (six groups), and to the base values of forest land for each quality group (four groups). The appraisal to determine cadastral base values rests on the transaction comparison method (used for buildings and rural land) and the income capitalisation method (used for forest land).

The Lithuanian property valuation system ensures

the collection of qualitative data and values on properties and explains why certain qualitative attributes have been established and what their value is. Since 2002, property tax takes the value of the property, which is derived from the mass valuation of land, as the tax base. The procedure is based on an economic approach and involves collecting all the necessary information according to the same standard, using up-to-date market data; it also allows for periodic re-evaluation taking market developments into account. If the value determined in the valuation of an individual property differs from the market price by more than 20 per cent, a mark-up may be applied to the value of the property (Muniz Perez, 2012). Based on the analysis of the real estate market and average market values, statistics are compiled for state and local institutions.

In Poland, the determination of the cadastral value of real estate, which is the basis for the calculation of the agricultural property tax (adopted in 1985), is based on the mass valuation according to the rules defined in the Act of 21 August 1997 on Real Estate Management (Journal of Laws, 2004).

Romanian National Cadastre Agency is required to provide necessary data to the tax system to calculate taxpayers' levies. The government programme for 2009-2012 emphasised the implementation of the necessary measures for the taxation of real estate on the basis of its market value. Therefore, actual data was collected on the properties bought and sold (characteristics, size, types and transaction price). Furthermore, through statistical processing of information on the sales prices of different types of properties located in a given area, it was possible to calculate the tax value of different properties.

A real estate mass appraisal system has also been developed in Slovenia for estimating the market values of all real estate registered in the land register in order to develop common criteria for determining land tax. The estimated market values are stored in the publicly accessible real estate register.

The Spanish cadastre, which does not cover the entire state area (four provinces have their own cadastre), has databases of cadastral values of rural areas and urban properties that form the basis for calculating property tax. The cadastral value is defined as an 'objectively determined' value based on the data held by the cadastre; in determining it, account is taken of location, construction cost, production expenses and revenues, taking the market value as a reference, which is its upper limit since the cadastral value of real estate cannot exceed the market value, that is the most probable price at which the property could be sold in the free market.

APPENDIX 2

Table 1a. Number and area of sample sales by municipality in the study area.

	Municipality	Sale (no.)	Incidence no. sales (%)	Sold area (sq.m)	Incidence of area sold (%)	Average area sold (sq.m)
Zone 1	Buseto Palizzolo	2	1.1	18,467	1.2	9,234
	Custonaci	11	6.1	81,538	5.3	7,413
	Erice	13	7.3	93,981	6.1	7,229
	Paceco	2	1.1	6,500	0.4	3,250
	San Vito Lo Capo	2	1.1	8,660	0.6	4,330
	Trapani	3	1.7	29,163	1.9	9,721
	Valderice	31	17.3	130,091	8.4	4,196
Zone 2	Baucina	32	17.9	151,815	9.8	4,744
	Bolognetta	6	3.4	37,012	2.4	6,169
	Caccamo	4	2.2	19,905	1.3	4,976
	Campofelice di Fitalia	4	2.2	87,904	5.7	21,976
	Casteldaccia	1	0.6	376,075	24.4	376,075
	Cefalà Diana	1	0.6	1,513	0.1	1,513
	Ciminna	7	3.9	63,773	4.1	9,110
	Godrano	5	2.8	15,863	1.0	3,173
	Marineo	24	13.4	109,668	7.1	4,570
	Mezzojuso	2	1.1	195,850	12.7	97,925
	Misilmeri	5	2.8	14,366	0.9	2,873
	Palermo	1	0.6	1,545	0.1	1,545
	Partinico	2	1.1	3,582	0.2	1,791
	Piana degli Albanesi	4	2.2	20,349	1.3	5,087
	Santa Cristina Gela	2	1.1	13,356	0.9	6,678
	Ventimiglia di Sicilia	7	3.9	16,622	1.1	2,375
	Villafrati	8	4.5	43,722	2.8	5,465
	Total Study area	179	100.00	1,541.320	100.00	8,611

Table 2a. Number and area of sample sales by municipality and crop quality.

	Municipality	Arable crops		Permanent crops		Permanent pastures and meadows		Mixed crop qualities	
		No. (%)	Area (%)	No. (%)	Area (%)	No. (%)	Area (%)	No. (%)	Area (%)
Zone 1	Buseto Palizzolo	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
	Custonaci	9.1	4.1	18.2	5.1	27.3	44.2	45.5	46.6
	Erice	30.8	21.8	23.1	10.8	15.4	1.2	30.8	66.2
	Paceco	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
	San Vito Lo Capo	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
	Trapani	33.3	55.0	0.0	0.0	0.0	0.0	66.7	45.0
	Valderice	38.7	31.3	32.3	13.1	3.2	0.2	25.8	55.3
Zone 2	Baucina	62.5	49.6	3.1	5.5	0.0	0.0	34.4	45.0
	Bolognetta	16.7	7.2	33.3	7.0	0.0	0.0	50.0	85.7
	Caccamo	50.0	58.6	0.0	0.0	0.0	0.0	50.0	41.4
	Campofelice di Fitalia	50.0	83.1	0.0	0.0	0.0	0.0	50.0	16.9
	Casteldaccia	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
	Cefalà Diana	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
	Ciminna	42.9	55.3	0.0	0.0	0.0	0.0	57.1	44.7
	Godrano	60.0	93.8	0.0	0.0	0.0	0.0	40.0	6.2
	Marineo	54.2	43.5	8.3	4.7	0.0	0.0	37.5	51.8
	Mezzojuso	50.0	99.2	50.0	0.8	0.0	0.0	0.0	0.0
	Misilmeri	40.0	13.7	20.0	19.0	0.0	0.0	40.0	67.3
	Palermo	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
	Partinico	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0
	Piana degli Albanesi	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
	Santa Cristina Gela	50.0	42.3	0.0	0.0	0.0	0.0	50.0	57.7
	Ventimiglia di Sicilia	42.9	20.0	14.3	5.5	0.0	0.0	42.9	74.5
	Villafrati	62.5	61.1	0.0	0.0	0.0	0.0	37.5	38.9

Conclusions

The analysis conducted in this thesis offers a multidimensional overview of the Italian land market, which is often overshadowed by the urban real estate market in both policy and academic discourses. Each study presented here has contributed to deepening key aspects that impact the entire sector.

The Systematic Literature Review (SLR) highlighted the importance of considering multiple variables to fully understand price variability, emphasising that parcel-level characteristics play a significant role, but adding macro-level characteristics is also fundamental to an evaluation process that ultimately leads to price formation. However, the process of agricultural land valuation is by no means straightforward and requires a multidisciplinary analysis that considers a wide range of quantitative and qualitative factors and their interactions.

Identifying the right characteristics that influence the market value of land in a specific segment is essential, as accurate and reliable land assessments can provide valuable information for investors, farmers, and real estate operators involved in land management in various capacities within this market.

For professionals working in rural appraisal, the possibility to resort to an evaluation method equivalent to MCA, as proposed in the article in Chapter 2, would be a step forward - not only to overcome the limitations of traditional methods, often based on subjective estimates that do not adhere to international valuation standards, but also from a scientific research perspective. In this way, a greater precision in valuations could be achieved, contributing to improve reliability of estimates and to promote more transparent land market management.

To date, aside from the works cited in the paper, the literature on the topic is almost non-existent. Therefore, it is hoped that the publication of this thesis will gain some resonance, stimulating interest among practitioners with the aim of advancing the state of the art in this direction.

The study thus addressed the issue of limited transparency in the Italian real estate market and the consequent difficulties that appraisers face in their professional activity. As highlighted by the paper, in such a context, the obtaining of market data is difficult and costly, both due to the lack of a centralized database and to regulatory restrictions. All this hinders the implementation of the guidelines set by valuation standards, thereby undermining the reliability of the valuation results regardless of the method adopted. Helping policymakers understand the importance of transparency and the role of appraisers could lead them to enact changes in current regulations, allowing barriers to be broken down and the gap between valuation standards and valuation practice to be reduced.

The study of the Italian Land Cadastre demonstrated that the cadastral taxation system suffers from profound obsolescence. The cadastral rates currently in use date back to the late 1970s and are misaligned with current socioeconomic conditions and market dynamics despite the increases applied

over time. The results obtained highlighted the significant discrepancy between cadastral income values and market prices, creating tax inequities that harm both taxpayers and public institutions. The inefficiencies identified suggest an urgent need to reform the cadastral system, proposing a tax system based on market values. This would ensure greater tax equity while creating a database of values and finally granting probative value to the Land Cadastre.

The study of these issues from an evaluative perspective has allowed for the exploration of the challenges, strengths, possibilities for evolution, and the extraordinary adaptability of a market such as land, often overlooked but returned to in times of need, recognising its priceless value.

It is hoped that research in this field will continue, addressing issues relevant to the current and future economic, political, environmental, and social landscapes.

On one hand, climate change risks profoundly altering the current framework of the land market, as it threatens the profitability expected by agricultural entrepreneurs. These variations in climatic variables may lead landowners to sell their land, even at a price lower than its actual market value.

On the other hand, incentive policies and the expected profits from innovative systems for green energy production, such as agrivoltaic plants, are generating interest in land acquisition by non-agricultural actors. This phenomenon raises concerns that agricultural production could become increasingly marginal compared to energy production, potentially causing irreparable harm to food security.