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CARTOGRAPHIC AND STATISTICAL METHODS IN THE ANALYSIS OF LOCAL REAL ESTATE MARKET AS EXEMPLIFIED BY RABKA-ZDRÓJ

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Summary

The article focuses on the use of cartographic and statistical methods in the analysis of local real property market. The analysis covered the area of Rabka-Zdrój city. The database consists of plots of undeveloped land traded between 2010 and 2015. The structure of transactions, spatial distribution of unit prices and the impact on size of land on its price, depending on a category of transactional real estate, have been examined.

Keywords

real property market • thematic map • spatial analysis • Rabka-Zdrój

1. Introduction

The article deals with the use of thematic maps and statistical methods in analysis of local real property market. "Thematic maps present one or a few chosen elements of geographic space, phenomena, processes, but also ideas, hypotheses and results of analyses and syntheses" [Żyszkowska et al. 2012]. In case of real property market, thematic maps are usually used to present spatial distribution of real property prices [Bitner and Bysina 2014, Kolbe 2015, Maćkiewicz 2008, Tsutsumi 2011]. In this article transactional real properties and the structure of transactions have been presented. The analysis covers the area of Rabka-Zdrój city. Database consists of plots of undeveloped land traded between 2010 and 2015. The data were acquired form the price and value register available at the Geodesy, Land Registry and Cartography Department of the Starost's Office of the Districts of Nowy Targ. In order to create thematic maps, digital cadastral map, obtained from this Office, was used. Thematic maps were created in ArcGIS software (ESRI Inc. 2016).

Rabka-Zdrój is situated in southern Poland in the Małopolskie voivodeship, district Nowy Targ. The city is located 23 km north of Nowy Targ and 68 km south of Kraków. Rabka-Zdrój jest located in the Rabka Valley, at an altitude of 500–600 m a.s.l. in the Gorce and Island Beskid range, where Poniczanka, Skomielnianka and Słonka streams join the river Raba. From the north and north-west Rabka-Zdrój borders on the Lubień

commune, from the east – on Mszana Dolna and Niedźwiedź communes, from the south on the Nowy Targ commune, and from the west – the Raba Wyżna commune. The city lies at the intersection of important communication routes, namely of Zakopianka, that is the road from Kraków to Zakopane, and national road no. 28 to Nowy Sącz and Bielsko-Biała.

The history of Rabka-Zdrój goes back to XIII century and is related to brine springs. The name of the city was first used by Jan Długosz, who referred to a document issued by the king Bolesław V the Chase in 1254. In it the lands of Rabka have been handed over for use to the Cistercian Order from Szczyrzyca. However in 1382 Louis I of Hungary took the property back from the Order. In 1446 Rabka was granted location privilege by Magdeburg rights, which was an important event in its history. In 1557 a parish was established and a few years later the first church in Rabka was built. It was destroyed for unknown reasons and in its place a new one was erected, St. Mary Magdalene's Church, where today the Ethnographic Museum can be found. Since the second half of XVI century there was a growing interest in brine springs. In 1858 the first chemical analysis of brine was conducted. The results showed that local saltwater contains large amounts of iodine and bromine. In 1864 a spa, created by Julian Zubrzycki, was officially opened. The spa developed since then, reaching its greatest splendour in the interwar period. During the Second World War the spa resort was closed due to pollution of springs and lack of equipment, as it was taken to Germany. After the war Rabka became an important centre of tuberculosis treatment. On 21 September 1953 Rabka was granted municipal rights and in 1967 it was officially recognized as a health resort. In 1999 the name of the city was changed into Rabka-Zdrój to emphasise that the town has a spa character. The only brine graduation tower in Małopolska can be found here. The climate of Rabka-Zdrój is characterized by small amount of winds and precipitation, and strong insolation, which is not a typical mountain climate [Matuszczyk and Trybowska 2001].

The area of the city is 36.3 km^2, which is 2.4% of the Nowy Targ district. The city has 13 074 residents, 47.2% of which are men, and 52.8% are women. In recent years a slight increase in population, of 0.96%, has been noted. The population density is 360 person $\cdot$ km^{-2}. There are no big industrial plants in Rabka-Zdrój. Entrepreneurship is focused on service of tourists, accommodation and catering services, trading, construction and medical services. The companies active in Rabka are mainly small and one-man firms. Green areas constitute large part of Rabka, namely 1.32% of the city area, compared to 0.21% in the Małopolskie voivodeship. In the centre of the city there is a Park Zdrojowy of 32.5 ha. The Park came into being 112 years ago and in 2010–2011 it was comprehensively revitalized. It consists of two characteristic areas: representative-recreational and pedestrian-meditative, and it is one of the largest parks in Małopolska [Program Rewitalizacji…].

2. Database

The analysis presented in the article concerns plots of undeveloped land sold between 2010 and 2015. In the researched period 233 of transactions were conducted. The terri-

torial scope of the local market is demarcated by administrative boundaries of Rabka-Zdrój city. Data were obtained from the Geodesy, Land Registry and Cartography Department of the Starost's Office of the Districts of Nowy Targ in a PDF format. The data were used to create a database of real properties in Microsoft Exel. Transactions, the subject of which were roads and land designated for perpetual usufruct have been excluded. Finally, the analysis covers 199 transactions.

3. Data analysis

The analysis of real properties [Dudek et al. 2011, Guntermann and Thomas 2005, Colwell and Munneke 1997] started from examining trends of unit price of land plots during 6 studied years. Linear regression model was used for this purpose. The analysis showed that the market of undeveloped land is stable, the prices in the studied period were fixed at a constant level. The diversity of prices was greater in the second half of the studied period. The dynamics of the transaction showed that the highest number of transactions was carried out in 2015, the lowest in 2014. In the remaining years the number of transactions was fixed at about 30 annually. The total surface area of land sold was the largest in 2015, which was 0.35% of the whole land in the city. The land sold annually was on average 0.2% of the whole land in the city. Table 1 presents data on the dynamics of transactions.

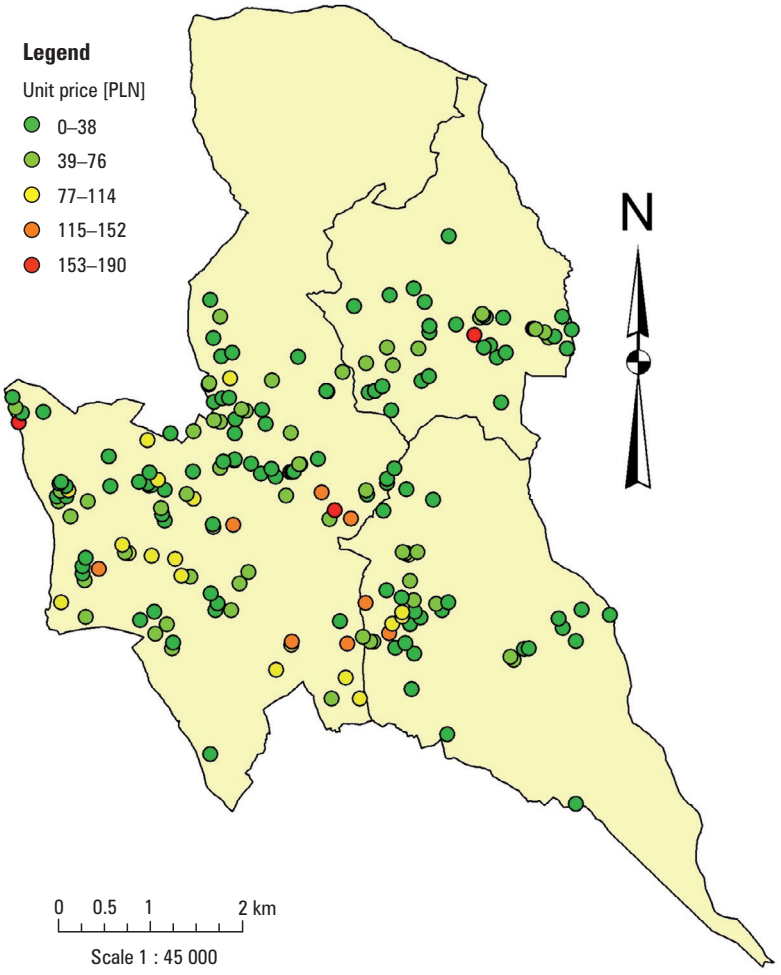
Table 1. The number of transaction and structure of sold land in consecutive years from 2010 to 2015

Year	No. of transactions	Area of sold land [ha]	Share of transactional land in total land of the city [%]
2015	58	12.6	0.35
2014	17	2.7	0.07
2013	31	6.3	0.17
2012	28	5.9	0.16
2011	36	8.4	0.23
2010	29	5.8	0.16
Mean	**33**	**7.0**	**0.19**

Source: authors' study

Figure 1 shows the spatial distribution of transactions carried out in Rabka-Zdrój. The area of the city is divided into three separate register zones: Rabka-Zdrój, Rabka-Zaryte and Rabka-Słone. One dot on the map corresponds to one transaction, while the colours of dots indicate the unit price level. The map shows 199 transactions of undeveloped land, carried out from 2010 to 2015. The analysis proves that the greatest number of transactions was conducted in the central part of the city. At the outskirts,

that is in forest areas, there were no transactions concluded. The highest number of transaction was finalized within Rabka-Zdrój, the smallest one within Rabka-Zaryte.



Source: authors' study

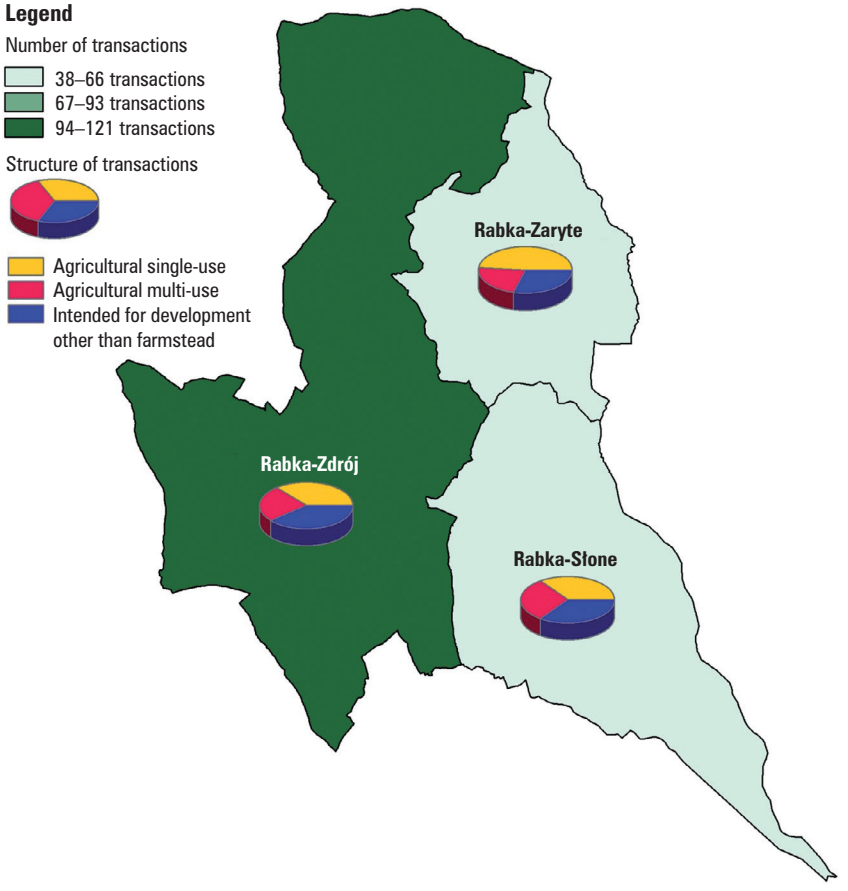
Fig. 1. The spatial distribution of transactions in undeveloped land

Three kinds of transactional properties can be singled out: multi-use agricultural land property, single-use agricultural land and properties intended for development other than farmstead. The structure of these transactions, according to their type, are shown in Table 2. The greatest increase of transactions has been noted in single-use agricultural, whereas multi-use agricultural land was least frequently traded, but the total area of these was the largest.

Table 2. The structure of transactions according to a type of land property

Type of real property	No. of transactions	Share in the market [%]	Area of sold land [ha]
Agricultural multi-use	44	22.11	17.5
Agricultural single-use	86	43.22	11.5
Indended for development other than farmstead	69	34.67	12.8

Source: authors' study



Source: authors' study

Fig. 2. Structure of transactions in undeveloped land properties

Thematic map (Figure 2) shows the number of transactions carried out in three zones of the city, depending on the kind of real property. The highest number of trans-

actions was conducted within Rabka-Zdrój, in the remaining zones: Rabka-Zaryte and Rabka-Słone the number of transactions was much lower. In Rabka-Zdrój the centre of the city is included, that is why the number of transactions in real properties intended for development other than farmstead was the highest. Within Rabka-Słone the most transactions were concluded in multi-use agricultural properties. In Rabka-Zaryte the agricultural single-use properties were sold the most.

The relation between unit price and the surface area of undeveloped land property was examined [Thorsnes and McMillen 1998]. This relation was defined for three types of properties. To this aim, the area of particular type of property was divided into equal class ranges and in each of them the prices were averaged out. Then for mean values a linear model $y = a + bx$ of relation between the price and the surface area was adjusted by the least square method described in the work of Bitner [2008]. The obtained values of model coefficients determined for each type of real properties are presented in Table 3.

Table 3. The values of coefficients in linear model $y = a + bx$

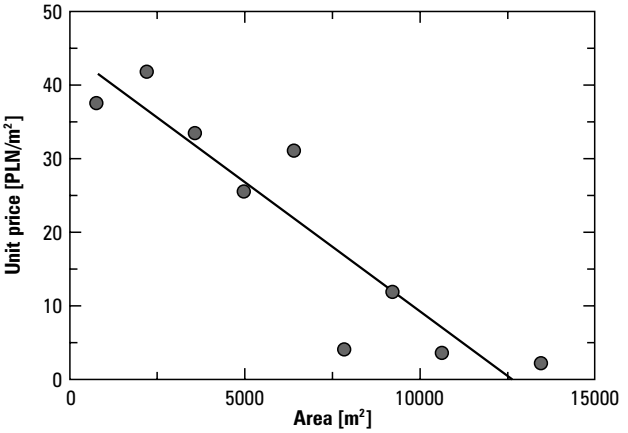
Type of real property	Direction coefficient b	Standard error of direction coefficient b	Constant term a	Standard error of constant term a
Agricultural multi-use properties	–0.0035	0.0006	44.23	4.51
Agricultural single-use properties	–0.0020	0.0021	37.92	6.40
Properties intended for development other than farmstead	–0.0125	0.0024	75.37	7.53

Source: authors' study

Relation between unit price and the area in case of three types of undeveloped land properties is presented in Figures 3–5, together with regression lines adjusted by the least squares method.

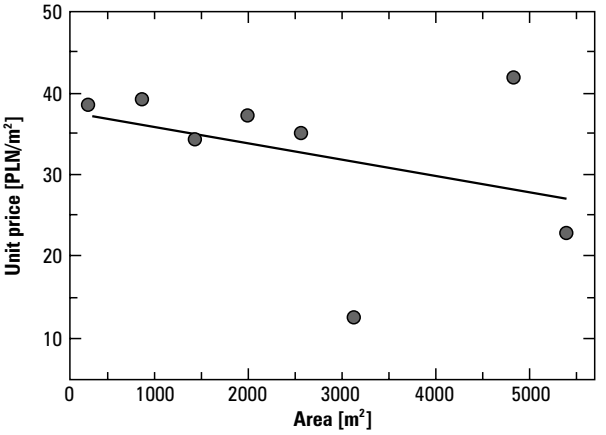
As Table 3 and the charts shown in Figures 3–5 prove, the surface area of transactional property has the greatest impact on the price of real property intended for development other than farmstead. Together with the increase of the surface area by one are, the price of this kind of property dropped by 1.25 złoty, while the mean unit price in the studied area was 5578 złoty per are. The least influence of the surface area on the price has been noted in agricultural single-use properties and it amounted to 0.20 złoty per are, while the mean price was 3596 złoty per are. In agricultural multi-use properties the unit price falls by 0.35 złoty per are with the increase of surface area by one are, the mean price was 3141 złoty per are. The scope of the surface area of agricultural multi-use properties reached the areas between 60 m^2 to 14156 m^2. When making corrections, the attention should be paid to errors of the model's determined direction coefficients. In agricultural single-use properties the direction coefficient error was 105%. Such high value of the error eliminates the obtained coefficient from practical

use and it resulted from wide diversity of prices in agricultural single-use properties of more than 30 ares.



Source: authors' study

Fig. 3. Relation between the price and area in agricultural multi-use real properties

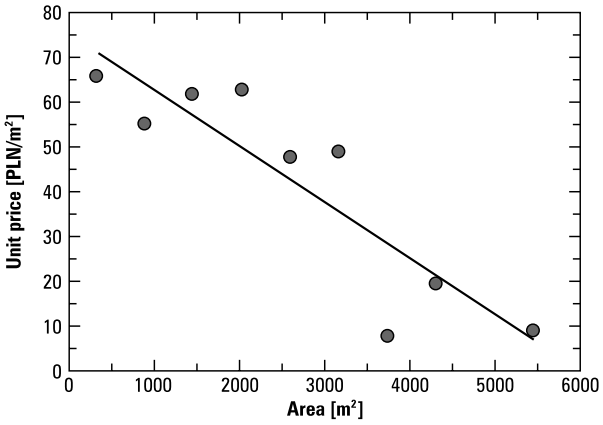


Source: authors' study

Fig. 4. Relation between the price and surface area for agricultural single-use properties

The quota corrections made with regard to an area of property, obtained from the analysis, were compared with the quota correction determined in Prystupa [2001]. The author used a representative sample of a few dozen of representative empirical data gathered from undeveloped real properties and to these data adjusted a linear model by the least squares method. The linear model of the relation between the unit price (Y) and the surface area of (X), measured in m^2, within the range from 0 to 10000 m^2,

has been described by the formula: Y = 233.1 – 0.012X. The direction coefficient of straights is a quota correction due to area of the property, which is 1.2 zloty per are. The numbers and the results of the analysis presented in Table 3 can therefore be compared.



Source: authors' study

Fig. 5. Relation between the price and surface area for properties intended for development other than farmstead

4. Conclusions

In the article the analysis of the undeveloped land property market has been presented. Statistical and cartographic methods were used. The study covered six years, from 2010 to 2015. The analysis covered the area of Rabka-Zdrój city. The base of selected data included 199 records. In the studied period the prices were stable. The spatial distribution of transactional real estate has been illustrated by a dot map (Figure 1). The highest number of transaction was completed in the central part of the city. The structure of transaction in three register surveying districts was presented by cartogram (Figure 2) and Table 2. It turned out that agricultural single-use properties were the subject of the highest number of transactions. The impact of plot's area on the unit price was examined by statistical methods. The results show that surface area is an attribute that has the highest influence on the price of property intended for development other than farmstead.

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