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DETERMINATION OF MARKET VALUE OF ARABLE LAND IN THE AREA OF MSZANA DOLNA MUNICIPALITY, USING THE CURRENT VALUATION MODELS[1]

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ABSTRACT

The aim of the work was to verify the currently available valuation approaches and algorithms, as illustrated with the example of a farming property located in the Małopolska region. The valuation of agricultural real estate property was carried out using the comparative approach (statistical method of market analysis, using a multiple linear regression model), then the income-based approach (investment method, by simple capitalization technique), and finally, the mixed approach (method of land index estimates). The analysis we have conducted produced varying results of the determination of value when using different valuation approaches. In the comparative and income-based approach, the values were obtained at a very similar level, which most probably results from correctly selected similar properties in both databases. The value of real estate obtained using the mixed approach turned out to be an excessively low and inadequate value compared to the values obtained in the other two approaches.

Keywords: real estate valuation, Małopolska region, cadastral land plot, statistical modelling.

INTRODUCTION

An agricultural real estate property is defined as a property used to conduct manufacturing activity in agriculture, in the field of crop and animal production, including horticultural, fruit and fish production [Ustawa… 1964]. The subject of the valuation may be the entire property, the land itself, or some of its components. The land components may include, for example, residential buildings included in farm holdings, agricultural buildings related to agricultural activities on the farm, plants (for instance, sown and cultivated vegetation), stagnant water basins, and "common" minerals [Ustawa… 1997]. The valuation of agricultural land is usually carried out using the comparative approach, whereas the income-based approach is very rarely used, and the method of land index estimates is most often used in the absence of market transactions or an order resulting from legal provisions. However, the last, cost-based approach is not applied, because it defines the replacement value of the land components that are not or cannot be traded on the market. In addition, more advanced proprietary methods can also be used in the valuation of agricultural real estate [Kozioł-Kaczorek 2014]. However, they must comply with the applicable valuation regulations.

Establishing the market value of agricultural real estate is determined by many factors: physical, economic, legal, and social. All of the factors affecting the value of the property must be included in the determination of the value of the land in the form of attributes (features). In the real estate valuation process,

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it is important to determine the hierarchy of influence of respective features on the property's price [Kozioł-Kaczorek and Parlińska 2011]. In some approaches and valuation methods, it is required that a database is created of at least several, a dozen or more properties similar to the one subjected to the valuation. According to the law [Ustawa… 1997], a similar property "should be understood as a property that is comparable to the real estate property being the subject of the valuation, due to its location, legal status, purpose, use, and other features affecting its value". This definition refers to the characteristics of the notion of similarity, and it allows the criteria for its assessment to be created, whereas in the process of property valuation, it plays a very important role [Zyga 2009]. This type of database is used, inter alia, during the valuation using the comparative approach [Cichociński and Parzych 2006]. A correctly compiled database should guarantee the possibility of comparison according to the criteria of selected features, which affect the value.

In the process of agricultural real estate value appraisal, the comparative approach is used in most cases [Siejka 2011, Zydro et al. 2016]. In this approach, value is influenced by many factors, depending on the market characteristics in the given type of the real estate market being analysed. These include geometric, physiographic, environmental, and utilitarian factors [Borcz and Kowalczyk 2003, Gawroński and Prus 2005]. One of the features taken into account in almost every valuation of this type is the soil valuation class, i.e. the category of soil quality. As demonstrated by the analyses, plots with IV–VI valuation class often have higher prices than land with the valuation class of I–III, which results from the easy option of changing their farming designation (not requiring the consent of the Minister of the Environment) and transformation into construction plots, for instance [Pietrzykowski, 2011]. Similar analyses have shown that the local spatial development plan (MZPP) also has a major impact on the value of agricultural real estate property [Zydroń 2011, Lasota and Stanek 2016], having compared the prices of agricultural properties in the areas with and without the current local plan.

The valuation of agricultural real estate using the income-based approach is very rarely used, because in this method of valuation, the value of real estate depends on the expected income that the investor will obtain from payments of rent, or other income from the real estate. The market segment for this type of real estate has a much lower rate of return than, for example, office properties that can bring income from their lease. Therefore, it is now a rare practice to invest in agricultural property as real estate that could generate income from rent or lease [Laskowska 2011]. Nevertheless, over the past few years there has been an upward trend in the demand for arable land, as well as a climbing trend in prices, which has not been observed for other types of real estate property. Investment decisions are influenced not only by the potential income from the lease, but also by other factors, such as the potential appreciation of the value of agricultural land in the long run, the benefits of EU subsidies and other forms of agricultural support, the right to insurance in the KRUS system, or the increase in the area of farms in order to increase the profitability of agricultural production. Additionally, the increase in demand may be influenced by the ending of the 12-year protection period after Poland's accession to the EU. Until May 2, 2016, entrepreneurs and citizens of the European Economic Area needed to obtain a permit for the purchase of agricultural and forest property [Ustawa… 1920].

The mixed approach and the method of land index estimates are most often used in the absence of market transactions, when it is not possible to apply either the comparative or the income-based approach. The method takes into account the correlation between valuation classes and location in a specific tax district [Dudzińska 2010]. In addition, it takes into account several other factors that include, for example, the threat of erosion, farming culture, or the quality of access roads.

RESEARCH METHODOLOGY

In order to estimate the market value of a real estate property in a comparative and income-based approach, prices and/or rents should be adjusted according to the valuation date, that is, the price/rent trend over time should be determined. Among the methods of determining the trend of price changes over time, a number of models can be applied, whilst the most popular and the most frequently used include the interval model, linear regression, or linear weighted regression. The linear regression model can be applied to databases that contain real estate properties with similar attri-

butes to the valued property, where extreme transactions in these databases are offset from each other by at least 12 months, and where the valuation date does not fall later than 3 months after the last transaction date [Czaja 2001]. In this type of model, the line regression index B is calculated first, which determines the most probable increase in the unit price for each month.

$$B = r\frac{\sigma(c)}{\sigma(t)} \tag{1}$$

where:

r – price-time complete correlation coefficient,
$\sigma(c)$ – standard deviation for price,
$\sigma(t)$ – standard deviation for time.

Simple linear regression parameter A describing the projected price in the zero month is:

$$A = c_{śr} - B \cdot t_{śr} \tag{2}$$

where:

$c_{śr}$ – average price of real estate property from the database,
$t_{śr}$ – average time [in months] between the date of the valuation and the date of concluding the transaction for particular real estate properties.

The price updated relative to the date of the valuation of the i-th real estate property $C_{i(t)}$ is calculated as:

$$C_{i(t)} = C_i + B \cdot \Delta t \tag{3}$$

where:

C_i – transaction price,
Δt – time difference between the date of the valuation and the date of concluding the transaction.

The values of random deviations δ of adjusted prices to the prices from the regression model can be calculated from the following formula:

$$\delta_i = c_i - (A + B \cdot t_i) \tag{4}$$

where:

c_i – adjusted price of the i-th real estate property,
t_i – difference in months between the date of concluding the transaction of the i-th real estate property and the date of the valuation.

On the basis of the transactions occurring within a given real estate market, we should select such attributes that will best reflect the trend of price change. For undeveloped agricultural real estate or land not designated for this kind of development, in the valuation process, attributes such as location and situation, type of arable land, soil class, farming culture, obstacles to farming, shape of the plot, or the access to property are assigned [Dydenko 2015]. In order to relate the projected value of the appraised real estate property to the prices of the comparable real estate properties, it is necessary to assess to what extent the individual attributes shape transaction prices. The selection of attributes and their scales should be objective, and it should be established for similar real estate properties, which can provide grounds for comparison.

In the comparative approach to the valuation of agricultural land, three valuation methods can be applied: pairwise comparison, average price adjustment, and statistical analysis of the market. In the pairwise comparison method, the value of the appraised real estate property is determined on the basis of properties as similar as possible to the one being appraised. In the method of adjusting the average price, the value of the appraised real estate property is determined on the basis of average values from the whole database of similar properties. In the method of statistical analysis of the market, a group of representative real estate properties on the given market is taken into account for comparison, according to the location of the real estate being appraised. The method of statistical analysis of the market is implemented using various techniques, based on the assumption that all values related to the real estate market are random. Valuation procedures in this method must be based on mathematical statistics models. The present work uses the model of a multidimensional random variable, in the procedure of linear multidimensional regression. This procedure assumes that real estate prices can be modelled using linear multiple regression models, in which prices represent a dependent variable, while the attributes are independent variables. Parameters of these models are determined according to the least-squares principle, using matrix calculus. The linear model of multiple regression can be expressed with the following function [Czaja, 2001]:

$$c = a_0 + a_1 \cdot X_1 + a_2 \cdot X_2 + ... + a_k \cdot X_k \quad (5)$$

where:

c – unit price of the real estate property being appraised.
$X_1, X_2, ... X_k$ – attributes,
$a_0, a_1, ... , a_k$ – regression coefficient of variable c versus variables X_i (slope).

Regression coefficients can be determined on the basis of the correlation matrix K, whose elements are linear correlation coefficients r_{ij} between variables X_i and X_j. The goodness of fit of the regression model to the set of information representing prices and property attributes is determined by the coefficient of determination, i.e. the square of the linear coefficient of multiple correlation R^2, which can be calculated according to the following formula:

$$R^2 = 1 - \frac{\det(K)}{\det(K_0)} \quad (6)$$

where:

$\det(K)$ – determinant of the correlation matrix K,
$\det(K_0)$ – determinant of the submatrix K_0 (matrix K after removing those matrix elements which concern prices).

The coefficients of the multiple linear regression model can be determined also on the basis of a system of equations, written in matrix format, as follows:

$$X \cdot a = c \quad (7)$$

The matrix X contains the values of individual property attributes that are the basis for the valuation. The matrix a is a one-column matrix of multiple correlation coefficients. Matrix c is a single-column matrix containing real estate prices being the basis for the valuation, adjusted for the valuation date. Therefore, the matrix of regression coefficients $\hat{a}$ is defined as:

$$\hat{a} = (X^T \cdot X)^{-1} \cdot (X^T \cdot c) \quad (8)$$

whereas, the value of the standard deviation, specifying the inaccuracy of estimation of the parameters in the multiple regression model, is determined using the following formula:

$$(\hat{a})^2 = \frac{c^T \cdot c - \hat{a}^T \cdot x^T \cdot c}{n - k - 1} \quad (9)$$

where:

n – number of real estate properties being compared,
k – number of attributes being considered.

On the basis of multiple linear regression coefficients, a unit value of w is determined in the valued real estate of the following attributes: $x_1, x_2, \ldots, x_k$ as follows:

$$w = [1\ x_1\ x_2\ ...\ x_k] \cdot \begin{bmatrix} a_1 \\ a_2 \\ a_k \end{bmatrix} \quad (10)$$

The market value of the property W is calculated by multiplying the unit value w by the area S of the property:

$$W_{wyc} = w \cdot S \quad (11)$$

In order for the forecast obtained from the multiple linear regression model to be reliable, and its application to be feasible in the property appraisal process, the values of the attributes $\hat{a}$ of the real estate property being appraised must remain within the variability intervals of $\sigma(\hat{a})$. If this condition is not met, then the projected property value will have little credibility, as it will result from extrapolation of the regression model.

The income-based approach is used to determine the value of income-generating properties or those that may potentially generate income, if the amount of this income is known or determinable. When using the income-based approach, we need to know the earned or potential income from rent or lease, or another income from the real estate property. In the case of arable land valuation, the income-based approach consists in capitalizing the expected income obtained from the rent or lease, whereby the value of the land depends on the annual income from land, and the value of the capitalization rate. In the income-based approach, we distinguish two methods: investment-based and profit-based. The investment-based method is used to determine the value of real estate properties that bring income from rents, which can be determined on the

basis of the analysis of the market rates regarding rent or lease. The profit-based method can be applied to agricultural real estate properties that bring or may bring income, for instance, orchards or fishing ponds. The income for this method is determined in an amount that is equal to the share of the property owner in the profits the property generates from the activity carried out on that property. Both the investment-based method and the profit-based method are applied using the simple capitalization technique, or the discounting of earnings streams. The simple capitalization technique consists in determining the value of real estate as the product of annual income multiplied by the capitalization rate. The capitalization rate represents the period in which the return on the funds invested for the purchase of real estate should take place, from the income obtained from the property. The capitalization rate is determined based on studying the real estate market, as the relationship between the transaction price that was paid for the property and the income that can be obtained from that property. While applying the technique of discounting income streams, the value of real estate is defined as the sum of discounted income streams, which originate from the income expected to be obtained from the given real estate property in particular years, increased by the residual value of the property.

In the simple capitalization technique, effective gross income (*EGI*, Polish: *EDB*) or net operating income (*NOI*, Polish: *DON*) can be considered, which is determined on the basis of earnings from the rental or lease of the real estate property. *EGI* (*EDB*) is adjusted by the rent risk factor:

$$EDB = PDB - S \tag{12}$$

where:

PDB (*PGI*) – potential gross income,
S – income loss justified by the market mechanism and the condition of the valuated property.

The income generated by the given property is expressed in real terms, which means that inflation is not the basis for differentiating its future levels. *PGI* (Polish: *PDB*) determines the gross income possible to obtain from the given real estate property, not taking losses into account. The latter include incomplete lease time throughout the year and losses due to delayed payments, based on information obtained from the local real estate market. Ownership of a property is connected with incurring the operating costs (OC, Polish: WO), that is, the annual costs of property maintenance, encumbering the owner and conditioning the achievement of income at the anticipated level. In the valuation of real estate, these operating expenses are incurred, like the income obtained, at the end of the year. Operating costs include: property taxes, annual fees for perpetual usufruct of land, and other costs that are incurred periodically. These costs do not include, on the other hand: depreciation charges, repayments of principal and interest instalments on loans, or income tax. Due to the above, the actual income from the real estate property is net operating income *NOI* (*DON*), defined as:

$$DON = EDB - WO \tag{13}$$

The unit market value of the real estate property is defined as the product of the annual real estate income *NOI* (*DON*) and the straight-line capitalization rate (W_K):

$$W = DON \cdot W_k \tag{14}$$

The simple capitalization rate W_K reflects the number of years over which the sum of forecasted income can offset the market value of the real estate property. The value of the simple capitalization rate is determined on the basis of the market information collected, pertaining to the group of real estate properties sold and the group of real estate properties leased. Properties in both groups of real estate should be similar to the one being valued using the suitably selected scale of attributes.

$$W_k = \frac{C}{D}\ \text{year} \tag{15}$$

where:

C – transaction price obtained for real estate property similar to the one being valued,
D – income obtained from real estate property similar to the one being valued.

Risk factors affecting the capitalization rate include primarily: location, utility standard, technical condition, leaseholders' reliability, size of buildings

and their functions, lease contract conditions for the real estate, or monument conservation protection. In addition, the W_k value should also take into account the risk regarding the volatility of income from the valued real estate property [Kucharska-Stasiak 2009].

According to art. 152 of the Law [Ustawa… 1997]: "If the existing conditions do not allow for a comparative or income-based approach, the market value of the property is determined using a mixed approach." From this provision it unmistakeably follows that we can determine the market value of real estate property in the mixed approach, but there must be clear and evident premises for the use thereof, that is, it is necessary to first exclude the possibility of applying other concepts. The mixed approach distinguishes three valuation methods: residual, liquidation costs, and land index estimates. The residual method is used to determine the market value of the real estate property, and it can be used to value the property that is subject to construction works. The method of liquidation costs is applied when the land components are designated for demolition, and the value of the property is determined as the difference between the costs of land acquisition and the costs of the liquidation of its components. In turn, the method of land index estimates is used in the process of property valuation of real estate designated for agricultural or forestry purposes, when there have been no comparable real estate transactions in the given market. The latter method is used only when data on either transaction prices or market rates of lease on real estate is missing on the local market [Konowalczyk et al. 1998]. According to § 18.2 of the Regulation [Rozporządzenie… 2004], "the value of the land is defined as the product of the estimated index of 1 ha of land multiplied by the price of 1 deciton of rye grain or the price of 1 m^3 of wood". The basic formula when using the land index estimates method for the valuation of real estate properties designated for agricultural purposes is presented below:

$$W_{wyc} = \sum (P_i \cdot N_{SZ}) \cdot C_{\dot{Z}} \cdot (1 + v_1 + v_2 + ... + v_k) \quad (16)$$

where:

P_i – the total area of arable land.
N_{SZ} – estimated land index,
$C_{\dot{Z}}$ – price per 1 deciton of rye grain,
v_k – adjustment coefficients.

The rye grain price is quoted from the local market. The data from the real estate cadastre is used to determine the class (designation) of land. Valuation using this particular method is a complicated exercise in its procedure, whilst its application typically requires specialist knowledge of experts, whose assistance is often required in the valuation process. Adjustment coefficients *v* include: location in relation to main roads, quality of access roads, threat of erosion, difficulty of cultivation, farming culture, scale of environmental pollution, land use structure, presence of irrigation devices, and presence of infrastructure that would hinder the use of farming technologies.

Table 1. Arable land index estimates

Tax district	Land index estimates in decitons of rye grain from one hectare of arable land								
	Soil quality classes (categories)								
	I	II	IIIa	IIIb	IVa	IVb	V	VI	VIz
I	145	132	118	100	80	60	35	15	8
II	126	115	103	86	70	52	30	12	5
III	110	100	90	75	60	45	25	10	1
IV	94	85	76	64	50	38	20	6	1

Source: Ustawa… 1920.

The catalogue of the coefficients listed above is legally delimited in §19 of the Regulation [Ustawa… 1920]. The value of land, determined in this method, also depends on the location in the given tax district, and on soil quality class (see: Table 1). The allocation of municipal areas to respective tax districts takes place in accordance with the legal regulation [Rozporządzenie… 2001].

DESCRIPTION OF THE DATABASE

For the purpose of the present study, a real estate property was selected, located within the Mszana Dolna municipality. This municipality is situated in the Małopolska region, about 50 km south of Kraków – the capital of the Małopolska (Lesser Poland) region. The municipality in question is located in the southern part of the region, in the Limanowa *poviat* (district).

State road number 28 and provincial roads numbers 964 and 968 run through the area of the Mszana Dolna municipality, enabling communication with nearby cities as well as with the capital of the province. The remaining roads running through the municipality are mainly *poviat*-grade and municipal-grade roads, in fairly good technical condition, with only some roads in residential areas having narrow roadways. The whole area of the municipality possesses high tourist and natural values; it is distinguished by a varied landscape and the richness of nature. The area of the municipality consists of mountainous terrain, with average soil quality, and favourable environmental values suitable for the farming economy. The area of the entire Mszana Dolna municipality is regulated by the local spatial management plan in accordance with [URL1, 2016]. Agricultural land in the municipality covers about 50% of all area, while forests cover the further 45%. Mszana Dolna municipality constitutes 18% of the district's area. The municipality includes nine towns: Glisne, Kasinka Mała, Kasina Wielka, Lubomierz, Łętowe, Łostówka, Mszana Górna, Olszówka, and Raba Niżna. The total area of the municipality is about 170 km^2. The population living in the municipality counts 17,500 people [URL2 2004, 2005 and 2010]. The figure below shows the area of the Mszana Dolna municipality.

In order to determine the value of real estate appraised in the comparative approach, a database of similar properties from the entire Mszana Dolna municipality was adopted. The database of real estate properties accepted for valuation was created in stages. Initially, the database included 162 transactions. In the first step, real estate properties with the non-agricultural designation in the Land Use Plan were removed from the database. Next, the mean area and its standard deviation were calculated from the database thus obtained. Only those properties were left in the database whose size remained within the range no greater than the value of a single standard deviation from the average price. Similar filtration was performed with respect to real estate prices. At the final stage of modelling the real estate database, only transactions up to 2 years back from the valuation date (August 2016) were adopted; also, areas designated as built-up agricultural land, undeveloped land, mixed-use land, agricultural land intended for development, as well as meadows

Fig. 1. Mszana Dolna municipality (source: URL3 2017).

and pastures, have all been removed. Having applied the aforementioned filters, the real estate property database adopted for the valuation process consisted of 37 transactions on land with an area between 0.0300 and 0.1900 ha, with prices in the range between PLN 23,500 per hectare and PLN 200,000 per hectare, and land classes from IVa through to VI. Next, seven attributes were established for each property in the valuation database: size, location, soil quality class, shape, access, obstacles, and surroundings. All the attributes other than the size were assigned a 3-point scale (see: Table 2).

Based on the analysis of the real estate properties from the database, it was observed that the highest prices were paid for properties located near other real estate properties with a similar designation, i.e. agricultural real estate. Another factor affecting the prices was the class of soil quality, namely, higher prices were obtained from land real estate properties with soil quality class IVa and IVb. The worse the class, the lower the property value. The value also decreased in the cases where the given land property was a meadow or a pasture. As for the shape of the property, land with the favourable ratio between the lengths of the sides is

Table 2. Database of similar real estate properties – comparative approach

No.	Plot of land	Cadastral area	Transaction date	Size, ha	Location	Soil quality class	Shape	Vehicle access	Barriers/obstacles	Surroundings	Unit price PLN per ha	Transaction price PLN	Corrected unit price PLN per ha	Random deviations to
1.	3769	Kasina Wielka	05-02-2015	0.0400	1	1	1	0	0	0	100 000	4000.00	83 300	–20 700
2.	9666	Kasina Wielka	17-02-2015	0.0500	2	2	2	1	1	1	150 000	7500.00	133 600	30 000
3.	2098	Lubomierz	18-02-2015	0.0900	1	1	0	2	0	2	55 600	5000.00	39 300	–64 300
4.	3016/1	Mszana Górna	15-04-2015	0.0500	2	1	0	1	1	2	40 000	2000.00	25 400	–76 500
5.	1718	Raba Niżna	16-04-2015	0.0300	1	2	2	2	0	1	166 700	5000.00	152 100	50 200
6.	7620	Kasinka Mała	21-04-2015	0.1500	0	2	1	2	1	1	66 700	10000.00	52 200	–49 400
7.	1723	Lubomierz	04-05-2015	0.1700	0	1	1	2	1	1	47 100	8000.00	33 000	–68 300
8.	5444	Kasina Wielka	19-06-2015	0.0500	2	2	2	2	1	2	120 000	6000.00	107 300	7 400
9.	4298	Kasina Wielka	24-06-2015	0.0900	1	1	1	0	1	1	44 400	4000.00	31 900	–67 900
10.	5424	Mszana Górna	03-07-2015	0.1900	1	1	1	0	2	1	73 700	14000.00	61 400	–38 000
11.	6877	Kasina Wielka	31-07-2015	0.0500	1	1	0	0	2	0	40 000	2000.00	28 600	–70 100
12.	3225	Kasinka Mała	21-08-2015	0.0700	0	0	1	2	1	2	64 300	4500.00	53 500	–44 500
13.	5083	Kasinka Mała	16-09-2015	0.0700	1	2	1	0	0	1	114 300	8000.00	104 300	7 100
14.	4979	Kasinka Mała	23-09-2015	0.0600	2	2	1	2	2	2	150 000	9000.00	140 200	43 200
15.	4066	Kasinka Mała	12-10-2015	0.0400	1	0	0	0	0	0	75 000	3000.00	65 800	–30 600
16.	2077	Lubomierz	12-10-2015	0.0300	0	1	2	2	2	1	150 000	4500.00	140 800	44 400
17.	3088/2	Lubomierz	25-11-2015	0.0800	0	2	2	2	2	1	150 000	12000.00	142 100	47 000
18.	3089/10	Lubomierz	11-12-2015	0.1100	2	1	1	2	1	2	140 000	15400.00	132 600	38 000
19.	7373	Kasina Wielka	29-12-2015	0.0500	0	1	1	2	0	1	60 000	3000.00	53 100	–40 900
20.	7830	Kasina Wielka	29-12-2015	0.0300	2	2	1	0	2	2	100 000	3000.00	93 100	–900
21.	1724	Lubomierz	15-01-2016	0.1700	2	0	1	2	1	2	70 600	12000.00	64 300	–29 300
22.	1347	Raba Niżna	03-02-2016	0.1700	1	0	1	1	1	1	23 500	4000.00	17 700	–75 300
23.	4570	Olszówka	18-02-2016	0.0541	2	2	2	2	2	1	184 800	10000.00	179 500	86 900
24.	8254	Kasina Wielka	16-03-2016	0.0400	0	2	1	2	0	1	50 000	2000.00	45 500	–46 200
25.	1343	Mszana Górna	17-03-2016	0.0700	2	2	1	1	2	1	100 000	7000.00	95 500	3 800
26.	3865	Lubomierz	24-03-2016	0.1600	1	0	0	0	0	0	50 000	8000.00	45 700	–5 700
27.	6953	Kasina Wielka	16-04-2016	0.1700	1	2	1	2	2	2	100 000	17000.00	96 400	5 600
28.	4276/1	Kasina Wielka	26-04-2016	0.1500	1	0	2	0	1	1	80 000	12000.00	76 700	–13 800
29.	1622	Mszana Górna	27-04-2016	0.1800	1	1	1	0	1	1	88 900	16000.00	85 700	–4 800
30.	4313	Łostówka	27-04-2016	0.1300	1	1	1	1	1	1	100 000	13000.00	96 800	6 300
31.	452	Kasina Wielka	27-05-2016	0.0400	2	2	1	2	2	2	200 000	8000.00	197 700	108 100
32.	6959	Kasina Wielka	07-06-2016	0.1200	2	1	1	2	2	2	116 700	14000.00	114 700	25 500
33.	8819	Kasina Wielka	13-06-2016	0.0900	2	1	1	1	2	1	72 200	6500.00	70 400	–18 700
34.	2832	Łostówka	15-06-2016	0.1200	1	0	0	1	1	1	100 000	12000.00	98 200	9 300
35.	1115	Kasina Wielka	24-06-2016	0.0400	1	2	0	2	2	2	150 000	6000.00	148 500	59 800
36.	2053	Lubomierz	06-07-2016	0.1300	2	1	0	2	2	2	100 000	13000.00	98 900	10 500
37.	5981	Kasina Wielka	12-08-2016	0.1100	0	1	0	0	0	1	63 600	7000.00	63 600	–23 600

Source: own study

the most highly valued, as it is the easiest to cultivate. The situation is the least favourable in the case of real estate with the length of one side not exceeding several meters. Concerning access to the property, the lowest prices were charged for real estate properties, to which there was no direct access either from the main road or from a dirt road. Obstacles affecting the cultivation of the land property, such as the presence of stones or trees, or the presence of utility infrastructure, did not have a clear impact on the value of the given property. The highest prices were charged for real estate properties on which these obstacles were not present, but also for those where such obstacles were present only on one part of the real estate. The weakest correlation between any given attribute and the price was observed for the attribute of surroundings. It is not possible to unambiguously assess which value of this latter feature had the greatest impact on the price. High prices were obtained for real estate properties located in the vicinity of areas with similar land use, as well as in the vicinity of land with designation other than farming. Also the fact whether or not there was a road in the neighbourhood did not seem to have much impact on the price of the real estate property.

For the purpose of the valuation using the income approach, two databases of similar properties being the object of sale and lease have been created (Table 3). The database of 37 properties sold was adopted from the comparative approach. Due to the fact that only 13 properties that were the subject of the lease were found in the Mszana Dolna municipality, the equal number of 13 properties with the attributes as close as possible to the valued property were selected from among the 37 properties obtained. The size of real estate properties in the database ranged between 0.0400 ha and 0.1900 ha. The lowest price of the real estate property from the database was PLN 23,500 per hectare, while the most expensive real estate property was valued at PLN 120,000 per hectare. Within the municipality, there exists no register of real estate being the subject of the lease, due to the fact that most contracts are concluded verbally, and there is no written confirmation of the transaction. Therefore, database of the real estate properties being the subject

Table 3. Database of real estate properties sold – income-based approach

No.	Plot of land	Cadastral area	Transaction date	Transaction price PLN	Size, ha	Location	Soil quality class	Shape	Vehicle access	Barriers/obstacles	Surroundings	Price PLN per ha	Corrected price PLN per ha	Random deviations to the δ model	Weight p
1.	3769	Kasina Wielka	5-02-2015	4 000	0.0400	1	1	1	0	2	0	100 000	106 700	31 600	1.40
2.	1723	Lubomierz	4-05-2015	8 000	0.1700	0	0	1	2	1	1	47 100	53 100	–23 200	1.75
3.	5444	Kasina Wielka	19-06-2015	6 000	0.0500	2	1	1	1	1	2	120 000	125 200	48 600	1.75
4.	5424	Mszana Górna	3-07-2015	14000	0.1900	2	1	0	1	2	1	73 700	78 900	1 900	1.40
5.	7373	Kasina Wielka	29-12-2015	3 000	0.0500	0	1	1	2	0	1	60 000	63 000	–16 200	1.40
6.	1347	Raba Niżna	3-02-2016	3 995	0.1700	1	0	1	0	0	1	23 500	25 700	–53 900	1.75
7.	8254	Kasina Wielka	16-03-2016	2 000	0.0400	0	1	1	1	0	1	50 000	51 900	–28 500	1.75
8.	1343	Mszana Górna	17-03-2016	7 000	0.0700	1	2	0	1	2	1	100 000	101 900	21 500	1.40
9.	6953	Kasina Wielka	16-04-2016	17000	0.1700	1	1	1	2	2	2	100 000	101 500	20 800	1.75
10.	1076	Kasina Wielka	26-04-2016	12000	0.1500	1	1	2	0	1	2	80 000	81 500	800	1.75
11.	1622	Mszana Górna	27-04-2016	16 000	0.1800	2	2	1	0	1	1	88 900	90 400	9 700	1.75
12.	4313	Łostówka	27-04-2016	13 000	0.1300	1	1	2	1	1	2	100 000	101 500	20 800	2.33
13.	8819	Kasina Wielka	13-06-2016	6 500	0.0900	1	1	1	1	0	2	72 200	72 900	–8 100	2.33

Source: own study

of the lease was collected based on the data of lease offers, available in August 2016 (see: Table 4). Size of the real estate properties from the database ranged from 0.0720 ha to 0.2200 ha. The annual rent for the lease of real estate from the database remained in the range between PLN 3,000 per hectare and PLN 6,300 per hectare. The highest number of agricultural properties designated for rent or lease, corresponding to the specified criteria, was found in Kasina Wielka and Kasinka Mała. Having analysed the database and its attributes, it can be observed that the largest impact on the price resulted from the soil quality class of the leased land, as well as from its surroundings. Also, the access to the property was not without significance for the amount of the rent, above all the direct access from the main road. On the other hand, the obstacles present on the land property had the smallest impact on the amount of rent charged.

Table 4. Database of real estate properties leased – income-based approach

No.	Cadastral area	Size, ha	Location	Soil quality class	Shape	Vehicle access	Barriers/obstacles	Surroundings	Annual rent PLN	Annual unit rent PLN per ha	Weight p
1.	Kasina Wielka	0.0720	1	1	1	1	1	1	450	6250.00	3.5
2.	Kasinka Mała	0.0880	1	2	1	1	1	2	550	6250.00	1.8
3.	Kasina Wielka	0.1000	1	1	2	2	0	1	300	3000.00	1.4
4.	Kasinka Mała	0.1300	1	2	1	2	2	2	700	5384.62	1.4
5.	Łostówka	0.1500	1	1	1	1	1	1	500	3333.33	7.0
6.	Mszana Górna	0.1580	1	0	1	0	1	0	600	3797.47	1.8
7.	Mszana Górna	0.1600	1	1	1	1	1	1	600	3750.00	7.0
8.	Kasinka Mała	0.1700	2	2	1	2	1	2	900	5294.12	1.4
9.	Kasinka Mała	0.1800	2	2	0	2	1	2	800	4444.44	1.2
10.	Kasina Wielka	0.2000	1	1	1	1	1	1	650	3250.00	7.0
11.	Lubomierz	0.2000	0	0	0	1	1	1	900	4500.00	1.4
12.	Mszana Górna	0.2100	2	2	1	1	0	1	800	3809.52	1.4
13.	Kasina Wielka	0.2200	1	1	1	1	2	2	800	3636.36	1.8

Source: own study

PRACTICAL CONSIDERATIONS

An agricultural plot located in Łostówka No. 4313 with an area of 0.1300 ha (see: Figure 2) was selected as the real estate property that was subjected to evaluation. Łostówka is a village located in the Beskid Wyspowy mountain range, with a population of around 1,500 people. Soil qualities classes IV, V and VI are prevalent in the village. Although these soil classes cannot be classified as very good, there are still many working farms in the area of Łostówka. This particular real estate property was chosen due to the fact that its area remained within the range of the databases selected in both the comparative and the income-based approach. In addition, it had attributes that were assumed as medium (average) on the scale (see: Table 5).

The property subject to valuation is located in the central part of the Mszana Dolna municipality, and it is covered by the MPZP local plan, being designated as farmland.

The real estate property subject to valuation is located in the vicinity of agricultural and built-up prop-

Table 5. Attributes of the real estate property subject to valuation

Area Plot	Size, ha	Location	Soil quality	Shape	Access	Obstacles	Surroundings
Łostówka 4313	0.1300	Average (1)	Average (1)	Average (1)	Average (1)	Average (1)	Average (1)

Source: own study

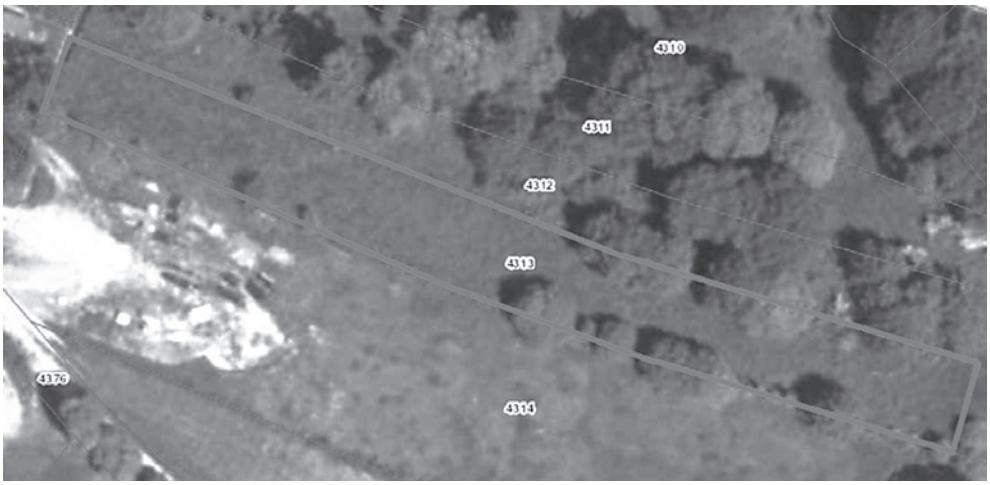

Fig. 2. Real estate property subject to valuation – Łostówka, plot no. 4313 (URL4 2017).

erties. It is a V-class arable land plot of rectangular shape. A dirt road leads to the property. In the vicinity of the valued property, various land use designations are present, but with a predominance of farmland and forest areas. The nearest main road is located approximately 20 metres from the property.

In the comparative approach, the valuation of the agricultural real estate property was carried out using the statistical analysis method of the market, with the linear multiple regression model. The distribution of the real estate properties from the database has been presented in Figure 3. The turquoise colour denotes the real estate properties from the database adopted for the valuation, while the black colour denotes the actual property that is being appraised.

In the first step, price adjustments were made due to time, using linear regression, as more than 12 months elapsed between the date of the last transaction from the database and the first one. The date for which the prices were updated is August 2016. Total price-time correlation coefficient r = –0.11 as well as standard de-

Fig. 3. Distribution of real estate properties adopted in the valuation process using the comparative approach (source: own study)

viations σ (c) = 4.43 PLN and σ (t) = 5.56 months have been calculated. Using the formula (1), linear regression coefficient was calculated, which determines the most probable increase in the unit price for each month B = PLN 900 per hectare per month, as well as the regression straight line parameter, describing the forecast price in zero month, according to the formula (2) A = PLN 10.40 Having the above data, it was possible to calculate the prices adjusted for the valuation date according to the formula (3). Values of random deviations of adjusted prices to the prices from the regression model were calculated from the formula (4). In Table 2, the adjusted property prices were presented, from the database of the real estate properties adopted for the valuation, and the value of random deviations to the model. Next, a correlation matrix was determined, whose elements are linear correlation coefficients r_{ij} between variables X_i and X_j. On the basis of the aforementioned matrix, regression coefficients of the variable c relative to the variables X_i were calculated, that is, between the attributes and the price. The resultant correlation matrix (see: Table 6) is as follows:

Table 6. Correlation matrix of attributes and prices in the comparative approach

	Size (a_1)	Location (a_2)	Soil quality (a_3)	Shape (a_4)	Access (a_5)	Obstacles (a_6)	Surroundings (a_7)	Price	Share of standardized weight in explaining the price
Size (a_1)	1.00	0.15	–0.13	–0.17	–0.17	0.06	0.12	–0.41	10%[2]
Location (a_2)	0.15	1.00	0.21	–0.08	0.01	0.09	0.19	0.33	6%
Soil quality (a_3)	–0.13	0.21	1.00	0.32	0.24	0.34	0.24	0.67	27%
Shape (a_4)	–0.17	–0.08	0.32	1.00	0.18	0.01	0.36	0.54	17%
Access (a_5)	–0.17	0.01	0.24	0.18	1.00	0.19	0.32	0.47	13%
Obstacles (a_6)	0.06	0.09	0.34	0.01	0.19	1.00	0.27	0.55	18%
Surroundings (a_7)	0.12	0.19	0.24	0.36	0.32	0.27	1.00	0.39	9%
Price	–0.41	0.33	0.67	0.54	0.47	0.55	0.39	1.00	

Source: own study

The last column in Table 6 shows the standardized weight percentage for each attribute in explaining the price. For the adopted real estate database, using the model (5), a determination coefficient (6) was calculated to determine the degree of adjustment of the regression model to the set of information representing the prices and the property's attributes. We thus obtained R^2 = 95.2%, which means that prices are explained by the attributes in more than 95%. Having performed the calculation, the following values of regression coefficients (8) and their standard deviations (9) were obtained:

$$\begin{aligned} \hat{a}_0 \pm \sigma(\hat{a}_0) &= 3.06 \pm 0.61 \\ \hat{a}_1 \pm \sigma(\hat{a}_1) &= -0.30 \pm 0.04 \\ \hat{a}_2 \pm \sigma(\hat{a}_2) &= 1.68 \pm 0.23 \\ \hat{a}_3 \pm \sigma(\hat{a}_3) &= 1.52 \pm 0.30 \\ \hat{a}_4 \pm \sigma(\hat{a}_4) &= 2.33 \pm 0.29 \\ \hat{a}_5 \pm \sigma(\hat{a}_5) &= 1.01 \pm 0.23 \\ \hat{a}_6 \pm \sigma(\hat{a}_6) &= 2.19 \pm 0.24 \\ \hat{a}_7 \pm \sigma(\hat{a}_7) &= -0.07 \pm 0.26 \end{aligned} \quad (17)$$

From the comparison of the values of regression coefficients and their standard deviations, it can be observed that the "surroundings" (a_7) attribute did not

[2] Negative weight percentage for the attribute in explaining the price.

have a significant impact on the explanation of the variability of prices in the database, in the multiple regression model. The determined market value of the real estate property under appraisal, according to the matrix product (10), based on the data from Table 5 and the value of regression coefficients (17), amounts to w = 70,700 PLN per hectare. Having multiplied the resulting value of the property by the size (surface area) of that property, the value of the entire property under appraisal was obtained (12) as W_{wyc} = PLN 9,196. The resulting value of the property being appraised falls within the range of prices of similar properties from the database, selected for comparison. The lowest unit price of real estate property from the database adopted for comparison is PLN 25,400 per hectare, while the highest one is PLN 197,700 per hectare, with the average of PLN 88,400 per ha.

In the income-based approach, the valuation was made using the investment method, with the simple capitalization technique. Figure 4 shows the distribution of the real estate properties selected for analysis in the Mszana Dolna municipality. The real estate properties, being the subject of lease, were marked with colour red; sold properties were marked in turquoise; while the particular property being appraised was marked with black.

The price adjustment was made relative to the time of real estate sale, from the database of properties sold, using linear regression. The total correlation coefficient was calculated, which is: r = 0.07, and standard deviations were determined at: σ (c) = 2.72 PLN, and since: σ (t) = 5.46 months. Also the regression straight line coefficient was calculated according to the formula (1), which determines the most probable increase in the unit price for each month B = 400 PLN per hectare per month, as well as the regression straight line parameter describing the forecast price in the zero month (2) A = PLN 7.51. Having the above parameters, an adjustment was made relative to the valuation date, using the formula (3); then, using the formula (4), the values of random deviations of adjusted prices to the prices from the regression model were determined. In the database, for each property, attributes were indicated that have the same value as the property being appraised. Next, for each property, the weights p were calculated from the following formula:

$$p = \frac{7}{1-n} \tag{18}$$

where:
n – number of attributes of the analysed real estate property different from the attributes of the real estate property being valuated.

From the above operation, we received the average weighted unit price of the valuated property in the database of properties sold, as C = 81,000 PLN per hectare. By analogy, using the database of the real estate being the subject of the lease, using the formula (18), the average annual unit rent D = PLN 4,100 per hectare was calculated. Based on the analysis of the real estate market of similar properties being the object of transactions and lease, the simple capitalization rate was determined on the basis of the formula (15) as W_k = 19.93. The value of the capitalization rate obtained means that in almost twenty years, the sum of forecasted revenues is likely to offset the market value of the property. In order to calculate NOI (Polish: DON) from the formula (13), real estate properties with identical attributes as the property being valued were selected from the leased real estate database, and

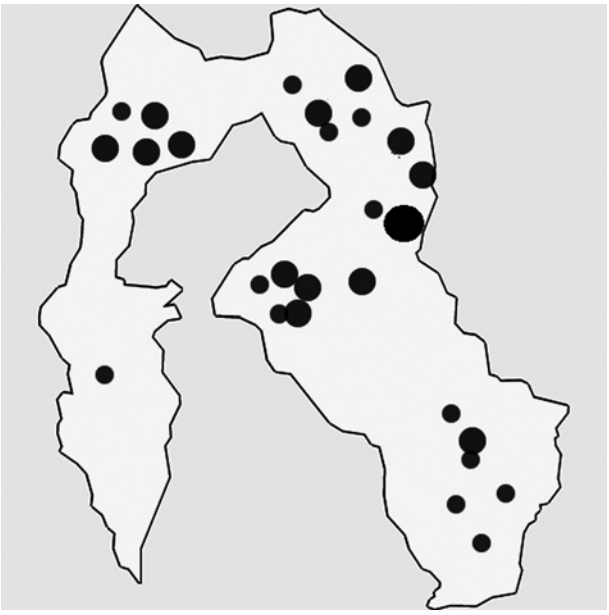

Fig. 4. Distribution of real estate properties adopted in the valuation process using the income-based approach (source: own study)

Table 7. Real estate properties adopted for the valuation using the pairwise comparison approach

No.	Area	Size, ha	Location	Soil quality	Shape	Access	Obstacles	Surroundings	Adjusted annual unit rent, PLN per hectare
5.	Łostówka	0.1500	1	1	1	1	1	1	3333.33
7.	Mszana Górna	0.1600	1	1	1	1	1	1	3750.00
10.	Kasina Wielka	0.2000	1	1	1	1	1	1	3250.00
valuated	Łostówka	0.1300	1	1	1	1	1	1	–

Source: own study

then the average income was calculated using the pairwise comparison method (see: Table 7).

Due to the fact that the properties had identical attributes, the average annual PGI (Polish: PDB) was calculated as the average of three incomes of PLN 3,444.44. In order to calculate net operating income, operating losses and costs should be deducted from the PGI (PDB). For the purpose of the analysis, we have assumed losses at the level of 0, with respect to the shortest lease period in the market, namely, 1 year. In turn, the OC (Polish: WO) for the land being valuated amounts only to real estate tax, and due to the fact that the land is designated to agricultural use in class V, it is exempt from agricultural tax. Therefore, according to the formula (13), the NOI (DON) = PLN 3,444.44, and the calculated w_k = 19.93 PLN, therefore the value of 1 hectare of the real estate property, according to the formula (14), is W = 68,634 PLN / ha. As a result, the value of the property being appraised, calculated with the formula (11), is W_{wyc} = PLN 8,922. The property value obtained is similar to the value obtained using the comparative approach, and it falls within the price range of similar real estate properties selected for valuation, which is between PLN 23,500 per hectare and PLN 120,000 per hectare.

In the mixed approach, the real estate property was valuated using the method of land index estimates. The property is situated in tax district IV, and it is a class V agricultural land. The land is located near a road, in the vicinity of agricultural property and built environment with single-family holdings. The valued property has the shape of a rectangle. The average rye grain purchase price for Małopolska, adopted as of 25 August 2016, was PLN 55 per deciton (URL5, 2017). Table 1 shows the estimated land index in rye grain decitons from 1 hectare of arable land for the valued property, amounting to 20. Based on a site visit, the values of adjustment coefficients for the valued property have been determined:

v_1 = 0.10 – location of the property in relation to main road – very good
v_2 = 0.10 – quality of access road – very good
v_3 = 0.05 – threat of erosion – not present
v_4 = 0.20 – conditions of cultivation – very good
v_5 = 0.05 – farming culture – good
v_6 = 0.05 – scale of environmental pollution – low
v_7 = 0.00 – land use structure – advantageous
v_8 = 0.05 – presence of irrigation devices – not present
v_9 = 0.05 – presence of infrastructure that would hinder the use of farming technologies – not present

The sum of all coefficients for the valued real estate is 0.65. According to formula (16), the value of this property, rounded up to full zloty (PLN) is W_{wyc} = PLN 236. The value obtained is underestimated, and inadequate compared to the values obtained in the previous approaches. This is mainly due to the poor quality of the soil in the valued property (V class), and the location of the property in the fourth tax district, which affected the value of the estimated ratio, and thus the value of the property being appraised.

CONCLUSIONS

Mszana Dolna is a rural municipality located in the Lesser Poland region, the Limanowski *poviat* (district), and it consists of 9 localities. Approximately 50% of its area is agricultural land, and 45% are forests, therefore, this municipality cannot be described as typically agricultural. The subject of the present work was to determine the value of an agricultural property located in the Mszana Dolna municipality, using three valuation approaches. The property being appraised, with an area of 0.1300, located in Łostówka, demonstrated mean (average) values for each of the attributes that described it. The database of purchase and sale transactions of agricultural real estate properties between June 2014 and August 2016 was developed based on the register of real estate prices and values, and it was prepared for valuation using the comparative approach. Initially, the database included 162 transactions, but about 40% of the real estate properties therein missed the descriptive data, which is why they were not included in the valuation process. For each property from the database, descriptive attributes such as: area, location, soil quality class, shape, access, obstacles, and surroundings have been established. As demonstrated by the multiple regression analysis, these attributes explain over 95% of the property value. Of all attributes, the class of land and the shape of the plot had the greatest impact on the price of the property, whereas the attribute of "surroundings" had the least impact on property prices.

The local market of the Mszana Dolna municipality is not rich in agricultural properties for lease. Only 13 transactions were found corresponding to the attributes of the valued property. No register of leased property prices is kept for the municipality area, as these contracts are usually concluded verbally, without confirmation in writing. Given the lack of necessary information, leased real estate properties selected for the valuation were obtained from offer-based transactions. This hindered conducting the valuation using the income-based approach. The resulting database is heterogeneous, and often the prices of lease in relation to the attributes of the property are overstated.

The method of land index estimates does not reflect market prices. The obtained value of the appraised property is less than 3% of the value obtained in the valuation when using the comparative and income-based approaches. Low soil quality, on which the appraised property is located (V class), and location in the fourth tax district, have an impact on such a low price, which affects the low value of the estimated index.

As follows from the valuation of agricultural real estate using various approaches, the obtained values demonstrate very large differences. In the valuation using the comparative and income approach, similar values of the appraised real estate property were obtained, differing by only approximately 3%. This result shows that the properties in the valuation databases were well matched, as they shared similar attributes. However, poor soil quality in this area may not encourage farmers to invest in arable land.

The value of the agricultural real estate property being assessed, as obtained using the mixed approach, is completely different from the actual prices of real estate in the analysed market, and this means that it should not be used in practice. In the analysed case, the obtained value cannot be considered to reflect market prices. In practice, in the absence of market transactions of real estate similar to the one being valued, it would be more appropriate to use a database of similar real estate properties located in the neighbouring municipalities, with a similar area and structure to the municipality in which the property being appraised is located. In addition, the table of land index estimates (see: Table 1) was established in 2004, and therefore it would be advisable to bring it up to date, so that the results produced in the valuation with the method of land index estimates would be closer to the actual market value.

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OKREŚLENIE WARTOŚCI RYNKOWEJ GRUNTU ROLNEGO NA OBSZARZE GMINY MSZANA DOLNA AKTUALNIE OBOWIĄZUJĄCYMI MODELAMI WYCENY

ABSTRACT

Celem pracy była praktyczne weryfikacja dostępnych obecnie podejść i algorytmów wyceny na przykładzie nieruchomości rolnej położonej na terenie województwa małopolskiego. Wycenę nieruchomości rolnej przeprowadzono podejściem porównawczym (metoda analizy statystycznej rynku z zas-

tosowaniem modelu liniowej regresji wielorakiej), podejściem dochodowym (metoda inwestycyjna, technika kapitalizacji prostej) i podejściem mieszanym (metoda wskaźników szacunkowych gruntu). Przeprowadzona analiza wykazała zróżnicowane wyniki określenia wartości różnymi podejściami wyceny. W podejściu porównawczym i dochodowym wartość ta uzyskała bardzo zbliżony poziom, co wynikało najprawdopodobniej z prawidłowo dobranych nieruchomości podobnych w obu bazach. Wartość nieruchomości uzyskana w podejściu mieszanym okazała się wartością zaniżoną i nieadekwatną do wartości otrzymanych w dwóch pozostałych podejściach.

Słowa kluczowe: wycena nieruchomości, Małopolska, działka ewidencyjna, modele statystyczne.