The Use of Cartographic Methods in the Analyses of the Rural Real Estate Market

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Abstract

The paper presents cartographic methods of analysis of the rural real estate market on the example of the commune Wąwolnica (Lubelskie Voivodship, Poland) located on the border of Kazimierz Landscape Park. The primary source of data is the register of notarial deeds of estate sales and purchases (in Polish: Rejestr Cen i Wartości Nieruchomości). The analyses result in presenting the phenomena and statistical indexes characteristics of local market. Besides basic values like mean price per cadastral unit or number of properties per property type, more complex computations in a form of interpolated statistical surfaces are included. The application of a cartographic method of research provides correlations of presented data and other features of the environment. The author stresses the meaning of proper cartographic methodology which is vital in the case of using Geographic Information System (GIS) software.

Keywords: real estate, property, maps, cartography, GIS, Wąwolnica

Subject and area of research

The real estate market is in the scope of interest of various professions. Its spatial diversity is caused by many different factors and is a subject of analysis. One of the essential tools used to present the spatial character of the phenomenon and to draw hypothesis regarding relations of the real estate market to other socio-economic and natural components of reality is a map. The research shows the possibility of using maps to present a local real estate market, its characteristics and price-shaping factors on the example of the commune of Wąwolnica.

The commune is located in the Puławy county, Lubelskie Voivodship. A diversified terrain, loess gullies of Nałęczów Plateau, natural and cultural values of Kazimierz Landscape Park and cities of Nałęczów and Kazimierz Dolny (forming, along with Puławy so-called "a touristic triangle") — all this justify defining a tourist potential of the commune as significant (not as high as of the neighboring communes however) and, what is important, regardless of the season.[1] The town of Wąwolnica itself is known as a religious and pilgrimage center. The commune has little industry — only a fruit processing factory is worth mentioning, as it takes advantage of a local farming type.

The commune is bordered to the west by the Kazimierz Dolny Commune, of which the administrative seat is a top tourist destination in Poland, while the surrounding villages undergo an intensive process of transforming old houses into temporary, summer residences of people from big cities. This is also a process visible in the Nałęczów Commune (Kacprzak 2009). It is located to the east of Wąwolnica and the town of Nałęczów, being a health-resort, is an interesting alternative real estate market for citizens of Lublin, looking for suburban properties in case they cannot afford estates just by the boundaries of Lublin. The little increase in the distance from a central settlement often causes a significant decrease of property prices, which can be seen in the example of

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1. See: Załącznik do uchwały Rady Gminy Wąwolnica Nr X/43/07 z dnia 30.08.2007 r. Strategia rozwoju gminy Wąwolnica na lata 2007–2015, przygotowana na zlecenie Urzędu Gminy w Wąwolnicy przez Agencję Wspierania Inicjatyw Lokalnych S.A., [@:] http://bip.wawolnica.pl/public/get_file_contents.php?id=223431.

these communes in the vicinity of Lublin, for example the Konopnica Commune (Nieścioruk 2015). Regardless of these changes in the character of villages, both Kazimierz Dolny and Nałęczów, as well as Wąwolnica, still are mainly agricultural communes, which is heavily based on the good and very good indicators of agricultural production space (Witek 1993). The paper contains analysis of the real estate market, comparing it with the situation in neighboring communes.

1 The data used

The commune consists of fifteen cadastral units (villages): Bartłomiejowice, Celejów, Huta, Karmanowice, Kębło, Łąki, Łopatki, Łopatki-Kolonia, Mareczki, Rąblów, Rogalów, Stanisławka, Wąwolnica, Zarzeka and Zgórzyńskie. The data used were obtained from the register of notarial deeds of estate sales and purchases (in Polish: Rejestr Cen i Wartości Nieruchomości) for Puławy County. The register contains detailed information on every single transaction, including a property number, price, parties, type of land-use, etc. The analysis includes a period of four years (2009–2012) and 142 records (excluding these with errors or incomplete data). The register, in text format, was manually converted into a spreadsheet table form and prepared to be used in GIS software on general (cadastral unit) and detailed (single property) levels. Besides this, public access data were used: vector files of boundaries of communes and cadastral units from the national registry of boundaries (PRG), property boundaries and numbers from the LPIS (system of property identification) and — as a background map — CC-BY-SA licensed OpenStreetMap data. The used programmes were: Excel, ArcGIS and CorelDraw.
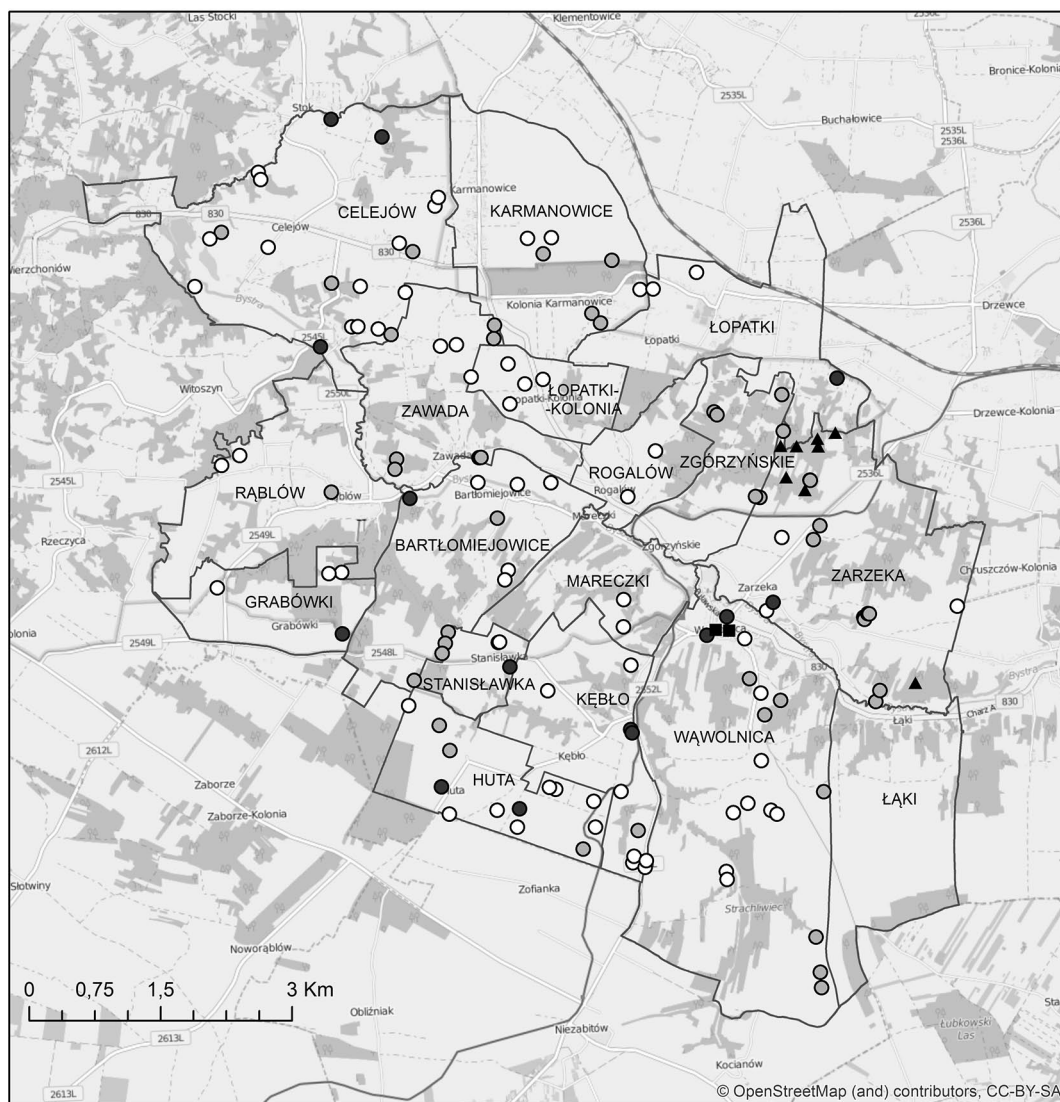
2 The analyses

The number of properties sold per cadastral unit (village) is listed in table 1 and their spatial distribution by property type can be seen in figure 1. The map uses simple geometric point symbols to locate a phenomenon. It presents a topographic localization and no symbol-with-symbol conflicts were resolved. The conversion from Digital Landscape Model (DLM — database model characterized by precise location according to coordinates) to Digital Cartographic Model (DCM), cartographic editing process included labels only, as they were often overlapping symbols and unit borders. The map shows the evident domination of agricultural single- and multi-use properties transactions. What is important is that most of these properties are located in field areas, away from built-up zones. Hence it can be supposed these transactions were done with agriculture purposes in mind, not with plans to convert them to property suitable for house construction. The other interesting observation is a concentration of forest properties in a single unit solely despite the fact of a high factor of forest fragmentation in the commune. The residential built-up properties were observed in Wąwolnica only, which is typical for communes with one settlement of city-type only.

The situation in neighboring communes is similar. Of 231 properties sold in Nałęczów Commune during 2009–2014, 168 (73%) properties were agricultural of a single- and multi-use type. In the

Tab. 1. Number of transactions (bought/sold) per unit during 2009–2012 period

Cadastral unit (village)	n	Cadastral unit (village)	n
Bartłomiejowice	11	Mareczki	2
Celejów	19	Rąblów	3
Grabówki	4	Rogalów	2
Huta	13	Stanisławka	3
Karmanowice	7	Wąwolnica	20
Kębło	10	Zarzeka	26
Łąki	0	Zawada	9
Łopatki	3	Zgórzyńskie	4
Łopatki-Kolonia	5		

Property type

○   single-use agricultural land   ▲   forest

◐   multi-use agricultural land   ■   built-up property

●   built-up agricultural land

Fig. 1. Properties included in the analyses

city of Nałęczów this proportion was lower, but still these properties formed the majority of those sold (56%). In the city of Kazimierz Dolny, consisting of seven, mainly agricultural cadastral units, 94 of 150 transactions (63%) involved single- and multi-use agricultural lands. Non-agricultural built-up properties were located in most cases in administrative centers of communes—Nałęczów and Kazimierz Dolny, while forest properties, as in the case of Wąwolnica transactions, took place on a small area and with very little number which could have been caused by the special character and little interest in this type of property (Pochwatka 2015; Stępniak 2016).

The overall view of properties on the market can be seen on figures 2 and 3. The former presents the number and the structure of transactions per unit, so it is a derivative of table 1, showing some additional information however. The biggest number of transactions was noted in Zarzeka, but—in the same time—over 25% of them regard forest properties. It is, as mentioned above, the only unit with such type of properties sold. In most of the remaining units, only agricultural properties were sold and bought with a different proportion of single- and multi-use properties. In three units (Rogalów, Mareczki, Łopatki-Kolonia) only single-use properties were sold, while
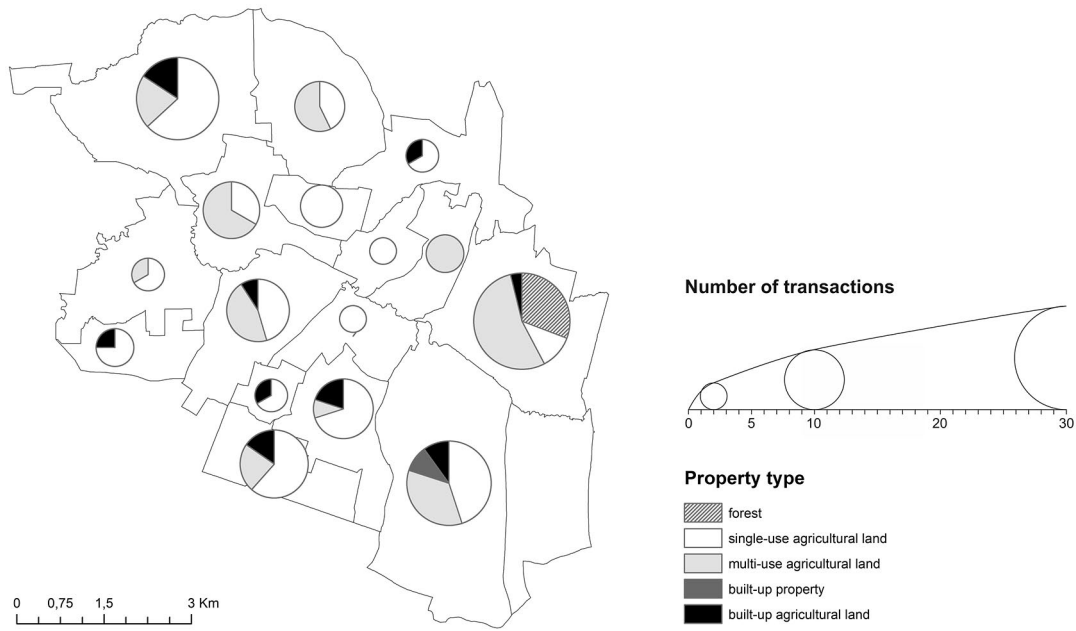
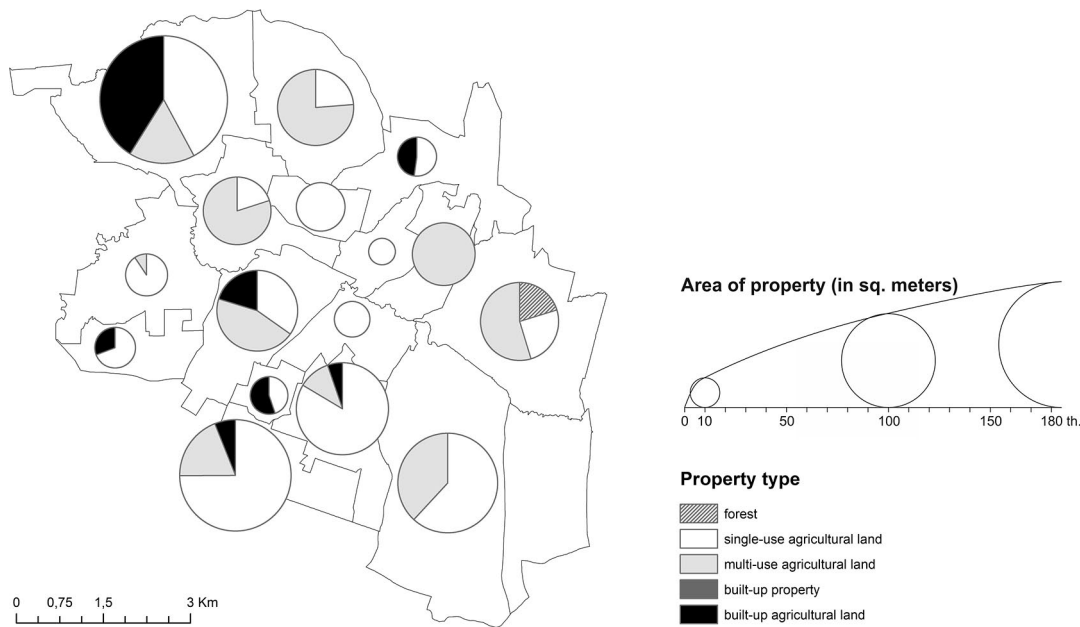**Fig. 2.** Number of transactions and property type per unit

Fig. 3. Property area and type per unit

in Zgórzyńskie—only multi-use lands were subjects of transactions. In the rest unbuilt agricultural properties formed a significant part or even 100% of transactions. The important part of the market was formed by built-up agricultural properties. They were sold in eight units, forming less than 25% in each however. Transactions of residential buildings were noted in Wąwolnica solely—the only city-type settlement in the commune.

Figure 3 shows transactions per unit and type as well, but not according to their numbers, but by an area of properties sold (in square meters). Such an approach changes the image of the phenomenon. The dominant unit is now Celejów, with the biggest area of properties sold. The other relations (in each unit) change as well. In Zawada the share of forest properties is smaller than in case of the map in figure 2. The southern and eastern units of Kębło, Huta, Wąwolnica and Zarzeka have smaller shares of built-up agricultural properties, with Zarzeka having less than 1% of them. The same situation can be observed in the case of built-up (residential) properties
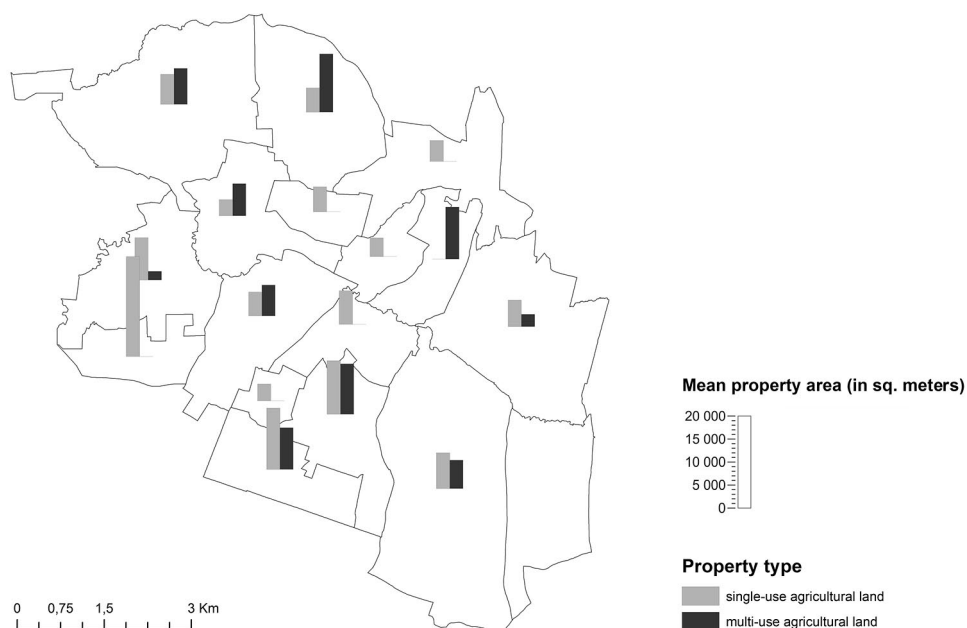
Fig. 4. Area of unbuilt agricultural properties per unit

Tab. 2. Agricultural properties data

Cadastral unit	Number of u.a.p.[a]		Mean area of u.a.p. (m^2)		Mean area of all prop. (m^2)	Mean price (PLN/m^2)	
	single[b]	multi[c]	single	multi		single	multi
Bartłomiejowice	5	5	25 900	33 500	4 406	0,97	1,98
Celejów	12	4	78 269	31 100	7 485	3,44	2,99
Grabówki	3	0	13 117	—	6 568	4,03	0,00
Huta	8	3	106 400	27 100	6 042	0,99	1,10
Karmanowice	3	4	15 700	50 500	4 970	1,89	1,35
Kębło	7	1	81 100	10 900	10 595	2,26	0,98
Łopatki	2	0	9 100	—	5 908	3,29	—
Łopatki-Kolonia	5	0	27 100	—	8 383	2,73	—
Mareczki	2	0	14 600	—	4 983	1,02	—
Rąblów	2	1	18 232	1 900	5 261	8,87	3,68
Rogalów	2	0	8 100	—	5 059	5,29	—
Stanisławka	2	0	7 300	—	4 657	8,22	—
Wąwolnica	9	7	69 998	43 109	4 292	4,59	1,24
Zarzeka	3	14	17 277	37 781	3 515	2,51	2,62
Zawada	3	6	10 500	41 900	5 485	11,49	4,16
Zgórzyńskie	0	4	—	45 220	6 542	—	2,05

[a]Number of unbuilt agricultural properties; [b]Single-use; [c]Multi-use

[In the journal European practice of number notation is followed — for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style). — Ed.]

in Wąwolnica. In a few units, proportions change with an opposite trend — the share of built-up agricultural properties increases (for example in the mentioned Celejów).

Both figures use the diagram method, with structural (pie-chart), cumulative diagrams. It is a method recommended for absolute data (such as a property number or area), but cartographers are not unanimous in this case (Korycka-Skorupa 2004, 13–14). The placement of a chart is done by the software and, in most cases, it has been done pretty well, with a proper diagram size. Single conflicts were solved in a satisfying way. The GIS software generates a completely useless legend for this method, hence additional works in a graphic manipulation software were needed.

Figures 1–3 show, as mentioned, the significant domination of unbuilt agricultural areas. According to this fact, the further analyses deal with single- and multi-use agriculture properties. Mean areas of unbuilt agricultural properties being a subject of transaction are shown on figure 4. It can be seen that there is no direct relation of a property type and its area. In units where both single- and multi-use properties were sold, no type was significantly larger (in Huta and Rąblów it was single-use and in Karmanowice and Zawada—multi-use). Mean areas of properties were diverse—from 1 900 m^2 to 21 700 m^2 with global average for the whole commune equal to 7 650 m^2. In each unit (with a single exception of one type in one unit) the mean area of agricultural property was much bigger than a mean area of property (regardless of type) in the unit. It is no surprise as the general average was calculated including even small private forest properties (such ownership is typical for forest areas in the commune) and small properties in villages, built up with houses. The detailed information can be seen in table 2. In the analyzed period of 2009–2012 the number of unbuilt agricultural properties sold was 117, which is almost 30 transactions per year (and including
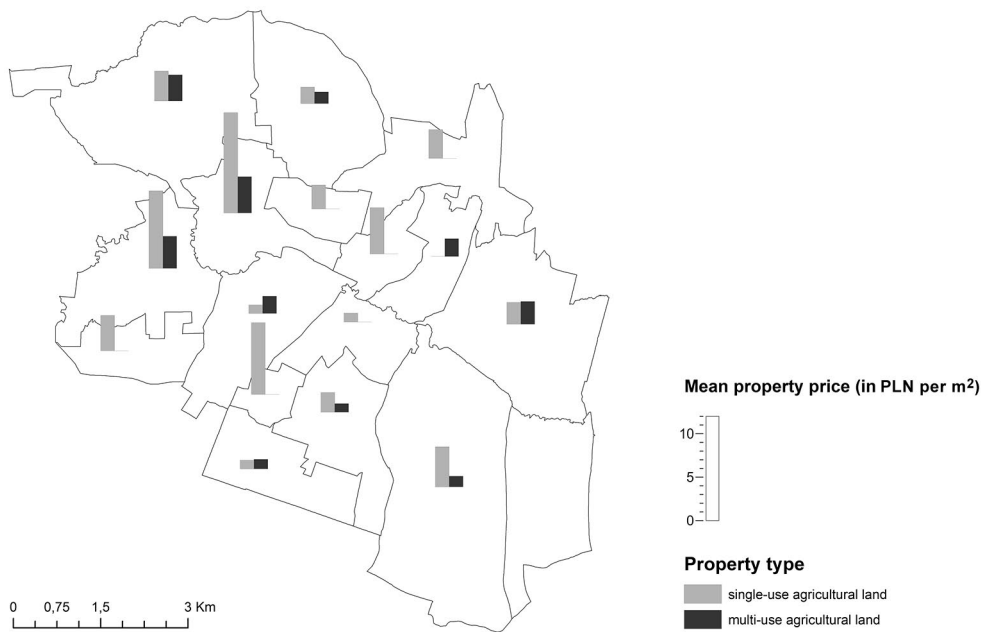

Fig. 5. Mean price of unbuilt agricultural properties per unit

Fig. 6. Mean price and area of properties per unit

forest properties raises this statistic to 125 in total). However, according to Motek (2009), during the period of 1995–2004 the number of unbuilt properties sold in Wąwolnica Commune was 65 per year. The big difference is mainly caused by the scope of research—the cited work analyses all properties with no buildings, according to their physical state, regardless of property types.

Figure 5 presents mean prices of both unbuilt agricultural properties types. In units with both types, single-use properties were, in general, more expensive (and the difference was easy to notice—even over 250% in case of Zawada for example). Only in the case of Bartłomiejowice the mean price of square meter for multi-use property was much higher (of only PLN 1, but it was almost 100%) while in Zarzeka and Huta the differences were insignificant (PLN 0,11). The figures 4 and 5 are diagram maps again, using—this time—bar charts. They show unique, absolute values with no structure as each type of data (type of property) is visualized with a separate bar. As in the case of pie-charts, the legend has to be updated manually in a graphic software.

It is worth taking a look at agricultural unbuilt properties regardless of their use. Figure 6 shows them using a diagram map again with bars corresponding to mean area of properties sold and bought per unit. An extreme value is noted for Grabówki (over 21 500 m^2 being a mean value of just three transactions). Not as high, but still significant are means for Huta, Kębło and Zgórzyńskie—over 10 000 m^2 each. The smallest mean value is observed for Stanisławka—only 3 650 m^2. On the other hand, the price of one square metre was the highest one here, even if calculated with two transactions only (PLN 8,22). This observation is pretty logical, as with the increase of an area, the price increases as well, but it is not equally proportional and price per area unit is smaller with the increase of total area of a property. The second characteristic (price) has been illustrated with a choropleth map with five equal classes of spread of PLN 1,5 per m^2. Use of this method is justified here as it is advised to use with relative values (Pasławski 2006, 215) and prices of lands are relative—it is a currency per area unit (PLN/m^2 in this case). The highest prices can be observed in the western part of the commune, especially in Rąblów (PLN 7,14 per m^2, based on three transactions) and Zawada (PLN 6,61 per m^2, nine transactions). The highest price is for Stanisławka. The lowest prices (PLN 1,02 per m^2) are in Huta (11 transactions) and Mareczki (2 transactions).

Comparing the mean values of unbuilt agricultural properties for Wąwolnica with prices in two neighboring communes, significant differences can be observed. In Nałęczów prices are much more diversified. In units forming Nałęczów city it is over PLN 25 per m^2, with over PLN 100 per m^2 in Nałęczów unit itself. In most of the remaining areas prices are between PLN 10 per m2 and PLN 25 per m^2 and lower in just a few (Stępniak 2016, fig. 12). A very similar situation can be observed in the units forming the city of Kazimierz Dolny. Even on its outskirts prices are much higher than in Wąwolnica—PLN 20–50 per m^2. Near the city center, in the cadastral unit of Kazimierz prices reach hundreds of złotys per square meter, with extreme of over PLN 2 000 per m^2 for one multi-use unbuilt agricultural property located less than 500 from the main city square (Pochwatka 2015, fig. 4.7 and 4.8). These properties, despite the official agricultural character, were very likely bought with other use in mind.

Wąwolnica is a commune with much lower prices. As a reason for such a situation, a few factors can be mentioned, with agricultural character of the commune and no typical city being the commune center being the most important. The town of Wąwolnica is of historical significance, but nowadays is not as popular as neighboring towns—the health resort of Nałęczów and Kazimierz Dolny overcrowded with tourists. It can be backed up by the data supplied by the Statistical Office. They show 80 870 overnight accommodations in Kazimierz Dolny, 52 265 for Nałęczów and none for Wąwolnica. Agrotourism is not included in these statistics, but it would not change the situation significantly (Sochacka 2011, tab. 18).

It is also worth mentioning that mean prices of properties in Wąwolnica increase toward the west. More research is needed however to answer if it is an accidental coincidence or the influence of Kazimierz can be seen here, especially in the case of agricultural properties. The fact of the high popularity of recreation properties in the Kazimierz Dolny commune is beyond discussion as transactions including properties outside the town itself occur in high numbers in recent times. The reason is so-called second home phenomenon—people living in big cities look for a calm, rural

area to buy real-estate for spending time there during weekends and/or vacations. The popularity of Kazimierz Dolny as a second home area among citizens of Lublin and Warsaw is even a topic in the mainstream media and popular thematic publications.[2]

With enough observations, it is justified to use an interpolation method to create a statistical surface. It is an approach quite often applied to a real-estate market to visualize the spatial diversity of prices (Cichociński and Dąbrowski 2013). In the analyzed case the number of transaction of unbuilt agricultural properties was over 100, hence the continuous data resulting from interpolation should present the data correctly. Figure 7 shows the result of inverse distance weighting (IDW) interpolation with power 2. Coordinates of unbuilt properties with price per meter were used as an input dataset. The resulting raster was trimmed to the commune boundary. The map

Fig. 7. Unbuilt agricultural properties price distribution using IDW method

Fig. 8. Unbuilt agricultural properties price distribution using topographic surface method

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2. See: Drugi dom — zbędny luksus czy inwestycja? (article published on 2012.11.04) [@:] http://poradnikbudowlany .eu/drugi-dom-zbedny-luksus-czy-inwestycja/#

shows the distribution of prices with no generalization in the form of average values per unit, so it contains more details. It can be observed that the cadastral units with the highest means (Rąblów, Zawada, Stanisławka) are characterized by non-extreme individual prices, but their distribution in unit is rather homogenous. A different situation can be seen in Wąwolnica or Celejów. In both units, high individual prices are observed (over PLN 20 per m^2) with a numerous transaction characterized by low prices (below PLN 3 per m^2 or even PLN 1,5 per m^2). It results in an arithmetic mean not showing the diversity, somehow "flattening" the image of the phenomenon. The concentration of higher prices can be seen, in general, in a central part of the research area. This zone is partly (especially for the highest prices) correlated with the main (voivodship) road, but it has to be noted that even very low prices appear in the vicinity of the road. However, these prices refer to properties not directly adjacent to the road, mainly fields with unpaved track access. The characteristic feature of the IDW method is a concentration of values around sample points. The created surface has unnatural peaks with concentric gradation of prices. The other interpolation method worth using is, often present in GIS programmes, the topographic method. It is basically used for the creation of topographic surface, but can also be successfully used when an elegant statistic surface with sample values kept is expected (Cichociński 2007).

The figure 8 shows the distribution of prices of unbuilt properties generated with the use of the topographic surface interpolation method. The image of phenomena is, compared to the IDW method, more "smooth," with less evident but still seen extremes and more separated zones. In addition, the relation of higher prices to voivodship road and local roads can be seen more clearly. The spline function algorithm used in this method results in extreme interpolated values exceeding minimum and maximum of the input. It can generate, especially in areas of no sample points, illogical values (e.g., negative prices). The problem can be solved by using a mask or by reclassification of the resulting raster. In the analyzed case, the distribution of sample points guaranteed interpolated values to be correct.

The influence of the road seen on figures 7 and 8 can be observed in the neighboring Nałęczów Commune too. The distribution of unbuilt agricultural properties prices shows the highest values in the city and west and east of Nałęczów, along the voivodship road no. 830 (the one crossing the Wąwolnica Commune). It is especially evident in units of Bochotnica, Bochotnica-Kolonia and Sadurki to the east and Charz A to the west (Stępniak 2016, 36–37). The less evident is the influence of the road no. 826, north of Nałęczów, but it has to be stressed that prices are not—what is obvious—formed by one factor only. It can be observed in the nearby city of Kazimierz Dolny, where distribution of highly diversified prices is much less correlated with a road network (Pochwatka 2015, 50–55). Additionally, the high differences in one type of property prices may suggest that in some cases they are bought with non-agricultural use in mind. With the high popularity of Kazimierz Dolny and tourist values of the region, such an assumption is justified, as these are the main factors in the purchase of a second home—a property used for weekend and vacation rest (Klimczak 2009).

Summary

The goal of this paper was a presentation of spatial and statistic characteristics of a real-estate market of a small, mainly agricultural commune located in the area of high tourist values. The main advantages of this paper are in its maps, clearly showing the analyzed phenomena. It must be stressed they were created with methodology and design rules in mind, which is important in the case of widespread use of GIS. It is a great and multi-purpose tool, hence it is often used by people of many professions with much diversified cartographic knowledge, so methodology and good design solution is of importance here. Ignoring the rules can lead to producing maps that seem to look good, but are hard to interpret or even misleading. The maps presented in this research can spark further analyses, asking questions and looking for answers, which has been partly done in the paper. The influence of spatial factors on property prices has been discussed, especially in the vicinity of other, more attractive areas in terms of a tourism commune and road accessibility. Besides this, the intention of buyers and further use of the land has been indicated.

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