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INFLUENCE OF RECREATIONAL, LANDSCAPE AND PROTECTIVE FUNCTIONS ON THE VALUE OF FOREST, WOODED AND BUSHY PROPERTIES IN URBANIZED AREAS ON THE EXAMPLE OF THE LOCAL MARKET OF THE CITY OF KRAKOW

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Abstract

The paper presents a proposal for an approach to the valuation of forest, wooded and bushy real estate located in cities, which allows for the assessment of the impact of natural, protective and landscape factors on the value of this type of real estate. The main problem in the valuation of this type of real estate is the correct estimation of the impact on the value of the non-production factors described above. Considering the above, the main goal of the study was to identify the factors influencing the prices and value of forested, wooded and shrubby properties located in urbanized areas. The supplementary goal was to confirm the suitability of the methods and statistical models used in the study for similar measurements. By implementing the adopted goals, the article presents an analysis of the impact of these factors on the prices and value of real estate. The study covered the southwest part of the city of Kraków, located between the Vistula River and the Kraków-Rzeszów railway line in the north and east, and the southern and western border of the city. Urban forests perform mainly social functions, constituting only a marginal source of wood raw material. The results of the study showed that, in the case of similar properties, prices are significantly influenced by factors such as location, type and nature of the surroundings, form of access to the road, landscape and recreational values, manner of use and development status, as well as the permissible form of development, which is a measure of the profitability of timber production. The work ended with a discussion on the results and proposed directions for further research.

Keywords: *real estate market, property valuation, city park and urban landscape, sustainable city, urban greenspace.*

JEL Classification: *C49, C50, R39, O18, Q51.*

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1. Introduction

Determining the relationship between prices and factors relating to the environment and the real

estate itself is one of the most important research problems in the area of real estate appraisal. Taking into account the above, the main goal of the study is to identify the factors influencing the prices and value of forest, wooded and bushy properties located in urban areas. The supplementary goal is to confirm the suitability of the methods and statistical models used in the study. So far, the main focus of researchers' interest have been factors relating to residential or commercial real estate (Batóg et al., 2019; Trojanek & Gluszak, 2018; Szopińska, et al., 2020). Ecological real estate has been given much less attention. Gaca et al. (2020) studied the factors determining the value and sale price of forests with a dominant timber production function, located in the Małopolskie and Kujawsko-Pomorskie voivodships. Currently, due to the growing importance of urban forests and green areas, in particular with regard to improving the quality of living conditions in cities, one should expect not only increased acquisition of new land for such projects, but also acquisition of already arranged areas by local government entities and, in the longer term, also other investors. In this context, the identification and assessment of the impact on prices and the value of various factors, including those relating to protective, recreational and landscape functions, is of particular importance. The protective functions of the forest include a whole range of impacts relating to both protection against the negative effects of civilization changes, against natural disasters, and in the field of nature protection. As part of recreational functions, the forest can be indicated as a place for hiking, cycling and horse riding. In terms of landscape functions, the forest is both, an element of the landscape affecting the surroundings by creating a specific background for the location of neighboring properties, but also a factor directly influencing the senses of people visiting it (Bennewicz, 2001). The identification and analysis of the significance of the studied factors will lead to an increase in the quality of estimates and additionally will allow for a critical assessment of the currently used methodology. The study verified the research hypothesis relating to the assumption about the relationship between real estate prices and the factors analyzed in the study, with particular emphasis on factors related to natural, protective and landscape values.

2. Literature review

One of the factors influencing the possibility of improving the lives of city dwellers is access to green public areas, including forests or forest parks. Recent studies have shown that the proximity of green areas in the metropolis of Sao Paulo has a positive effect on the medical indicators of the city's inhabitants (Moreira et al. 2020). Urban research focuses on the methods of identifying and planning the distribution of green areas and making them available to residents (Senetrae et al., 2018; Tian et al., 2017). Futurists weave scenarios about the cities of the future, known as the so-called "Green spaces" (Santiago, 2020). Zhihao (2021) examined the relationship between effective recreation in nature and personal preferences for the characteristics of green areas on the example of residents of the city of Taiyuan in China. The study showed a relationship between the features of urban green space and the age of the respondents: children prefer a diverse environment, rich in species and various forms of nature, young people prefer quiet places where they can find shelter, middle-aged people prefer peace and contact with nature, and the elderly they prefer bright green areas with a distant field of view, often frequented, where they look for companionship. The needs of city residents in terms of access to green areas are directly visible on the real estate market by the positive impact of the vicinity of a forest/park on the prices of construction land (Zygmunt & Gluszak, 2015). The positive impact of the vicinity of the park on the value of flats and houses has been demonstrated in numerous studies (Hendon, 1971; Crompton, 2005; Jim & Chen, 2010). The research conducted so far in this area has focused mainly on the mere presence of a forest in the vicinity of urbanized properties. Sometimes it was pointed out that the impact of the vicinity of a forest on the value of urbanized real estate depends on the safety of the district, as well as on ensuring safety in the park or forest itself (Troy & Grove, 2008). In Poland, Bazyl (2009) and Trojanek et al. (2018). While the positive impact of the neighborhood on the value of houses has not been demonstrated, in the case of the housing market it was calculated that the presence of green areas within a radius of 100 m from the apartment increases its price by about 3%, and in the case of new estates with a higher intensity of development and a greater deficit of greenery times bigger. There are much fewer works that would deal with explaining how the features of stands affect the ecological or aesthetic value of parks in the city. Millward and Sabir (2011) showed that the value of Toronto parks depends on species diversity and stand diversity. The principles of urban forest management show that older stands, bright, transparent, with a small amount of undergrowth and saplings, equipped with devices (alleys, benches, shelters, sunny

clearings, etc.) are most useful for recreational and tourist purposes in the city (Ważyński, 1995, 2005, 2011; Zygmunt, 2014). The results of a review of research on forests and greenery in cities indicate that scientists focused on valuing ecosystem services (Nesbitt et al., 2017). 38 studies on the value of mixed vegetation, 31 studies on the value of trees and 43 studies on the value of green spaces were identified. Mental health was the most studied ecosystem service, while social health, community economic development and tourism were the least studied. Only in 11 cases, monetary measures were used to determine the value of ecosystem services. The authors pointed to a gap in the literature covering such issues as the value of forests for improving social health, fair access to ecosystem services, the impact of urban forests on economic development, green exposure indicators and economic valuation. The work is part of a wide range of economic valuation of high green areas in the city and in particular deals with a problem that has not been noticed so far, such as determining the impact of landscape and recreational values of urban forests and forest parks on their market value. Based on the author's observations and the criteria of arranging and developing forests in the city for recreational purposes, the thesis was made that the value of forest property in the city, apart from such features as location and transport accessibility, may also be influenced by the natural, protective and landscape values of the stand. The above-mentioned features as obligatory to be included in the valuation of protective forests, forest parks located in urbanized areas are also indicated by the provisions of law relating to the principles of property valuation (Regulation ..., 2004)

3. Data and research method

The study covered a set of transactions relating to real estate including green areas, forests, meadows, trees, shrubs, park greenery, located in Krakow. In the research only market transactions were used. We eliminated sales where prices did not reflect the fundamental market conditions (that did not meet the definition of "market price"). As the result, the research sample only consists of observations in which a clear relationship between real estate price and the bundle of characteristics exists (Gaca, 2018). The above action also leads to the elimination of distortions generated by this type of transaction. As part of the preliminary analysis, transactions with specific conditions relating to such circumstances as sales for the improvement of the conditions for the development of a neighboring property, in-kind contributions, transactions between related persons, extended payment terms, sale by the receiver, etc. were rejected. collections of similar properties within the meaning of the Real Estate Management Act. The data was obtained from a direct analysis of notarial deeds, supplemented with both obligatory and optional sources of information. The survey covered transactions concluded in the period from mid-2015 to mid-2018. Due to the extensive process of obtaining data and description of the property, subsequent data was not included. The analysis also took into account the change in the price level over time, updating them to the date of the study at a level of 4% per annum. The adopted real estate price change index was determined based on a survey conducted on a wider sample of land properties in the observed area.

Taking into account the above, a separate set of 14 transactions is presented in Table 1.

Table 1

Collection of researched similar properties

Object	Transaction date	Plot size (m2)	Transaction price (PLN)	Transaction price per unit (PLN/m2)	Change in prices over time	Unite prices after time change (PLN/m2)
1	2018-04-05	2863	327957	114.6	1.054	120.79
2	2016-11-23	10520	1848896	175.8	1.125	197.78
3	2018-06-19	7272	1217501	167.4	1.046	175.10
4	2018-03-16	33423	4435497	132.7	1.058	140.40
5	2017-09-22	2630	289300	110.0	1.083	119.13
6	2016-10-11	6075	668250	110.0	1.129	124.19
7	2015-12-21	6700	734904	109.7	1.171	128.46
8	2017-03-02	8778	965580	110.0	1.108	121.88

9	2016-12-14	7562	831820	110.0	1.121	123.31
10	2018-05-07	4514	490717	108.7	1.050	114.14
11	2017-03-06	3047	335170	110.0	1.108	121.88
12	2017-05-26	4087	359329	87.9	1.100	96.69
13	2016-06-27	142762	23933460	167.6	1.146	192.07
14	2015-05-13	2190	219000	100.0	1.200	120.00

Source: own study.

The locations of the analyzed properties are shown in Fig. 1.

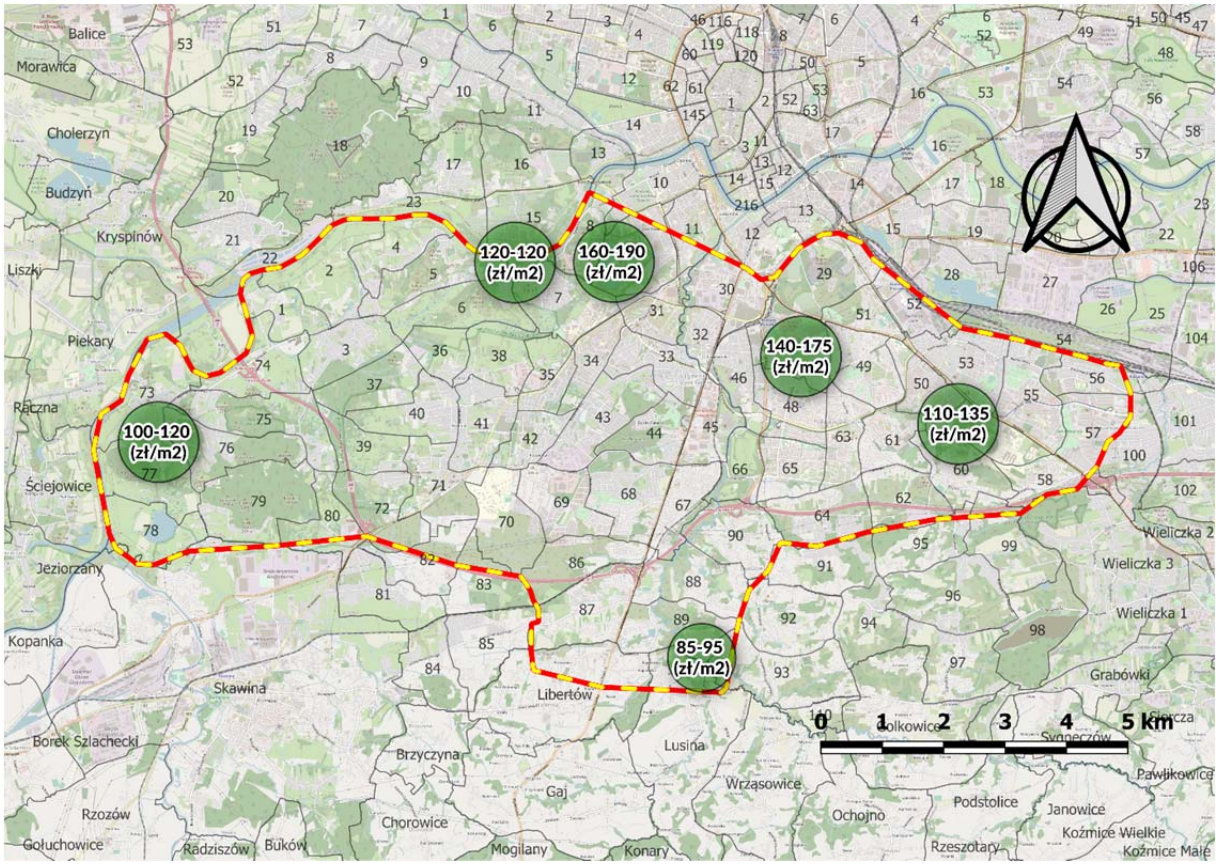


Fig. 1. Location of real estate on estates. *Source:* own study based on the OpenStreetMap database.

As part of the analysed factors, given the characteristics of the studied set and the purpose of the study, the following were distinguished:

- location understood as the location in relation to the city centre (X1),
- state of the environment (X2),
- road access (X3),
- area (X4),
- landscape and recreational values (X5),
- property use and development state (X6),
- acceptability form of buildings (X7).

When selecting the diagnostic factors of the model, the factors directly related to the purpose of the study were taken into account first. Due to the difficulties in the direct quantification of protective, recreational and landscape factors, their impact on the property value was considered in the framework of the above-described features X1, X5 and X6. Obviously, due to the complexity of the levels of impact, the impact of the described factors is partially overlapping within the scope of the variables described, with the "landscape and recreational values" feature taking into account the factors described in the quantification as dominant, while in the case of the "state of development" feature the leading role the assessment was assigned a protective function. The location feature, apart

from the assessment of the location itself in the urban space, partly takes into account all of the analyzed aspects. The selection of the remaining factors was made taking into account both the variability of the characteristics in the analyzed set of transactions as well as the results of research on the preferences of buyers conducted on various local real estate markets (e.g. cyclical analyses of the Krakow real estate market by the Instytut Analiz mrn.pl performed for 12 years). The type of features that affect the value of the real estate result directly from the information contained in the real estate purchase and sale announcements. Regardless of the type of property, the location and access are usually provided. In the segment of residential real estate (premises and houses), positively associated features of the surroundings, such as the presence of public utility facilities and green areas, larger forest complexes and parks, are usually emphasized. The standard features included in the offers for sale of land real estate include the purpose in the local plan or the type of real estate divided into forest, agricultural, construction, investment, which informs the potential buyer whether the plot can be developed and what type of development it may be. Numerous analyses of own and other property appraisers indicate that the prices of plots are the higher the more intensively they can be developed. In the case of forest areas and mixed green areas, the admission of buildings, even of very low intensity, increases their value. Some factors that should be taken into account in the valuation of real estate result directly from legal provisions. Among them, the following are indicated: the type, location, method of use, purpose and condition of the property, including its development, technical and utility condition, as well as the condition of the property surroundings (Act ..., 1997). In the case of determining the value of wooded, shrubby or forest properties, the following functions should also be taken into account: protective, recreational or landscape (Regulation ..., 2004).

For the selected factors, their intensity was measured, taking into account the rating scale described below.

X1 - 1 - location on the outskirts of the city, 2 - large housing estates relatively far from the center, e.g. Bieżanów, 3 - location near the city center, but in a high-risk flood zone, 4 - location closer to the city center and valuable areas, e.g. Łagiewniki, Pychowice, 5 - location closest to the city center and in fashionable districts, e.g. Zakrzówek,

X2 - 1 - the presence of open areas and only single-family housing, 2 - the vicinity of open areas and single-family and multi-family housing development, 3 - the vicinity of diversified, multi-family and single-family housing, 4 - the vicinity of dominant multi-family housing and commercial services.

X3 - 1 - no direct access, 2 - public dirt road or through other properties of the same owner, 3 - asphalt road or other hardened road,

X4 - 1 -> 3 ha, 2 - 1-3 ha, 3 - 0.3 - 1 ha, 4 - 0.2-0.3 ha,

X5 - 1 - no view, wetlands, damp, monotonous, 2 - a view of characteristic points, but in a narrow range, rather dry areas, 3 - an area with a varied landscape with vantage points in a wide perspective and interesting interiors landscape,

X6 - 1 - meadows and fields, with at most single trees, 2 - wooded areas but with a dominant layer of brush and shrubs, 3 - open areas with a dominant layer of trees, forests with an openwork interior with a small amount of undergrowth and undergrowth - varied with clearings, 4 - as above and a device for recreation and relaxation,

X7 - 1 - no possibility of erecting buildings, 2 - limited possibility of erecting small service facilities for servicing green areas.

In the measurement procedure, the principles of ordinal measurement have been used, taking into account its specificity observed when measuring the properties of the property (Foryś & Gaca, 2016). The evaluation scale was developed based on the analysis of the diversity of the studied set.

Based on the above, an evaluation matrix for the analyzed set was obtained, which is presented in Table 2.

The study of the dependence of transaction prices in relation to the selected factors was carried out using the non-parametric rank correlation method in conjunction with the method of adjusting prices to the ceteris paribus state, developed by Sawiłow and Gaca (Gaca & Sawiłow, 2014a; Gaca & Sawiłow, 2014b; Gaca, 2018).

The method was selected due to the generally ordinal level of measurement of the variables, the small size of the set and the lack of knowledge about the type of price distribution.

Table 2

Characteristics of the research set with evaluation of the features

Object	Transaction date	Location	X1	X2	X3	X4	X5	X6	X7
1	2018-04-05	Tyniecka międzywale	3	2	1	4	2	2	1
2	2016-11-23	Zielna	5	4	1	2	3	3	1
3	2018-06-19	Puszkarska	4	3	3	3	2	2	2
4	2018-03-16	Puszkarska	4	3	2	1	3	2	2
5	2017-09-22	Obronna	2	3	2	3	1	2	1
6	2016-10-11	past Medyka estate	2	3	2	3	1	2	1
7	2015-12-21	Sadka	2	3	2	3	1	2	1
8	2017-03-02	past Medyka estate	2	3	2	3	1	2	1
9	2016-12-14	past Medyka estate	2	3	2	3	1	2	1
10	2018-05-07	Mokra	2	3	2	3	1	2	1
11	2017-03-06	Czajna	2	3	2	4	1	2	1
12	2017-05-26	Chałubińskiego	1	1	2	3	1	1	1
13	2016-06-27	Wyłom, Norymberska	5	4	3	1	3	4	2
14	2015-05-13	Walgierza Wdałego	3	2	1	4	2	1	1

Source: own study.

The applied method by using the rank correlation in conjunction with the method of adjusting prices to the ceteris paribus state allows for an effective analysis of the sets with the above-described characteristics. The adjusted prices were calculated as the ratio of the total evaluation of the attributes of the i-th real estate, excluding the analyzed attribute, to the appropriate sum of medians from the rating scale. The above procedure has eliminated a significant part of the impact on transaction prices of features other than the one examined. The method, thanks to the use of a non-parametric procedure, allows analyses to be conducted in relation to sets with relatively small numbers, sets with an undetermined distribution of variables, and also allows for taking into account variables for which measurements were made at different levels. The above properties of the method, taking into account the nature of the data, were the basic premise for selecting the described research tool.

4. Research results

In the case of the non-parametric method, the prices were adjusted to the ceteris paribus level before calculating the rank correlation coefficients. Table 3 shows how to calculate the adjusted price vectors for individual attributes.

Table 3

Evaluation of the features along with prices adjusted Csij

Object	Features and ratings							Prices adjusted to the ceteris paribus level (PLN/m2)						
	X1	X2	X3	X4	X5	X6	X7	Csi1	Csi2	Csi3	Csi4	Csi5	Csi6	Csi7
1	3	2	1	4	2	2	1	129.17	124.64	120.75	143.71	128.52	124.64	124.36
2	5	4	1	2	3	3	1	190.51	187.62	175.27	176.92	185.09	181.94	178.08
3	4	3	3	3	2	2	2	161.62	159.31	162.46	159.31	157.26	154.29	160.24
4	4	3	2	1	3	2	2	140.45	136.84	133.72	124.67	140.45	130.35	137.08
5	2	3	2	3	1	2	1	127.59	142.13	136.01	142.13	126.94	131.80	130.83
6	2	3	2	3	1	2	1	132.63	147.17	141.05	147.17	131.98	136.84	135.87

7	2	3	2	3	1	2	1	136.85	151.39	145.27	151.39	136.20	141.06	140.09
8	2	3	2	3	1	2	1	130.34	144.88	138.76	144.88	129.69	134.55	133.58
9	2	3	2	3	1	2	1	131.71	146.25	140.13	146.25	131.06	135.92	134.95
10	2	3	2	3	1	2	1	122.57	137.11	130.99	137.11	121.92	126.78	125.81
11	2	3	2	4	1	2	1	121.92	134.55	129.69	144.88	121.92	125.81	125.53
12	1	1	2	3	1	1	1	141.60	147.22	172.47	190.51	152.83	147.22	158.44
13	5	4	3	1	3	4	2	168.33	166.85	165.52	156.03	165.52	166.85	164.32
14	3	2	1	4	2	1	1	138.37	132.63	127.77	155.35	136.84	123.89	131.66

Source: own study.

In the next step, Spearman's rank correlation coefficients were calculated for individual attributes and their respective adjusted prices. The statistical significance of individual coefficients was also determined. Then, the feature weights were calculated based on the share of the absolute value of the coefficients in their sum. The results of the estimation of market features determined by the non-parametric method are presented in Table 4.

Table 4

Results for specific weights of market features

Attribute	Direction coefficient	Relevance p>a (0.05) no grounds for rejecting H_0	Actual attribute share (%)
Location	0.6121	0.6121	17.00%
State of the environment	0.6374	0.6374	17.70%
Road access	0.4758	0.4758	13.20%
Area	-0.0033	0.0000	0.00%
Landscape and recreational values	0.7044	0.7044	19.50%
Property use and development state	0.5758	0.5758	16.00%
Acceptability form of buildings	0.6000	0.6000	16.60%

Source: own study.

As a result of the analysis, the null hypothesis about the lack of a relationship between the factors and prices for six of the seven examined features at the significance level of 0.05 was rejected. The only feature for which there were no grounds for rejecting the null hypothesis in the analyzed set was the area of the property. The above may be related to the nature of the real estate and its typical large-area character in relation to the area of other segments of the land real estate market located in urban areas. However, it cannot be ruled out that the observed lack of dependence is a manifestation of specific, individual conditions for the surveyed community. In the case of the most interesting factors quantified under the variables X1, X5 and X6, including both landscape-recreational and protective values, the obtained result indicates a significant dependence of prices on the analyzed set of factors. In the case of the variable comprising mainly landscape and recreational factors, this relationship showed the greatest impact on price differentiation in the analyzed set. The landscape is shaped by an irregular forest shoreline, the presence of viewpoints, stands with an openwork interior with a small amount of undergrowth and undergrowth, additionally equipped with recreational and leisure facilities, may influence the differentiation of real estate prices with an increased biological factor, in total in the range of about 35% (X5 + X6).

5. Discussion and conclusions

Based on the results of the research, it was found that there is a significant positive correlation between the factors taking into account the protective, recreational and landscape aspects and the level of real estate prices. The study showed the legitimacy of considering the described group of

factors when determining the market value of bushy, wooded or forested real estate in urban areas. The study also found less direct relevance to assessing prices and value for this type of property - their timber stock. The above allows linking the non-economic functions of the studied areas with the economic dimension related to their value. The combination of natural, protective and landscape factors with the value of the real estate can have a significant impact on improving the methods of managing ecological areas in cities. In the authors' opinion, both the scope and hierarchy of factors influencing real estate prices indicated in the paper can be considered particularly important. Obviously, due to the local nature of the study, the analysis of both the set of factors and their scope should be the subject of further research. For application reasons, the scope of the methods used to estimate the parameters of the model for individual cases observed directly from the professional activities of property appraisers remains an open question. Taking into account the scope of the study, it seems that the conclusions drawn from the study may constitute the basis for determining the impact of factors of a protective, recreational and landscape nature for other cases of determining the market value of the real estate. According to the authors, the conducted research and its results confirmed both the usefulness of the non-parametric method used in the work as well as the research hypothesis relating to price efficiency in the context of real estate factors and features affecting their creations, including features of the studied nature, relating to a specific market area of ecological character. The study also allows for the formulation of a conclusion about the possibility of determining the impact of the analysed factors on the market value of the analysed real estate directly using the comparative approach. The issue of measuring the impact of the factors analysed in the study, due to the local nature of the research, requires further analysis, in particular relating to other urban centres, both in Poland and abroad.

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