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## SELECTED METHODS AND FACTORS IN THE RELIABLE APPRAISAL OF AGRICULTURALLY USED REAL ESTATES

**Abstract:** Effective management of land resources requires implementing suitable policies and tools enabling a sustainable approach towards the improvement of the structure of farms, the acquisition of agricultural properties, their subdivision, as well as other procedures concerning the use and turnover of agricultural land. Proper analytical basis for managerial decisions includes procedures concerning estimation of land value..

The estimation of agricultural real estate in Poland generally takes place using a comparative approach, however, an alternative to the valuation process is allowed - the land valuation index method, which falls under the mixed approach. The purpose of the following paper is to verify the effectiveness of the land valuation index method in the context of the changing prices of agricultural real estates in Poland over the years.

Moreover, there is widespread recognition that the estimation indices depend on the data of the real estate cadastre, as well as on the location of the real estate differentiated by its affiliation to a given tax district. As emphasised in the literature, the validity of the cadastral data is sometimes problematic and the state disclosed in the cadastre very often differs from the actual state. For the purposes of the following publication, examples of situations occurring in practice and affecting the reliability of the cadastral data on the basis of which the determination of the value of real estate is carried out were also indicated.

**Keywords:** appraisal of real estate, agricultural real estates, valuation methods, cadastral data in valuation

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## Introduction

As indicated in available climate scenarios, the demand for food will increase permanently on a global scale during the next 3–4 decades due to the growing population and the increasing gross domestic product of countries (Atzberger, 2013). As numerous factors that negatively impact the efficiency of agricultural production can be observed nowadays, the aim should be to provide tools that enable a sustainable and effective use of agricultural land and its management. As emphasised by Ostapchuk et al. (2021) land resources constitute an essential part of the enterprise potential providing, among others, the spatial and territorial basis for economic activities, as well as being used as production means in agriculture, alternative energies, etc. The authors indicate that effective management of land resources is crucial to providing the efficient functioning of the enterprise as a whole. According to Kassie et al. (2017), the possibility of securing land ownership and long-term renting influences the economic growth. Many activities have already been implemented around the world to support agricultural production. Rzaşa et al. (2019) claim that sustainable rural development is also one of the basic objectives of the rural areas policy in Poland. To improve the structure of farms, the regulations governing the acquisition of agricultural properties have been sharpened, resulting in restrictions on trade in and a decrease in prices. As highlighted by Źróbek-Róžańska (2019), the radical act of 2016 stopped the sale of Treasury resources and brought strong limitations of sales on the private market, but the provisions of the Act of April 2019 have alleviated the restrictions on agricultural real estate trade. According to the data of the Central Statistical Office, in 2020 a total of more than 137 thousand agricultural real estate sale transactions were finalized, of which 130 thousand were concluded on the free market. The total volume of trade reached almost PLN 16 billion, with a total area of agricultural land of 104 thousand hectares.

Apart from the above-mentioned turnover, agricultural properties can also be subject to, among others, inheritance proceedings, expropriation, land consolidation, and all of such processes bring demand for proper land management policies. Proper management, conditioning analytical basis for managerial decisions, includes procedures concerning estimation of land value. For the needs of the following paper, authors have concentrated on the activity related to reliable appraisal of agricultural properties. To begin with, the estimation of agricultural real estate in Poland generally takes place using a comparative approach. This is due to the fact that the considered market segment is relatively well developed throughout the country. However, the legislator allows an alternative to the valuation process in the comparative approach. This is the land valuation index method, which falls under the mixed approach.

The purpose of the following paper is to verify the effectiveness of the land valuation index method in the context of the changing prices of agricultural real estates in Poland over the years. In principle, the above-mentioned method leads to market value determination, however, there are doubts whether in fact the results obtained by means of land appraisal index method can be treated as representative for the current state of

agricultural real estate market. Furthermore, the question of the influence of the reliability of the cadastral data on the reliability of the appraisal reports was analyzed.

### **Literature review**

The literature review is divided into two sections. The first provides an overview of the literature thematically related to the analysis of the principles of valuation of agricultural properties in Poland and other selected countries. In the second section, the authors analysed the influence of the reliability of cadastral data on the property appraisal process.

### **Valuation of agricultural properties in Poland and other selected countries**

Along with the development of an economic society, it is necessary to develop a reliable and effective approach to determining the market value of real estate (Chen et al. 2017). As emphasised by Bieda (2018) real estate valuation is carried out properly if all the conditions occurring on a given market at the time of its performance are taken into consideration. The author indicates that the proper determination of the land use class of the valued property is one of the important determinants of correct appraisal. According to Ostapchuk et al. (2021), the value of land resources depends on several factors including, among others, land allocation, zoning, productivity, properties of soils, land use planning, environmental regulations, infrastructure development, value-added premium, relationship between demand and supply in the market, surrounding area, inflation, benchmark land price, etc. Kovalova et al. (2020) emphasizes the characteristics of the resources, such as the size of the plot, the landscape, the distance to the product sales places, the infrastructure, the transport system, etc. should be taken into consideration. According to Kocur-Bera (2016), in Poland, two groups of factors can be listed that influence the prices of agricultural properties: natural factors, as well as spatial and organizational issues. The author adds that they can be divided into exogenous, relatively permanent factors (for example demographic relationships, urban development, transport and retail networks, etc.), as well as endogenous, anthropogenic ones (including the size and shape of plots, location, land-use, etc.). The research conducted by Kocur-Bera (2016) showed that the prices of agricultural properties located up to 2 km from compact rural settlements are higher than those of plots located at a distance of more than 6 km (because of the higher cost and the longer time of transport to farmland) and that high quality soils also drive up prices. As emphasised by Sobolewska-Mikulska et al. (2014), there are many features that are unique and specific only for agricultural real estates, for example, the value of soil evaluation, the quality of the access road, the shape of the parcel, the relationship of water, etc. Meanwhile, as indicated by Matko (2008) in Slovenia, there are three factors determining the value of agricultural land, value per m<sup>2</sup> of a norm object (depending on the location), bonita factor (the quality of land), as well as size of a plot. An impact of location on the market value of the land can be observed that is expressed by value zones and constitutes the most important factor for models of mass appraisal. In the Primorje region for speculative

reasons, land is sold at relatively high prices (the maximum average value of agricultural land), irrespective of its quality. Also Helbing et al. (2017) in Germany claim that estimation of location values involves a variety of attributes and variables, such as plot size, soil quality, land use systems, or distance to cities. The authors emphasise that in Germany on average less than one percent of the agricultural land is sold every year, as there are only a few or even no land transactions within a particular subdistrict (Gemarkung). As a result, estimating location values entails including weighted observations from other subdistricts and if the assumption of equal location value is violated, considerable bias may be incurred. Moreover, the authors find variations in agricultural product prices, technological alteration and changes in legislation as a source of changes of the value of land. As described by Kharitonov et al. (2020) in the Russian Federation at present all the conditions have been created for performing high-quality appraisal works. However, when determining the value of agricultural land, environmental factors, such as the content of pollutants, are not taken into account. The authors propose a technology for complement the cadastral value calculation algorithm with an environmental indicator reflecting the ecological condition of land plots, which will allow taking into account not only future revenues but also future potential costs that directly depend on the anthropogenic factor. Kharitonov et al. (2020) indicate that there are several drawbacks of such solution, among others, the lack of data on the qualitative and environmental condition of lands in the cadastre and the perspective of a significant increase in the cost of appraisal works.

As mentioned above, the appraisal of agricultural real estate in Poland is generally carried out using the comparative approach, but there is also an alternative method of land valuation indices, which falls under the mixed approach. According to § 18 of the Regulation of the Council of Ministers on Real Estate Valuation and Development of the Valuation Report (Regulation, 2004), the land valuation index method is applied in the process of estimating the value of real estate intended for agricultural or forestry purposes only in the absence of market transactions. The application of this method can be formally difficult, especially from the point of view of already mentioned good condition of agricultural land segment, as well as from the point of view of possibility to extend the area of market monitoring from local level to regional or even supra-regional market. The idea of using the method of land estimation indices in the context of agricultural real estate is related to the production potential of land of a given classification class, expressed in a hypothetical number of decitons of rye grain that it is possible to obtain from 1 ha of the surface. The title "estimation indexes", depending on bonitification class shown in the real estate cadastre and tax district adopted according to the provisions on agricultural tax (Law, 1984), are defined in the annex to the decree (Decree, 2004). Paragraph 18 Subparagraph 3 of the Ordinance (Ordinance, 2004) states, in turn, that the price for rye grain must be taken from the local market, leaving it to the property appraiser to obtain the relevant data. The data sources that could be used were not indicated. It is important to note that the prices for rye grain are characterized by a significantly higher annual variability than the prices for agricultural real estate on the free market.

The last element of the land valuation method are the correction coefficients, which, with reference to § 19 of the Regulation (Regulation, 2004), should take into account such characteristics of the land as location in relation to main roads, quality of access roads, danger of erosion, difficulty of cultivation, agricultural culture, structure of land use or presence of infrastructure hindering agrotechnics, among others. Current legal regulations do not indicate how the indicated characteristics should be taken into account in the valuation process or what adjustment dimension may actually be applied. In the commentary to the professional standard V.6 - "Determination of the value of forest and wooded and bushland property", only exemplary numerical values of correction factors for forest land were proposed. However, such an elaborate document is not available for agricultural land. Regardless of that, it is worth re-calling that the professional standards of real estate appraisal do not have the value of currently binding legal regulations. Taking into account the above, the value of agricultural real estate estimated in the mixed approach, using the method of land estimation indexes, will be burdened with a large measure of subjectivity. The entire calculation procedure can be reduced to the following formula:

$$W_{GR} = \left[ \sum_{i=1}^n (W_{SRi} \times P_{Ri}) \right] \times C_z \times (1 + v_{R1} + v_{R2} + \dots + v_{Rm})$$

where:

$W_{GR}$  – market value of agricultural real estate;

$W_{SRi}$  – an assessment rate expressed in decitons of rye grain for 1 acre of agricultural land of a given class located in the appropriate tax district;

$P_{Ri}$  – an area of agricultural land of a given quality class (expressed in hectares);

$C_z$  – price of 1 deciton of rye grain from the local market;

$v_R$  – correction factors.

The market value determined in this way does not reflect the real development potential of the property, understood as the possibility of using agricultural land in a different way in the long run. Unfortunately, this aspect was also omitted from the catalog of features compiled in § 19 of the Regulation (Regulation, 2004).

### **Influence of the reliability of the cadastral data on the process of property valuation**

As has been mentioned, the estimation indices specified in the annex to the decree (Decree, 2004) depend on the data revealed in the cadastre, including the field of the cadastral parcel area, land use and bonitification classes. The legislator has provided different dimensions of estimation indices for arable land and meadows and pastures. For example, for arable land of class II located in tax district I, it is assumed that 132 decitons of rye grain can be produced and for meadows and pastures of similar parameters, 118 decitons of rye grain. Several adjustments have also been made for other types of land, such as orchards or land under ponds. Therefore, the estimation indices depend only on the data of the real estate cadastre, as well as on the location of the real estate differentiated by its affiliation to a given tax district. However, in

numerous publications the authors point out the fact that the validity of the above-mentioned data is sometimes problematic (Cienciąła, 2017; Cienciąła et al., 2021; Kocur-Bera & Frąszczak, 2021; Benduch & Pęska, 2016; Benduch, 2017; Benduch, 2019; Benduch et al., 2019; Felcenloben, 2009; Hanus et al., 2021; Konieczna, 2012). As a rule, Polish legal regulations define rules of the maintenance and update of the cadastral record, registering cadastral data concerning plots. The data inscribed in the cadastre are revised through the introduction of documented changes, displaying new cadastral information, or excluding incorrect information. The aim is to keep the record up-to-date and consistent with the source materials and documentation accessible to the authority. In the process of cadastre modernization and its current updating, outdated or erroneous data is corrected. The sources of discrepancies between the cadastre and the actual state are various, including, among others, lack of updating the land and building cadastre after the changes in the actual state, lack of reliability of the archival documentation, which is the basis for revealing the changes in the cadastre, etc. Attention is also drawn to the lack of updating the land use designation after a change in the regulations, deliberate avoidance of land use updates, or changes in accuracy requirements and technological progress guaranteeing more and more precise measurement results. In her publication, Kocur-Bera (2019) examined 3273 cases of differences between the documented situation and factual circumstances. The analysis revealed that the discrepancies were mainly affected by the quality of the source data and the terrain conditions.

The necessity of effective verification of the credibility of cadastral data and their regular update has been repeatedly emphasised in the literature (Lisec et al., 2013; Mika, 2017; Hycner, 2006; Kuznetsov et al., 2022), however, in many countries of the world, just like in Poland, there is currently no obligation for top-down, systematic control of the content of evidential data by the authorities. As indicated by Bieda (2018) one of the crucial determinants of correct valuation is the proper determination of the land use class of the valued property. Periodic verification of cadastral data concerning land use based on widely available surveying and photogrammetric materials, including orthophotomaps, would be advisable. For the registration of cadastral objects – the boundaries of land parcels and the outlines of buildings – very high-resolution aerial photographs can be used (Kurczyński et al., 2016), but also, due to the achieved quality of data, the terrestrial laser scanning (TLS) method can be applied. They obtained an accuracy of photogrammetric works (0.05m) sufficient to ensure a measurement accuracy of 0.10 m sufficient to measure the cadastral boundary on the orthophotomap. Their research showed that the most important issue was related to the ability to interpret the measured features depending on the geometric and radiometric quality of the images and the observer's experience. Also, according to Sedighkia & Datta (2022) traditional methods of surveying in case of quick update of data concerning land use might be expensive and arduous, whereas novel methods have been highlighted in recent decades. The authors highlight remote sensing data processing as one of the efficient methods to update the land use map.

## Methodology

In order to verify the efficiency of the land valuation index method in the context of changing prices of agricultural real estates in Poland in the course of years, the market value of hypothetical agricultural real estates with an area of 1 ha, located in the 2nd tax district, designated in the cadastre as arable land (R) of classes I to VIz, was determined. The calculations were based on the average prices of 1 dt of rye grain in the years 2005-2021. At the same time, the average market characteristics of the estimated real estates were assumed, which means that an additional correction of the obtained results with correction coefficients was omitted. It was analyzed whether the results obtained using the land estimation index method can be treated as representative of the current state of the agricultural real estate market. In addition, the question of the influence of the reliability of cadastral data on the credibility of agricultural real estate valuation was analyzed. The research was conducted on the basis of selected cadastral data and orthophotomaps gathered in the national geodetic and cartographic resource.

## Results

The table 1 shows the results of estimating the market value of 1 ha of arable land of a given class in the 2nd tax district for the years 2005–2021.

Table 1. Market value of 1 ha of arable land of a given class in tax district 2 over the years

Year	Rye grain price [zł/dt]	Bonitification class								
		I	II	IIIa	IIIb	IVa	IVb	V	VI	VIz
2021	61,48	7746	7070	6332	5287	4304	3197	1844	738	307
2020	58,55	7377	6733	6031	5035	4099	3045	1757	703	293
2019	58,46	7366	6723	6021	5028	4092	3040	1754	702	292
2018	54,36	6849	6251	5599	4675	3805	2827	1631	652	272
2017	52,49	6614	6036	5406	4514	3674	2729	1575	630	262
2016	52,44	6607	6031	5401	4510	3671	2727	1573	629	262
2015	53,75	6773	6181	5536	4623	3763	2795	1613	645	269
2014	61,37	7733	7058	6321	5278	4296	3191	1841	736	307
2013	69,28	8729	7967	7136	5958	4850	3603	2078	831	346
2012	75,86	9558	8724	7814	6524	5310	3945	2276	910	379
2011	74,18	9347	8531	7641	6379	5193	3857	2225	890	371
2010	37,64	4743	4329	3877	3237	2635	1957	1129	452	188
2009	34,10	4297	3922	3512	2933	2387	1773	1023	409	171
2008	55,80	7031	6417	5747	4799	3906	2902	1674	670	279
2007	58,29	7345	6703	6004	5013	4080	3031	1749	699	291
2006	35,52	4476	4085	3659	3055	2486	1847	1066	426	178
2005	27,88	3513	3206	2872	2398	1952	1450	836	335	139

Source: Central Statistical Office

The above mentioned researches confirm that the variability of rye grain prices year-to-year significantly influences the fluctuations of the valuation results made with the use of the land valuation index method, which can be clearly seen especially in the years 2006–2007, 2008–2009 and 2010–2011. In the last case, the price of rye doubled year-to-year, which directly translated into the doubled increase of the market value of the real estate.

It is also evident that, in the case of weaker classes of bonitations, the estimated value of real estates decreases very rapidly, reaching in practice a dimension that is inadequate to the market realities. Referring to the indicated problem, it should also be noted that the results obtained differ significantly from even the average transaction prices of agricultural land published by GUS. The figure below presents the variation of average transaction prices of agricultural real estate in Poland in the perspective of the last 30 years.

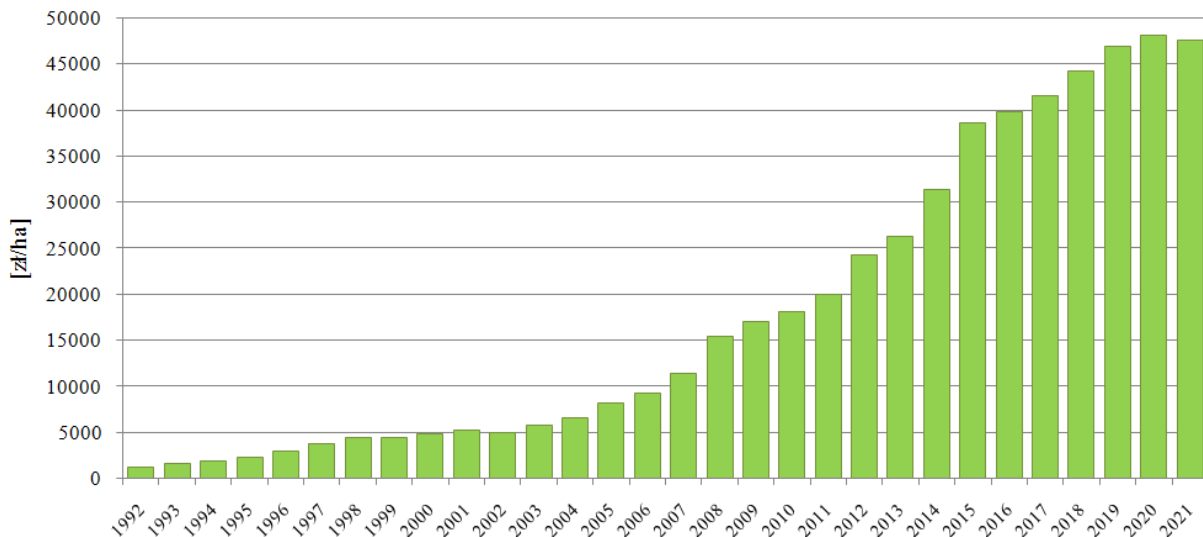


Fig. 1. Average prices of agricultural land in Poland in 1992–2021

Source: own elaboration based on CSO data

The above diagram confirms that the degree of the market value underestimation using the land valuation index method is significant, even being 10 times lower. This means that the prices of rye grain increase at a slower rate than the prices of agricultural land, which makes the method ineffective and leads to an underestimation of the market value. It is also connected with the fact that the algorithm of land estimation index method does not allow taking into consideration the development perspectives of agricultural land. More and more often, especially near larger urban centers, agricultural land is purchased for speculative purposes. The purchasers decide to buy an agricultural property located near existing buildings and the technical infrastructure network of the area, characterized by convenient access, and then take actions to change the land's designation for nonagricultural purposes. In such a case, the issue of land use and land quality class is of secondary importance. These are increasingly common free market mechanisms, especially in light of the desire to protect capital from rising inflation.



It should be emphasized that this kind of behavior is currently limited to some extent by the provisions of the Act of April 11, 2003 on shaping of the agricultural system (the Act, 2003), although it mainly concerns agricultural properties of the area exceeding 1 ha.

It is worth noticing that in the moment of coming into force of the Regulation on real estate valuation and making the appraisal report (Regulation, 2004), the average prices of agricultural land oscillated around 6000 zloty/ha (Fig. 1). At that time, the results obtained using the method of land estimation indexes appeared to be close to the actual state of the market. Poland's accession to the European Union and launch of the direct payments system for farmers caused a rapid increase of agricultural real estate prices, which finally separated this method from market reality.

In case of valuation, reliable information regarding the cadastral area of the plot is essential, whereas the area disclosed in the cadastral register is not always consistent with the geodetic (actual) area. Examining the quality and reliability of the materials of the state surveying and cartographic resource, one may conclude that especially plots within rural areas are exposed to significant, deviating from acceptable, differences between the registered data and the actual state. This is mainly due to the fact that in those areas until recently lower accuracy requirements were imposed on the surveying grid, to which the measurements of boundaries were attached, which influenced the accuracy of determination of coordinates of boundary points and the discrepancies in the location of boundary points obtained today. Before preparing the appraisal report, there is no obligation to update the cadastral data, and the activities associated with it would significantly increase the time of execution of the order. Consequently, the surveyor bases only on theoretical, outdated data, and, as practice shows, sometimes even dating back to the 1970s, when the land register (cadastre) was being established and the plot area was recorded with the precision of up to 1 acre. Underneath an example of such a case has been shown (Fig. 2). According to the entry in the land register and the graphical part – the cadastral map – the southern part of the plot of land No. 8 is designated as land use S (orchard), which is not consistent with the actual state in the field. Similarly, the southern part of the plot of land No. 8 is built up, while according to cadastral map it is arable land.

The size of the area of the land plot and individual land classes within it, disclosed in the currently binding unit - ha with the accuracy of 1 ara – shows that the area data are not geodetic data, but refer to the once rounded off area, given in acres. According to currently binding standards, the area of a cadastral parcel is calculated on the basis of coordinates of boundary points of the cadastral parcel, taking into account the value of the mapping correction, and is shown in hectares with the recording precision of up to 0.0001 ha. As a rule, for those parcels for which the area since the establishment of the registration has not been calculated with a precision of 0.0001 ha, it is permissible to record the area with a precision of 0.01 ha.



1	6	8		SI	1/2		R	R	IVb	0.2600	<b>0.6600</b>
				SI	1/2		R	R	VI	0.1300	
							S	R	VI	0.1500	
							Br	R	V	0.1200	

Fig. 2. Example of a discrepancy between the actual state of the plot no. 8 [shown on the orthophotomap (right)] and the data registered on the cadastral map (left); the descriptive part of the cadastre (bottom)

Source: own elaboration based on <https://mapy.geoportal.gov.pl/>, data from the state geodetic and cartographic resource

Updating the cadastre may in some cases show changes in legal status that have occurred over the years. Below (Fig. 3) is a situation of a change of the shoreline. There is widespread recognition that such situation may result in acquisition of the property right by the owner of the flowing water, which in this case is the State Treasury. This is because, according to Article 223. 1. of the Act of 20 July 2017 on water law. If inland flowing waters or waters of the territorial sea or internal sea waters occupy permanently, in a natural way, the land not being the property of the owner of the waters, this land at the moment of occupation becomes by law the property of the owner of the waters. In the case in question (Fig. 3) the northern fragment of the cadastral plots no. 94/29 and 94/31 is permanently occupied by inland flowing water; thus, it is necessary to conduct a demarcation and to regulate the legal status of the property.



3	2	94/29		Wł	1/1		Ps	Ps	VI	0.2451	<b>0.3430</b>
							N			0.0979	
4	2	94/31		Wł	1/1		Ps	Ps	VI	0.2270	<b>1.3116</b>
				DZ	1/1		Tr			0.1169	

Fig. 3. Example of plots of land that have been permanently occupied by flowing water and cadastral data describing an outdated state

Source: <https://mapy.geoportal.gov.pl/>, data from the state geodetic and cartographic resource

## Summary

The main disadvantages of using the land estimation index method include:

- 1) High degree of correlation of the results obtained with the prices of rye grain in the local market, which are characterized by periodic variability;
- 2) Problematic determination of the spread and dimension of the correction coefficients;
- 3) Inability to reflect the real development potential of the property;
- 4) Low efficiency of the method – generally provides results lower than those obtained when using the comparative approach (underestimated market value);
- 5) Relatively well-developed agricultural real estate market - the availability of market data on real estate sales transactions in the sector in question is a factor that limits the validity of the land valuation method.

The above indicates that for valuation of agricultural real estate should be used primarily a comparative approach. The regulations resulting from the assumptions of the land valuation index method are outdated and inadequate to the current market

realities. Taking into account the fact that the valuation of agricultural real estate is an important issue affecting a number of real estate management processes, we should consider changing the assumptions of the discussed method or even its removal from the catalog of legally permitted methods of property valuation applied in Poland.

As has been mentioned, the estimation indices, specified in the annex to the decree (Decree, 2004) depend on the data revealed in the cadastre, including the field of the cadastral parcel area, land use and bonitification classes. Meanwhile, the validity and reliability of cadastral data is sometimes problematic, and the state disclosed in the cadastre very often differs from the actual state. Often, the property appraiser works on the basis of theoretical data and the appraisal report does not refer to the actual geodetic area and the actual state of usage. There is no requirement to update the cadastral data before proceeding to prepare the valuation of the property, and such a rule would cause considerable difficulty and increase the time of execution of the order. However, it would be reasonable to implement standards and requirements for verification of cadastral data by the authorities that maintain the cadastre. Verification of the reliability of source materials – their unambiguity and compliance with the actual state on the ground would be the guarantee of the effectively conducted real estate valuation.

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