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LAND PRICES AS AN INDICATOR OF THE RECREATIONAL SERVICES OF ECOSYSTEMS

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CENA GRUNTU JAKO WSKAŹNIK WARTOŚCI ŚWIADCZEŃ REKREACYJNYCH EKOSYSTEMÓW

STRESZCZENIE: Poza produkcją roślinną i zwierzęcą, tereny rolne dostarczają szeregu różnych świadczeń ekosystemowych. Jednymi z nich są świadczenia rekreacyjne i estetyczne. Do takich świadczeń na przykład należy możliwość spacerowania wzdłuż brzegów jezior lub podziwiania krajobrazu z punktu widokowego. Właściciele gruntów dostrzegają część z tych świadczeń i kapitalizują je w cenach transakcyjnych sprzedawanych działek. Niniejsze badania pokazują zmienność cen działek w zależności od odległości do atrakcyjnych miejsc wypoczynku, biorąc jednocześnie pod uwagę warunki techniczne położenia działki takie, jak obecność mediów, usytuowanie działki względem dróg i zabudowy, wielkość działki czy też decyzje administracyjne niezbędne do rozpoczęcia budowy. Przeanalizowano położenie 445 działek rolnych zlokalizowanych na terenie powiatu poznańskiego, które zostały sprzedane pomiędzy 01.01.2011 a 08.05.2012 r. Spośród czynników przyrodniczych mających wpływ na walory turystyczne danego obszaru największy wpływ na cenę działki okazała się mieć odległość od terenów zieleni urządzonej oraz stref brzegowych wykorzystywanych na potrzeby turystyki pieszej i rowerowej. Promień oddziaływania tych terenów to odpowiednio 3 i 2 km, a wartość metra kwadratowego działki maleje wraz z oddalaniem się od tych miejsc odpowiednio o 17 i 10 PLN na każde 1000 m.

SŁOWA KLUCZOWE: świadczenia rekreacyjne ekosystemów, ceny ziemi, tereny rolne, metoda cen hedonicznych, aglomeracja poznańska

Introduction

The uniqueness of agricultural land in context of measuring the ecosystem services is due to three facts. Firstly, agricultural land occupies a very large area. The World Bank estimates the share of agricultural land in the world as about 38,5%. In Poland, its share is 53%, which puts it on the 60th position in the world in this respect[1]. Secondly, there is a strong pressure on agricultural land, associated with destining it for housing purposes. This was particularly important in recent years, when there was a significant increase in the demand for plots destined for construction purposes, which in Poland is associated with the liberalization of regulations on spatial planning and on excluding agricultural plots from agricultural holdings. Growth of the agricultural land's area designated for non-agricultural purposes in the last 10 years[2] and thereby reduction of ecosystem services is a sign of high pressure on agricultural plots, especially in urban and suburban areas. Thirdly, an agricultural plot contains large numbers of very different ecosystems, including the typically agricultural land, but also water, forests, grasslands, etc, so these plots may provide many different ES. The most important of them are provisioning services such as food or fibre and recreational and aesthetic services like open landscapes of fields, lakes or network of hedgerows and wild ways. The first of the mentioned ES have market nature and can be relatively easily measured, for example by the crops height. However, recreational services do not have market nature, and their valuation usually takes place with the use of Stated Preference Methods, mainly through the Willingness To Pay method. Another way is to measure these services with the use of indirect means based on the Revealed Preferences. Travel Costs method is a method frequently used in this group[3,4]. The method, which accounts pleasure arising from the use of environmental goods, is called the Hedonic Pricing Method. It is most commonly used to estimate economic benefits or costs associated with environmental amenities, such as aesthetic views. One of the economic benefits measure is the value of land intended for construction works[5]. On the one hand, this approach seeks to determine to what extent does the property's value depend on environmental conditions, and on the other to evaluate how much are we willing to pay for the environment's improvement[6].

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[1] The World Bank, 2009 http://data.worldbank.org/indicator/AG.LND.AGRI.ZS [Date of entry: 12-09-2012].

[2] *Ochrona* Środowiska, GUS, Warszawa 2011, p. 110.

[3] J. Bergin, C. Price, *The travel cost method and landscape quality,* „Landscape Research" 1994 No. 19, p. 21-23.

[4] M. Czajkowski, M. Giergiczny, J. Kronenberg, P. Tryjanowski, *The economic value of a White Stork nesting colony: a case of 'stork village' in Poland,* „Working Papers" 2012 No. 11(77), p. 1-19.

[5] S. Ma, S.M. Swinton, *Valuation of Ecosystem Services from Rural Landscapes Using Agricultural Land Prices*, „Ecological Economics" 2011 No. 70(9), p. 1649-1659.

[6] T. Bajerowski et al., *Ocena i wycena krajobrazu: wybrane problemy rynkowej oceny i wyceny krajobrazu wiejskiego, miejskiego i stref przejściowych*, Educaterra, Olsztyn 2007 p. 85-86.

The direct and indirect methods are often combined[7,8]. In this research, the author used the Hedonic Pricing Method for the following purposes: 1) comparison of Poznań district municipalities in terms of number and size of purchase and sale transactions for agricultural plots held for development and its equipment in the utilities, 2) identifying the tourism's most important natural values affecting the price of a plot, 3) determining the size of relation between tourism's natural conditions and the plots' price as well as interpolation of results in Poznań district's area. The research results may be helpful in determining the agricultural plots' use in the Study of the Conditions and Directions of the Spatial Management of the Commune and in the Local Spatial Management Plan (LSMP). It can also be used as a tool in setting guidelines for Environmental and Financial Impact Assessments of a Plan.

Methods

The plot's transactional prices along with the plot's area and the information about the presence of Conditions of Development and Spatial Management, Building License or Local Spatial Management Plan for the plot have been made available by the District Centre for Geodetic and Cartographic Documentation in Poznań. Other technical data of the plots, including equipment and information on the neighborhood was obtained from the iGeoMap system. The plots chosen for analysis had to meet the following conditions: 1) appear in the land and buildings register as agricultural, 2) were sold between 01/01/2011 and 05/08/2012, 3) were covered by the numerical version of Master Map, 4) the buyer's share amounted 100%, 5) their purpose was building development. Data on recreational and aesthetic values in the Poznań district was received from the team that developed this information for the Illustrated Atlas of the Poznań Agglomeration[9]. Spatial analysis and price interpolation for the 445 agricultural plots was performed in ArcGIS 9.3.1 program, and statistical analyzes were performed with the use of Statistica 10 software. The relation between the plot's transactional price and the technical and recreational conditions was analyzed with the use of multiple regression method.

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[7] T. Cameron, *Combining contingent valuation and travel cost data for the valuation of nonmarket goods*, „Land Economics" 1992 No. 68, p. 302-317.

[8] A. Fleischer, Y. Tsur, *Measuring the Recreational Value of Agricultural Landscape,* „European Review of Agricultural Economics" 2000 No. 27(3), p. 385-398.

[9] S. Bródka, *Walory przyrodnicze turystyki*, in: *Studium Uwarunkowań Rozwoju Przestrzennego Aglomeracji Poznańskiej*, ed. T. Kaczmarek, Centrum Badań Metropolitarnych, Poznań 2012, p. 168-171.

Results

The square meter value for an average agricultural plot destined for building development in the Poznań district equalled 164 PLN, and its average area was 1970 m² (Table 1). The research has shown that the Decision about Conditions of Development and Spatial Management as well as the plot's allocation within the LSMP had no significant effect on the plot's price. Large differences in prices were observed in the case of land's equipment in the utilities, especially sewerage, gas and electricity. The price of plots equipped with those utilities was about 60 PLN/m² higher.

Table 2 shows the average transactional price of land, along with the number of analysed transactions in Poznań district municipalities. It shows that the highest prices were reached by agricultural plots in Luboń urban municipality, i.e.

Table 1.

Average, minimum and maximum values and standard deviation for indexes describing the technical and recreational conditions of plots traded in the Poznań district in the period between 01.01. 2011 – 08.05.2012

	Unit	Mean	St. dev.	Min./No	Max./Yes
Sales price	PLN/m²	164,1	102,7	0,16	833,3
Technical conditions					
Plot's area	m²	1970,1	3746,2	100,0	36600,0
Local Spatial Management Plan	Y/N	-	-	159,0	170,0
Decision about Conditions of Development and Spatial Management	Y/N	-	-	166,0	162,0
Proximity of buildings and roads	Y/N	-	-	138,0	178,0
Water supply	Y/N	-	-	139,0	178,0
Sewerage	Y/N	-	-	147,0	216,0
Gas	Y/N	-	-	130,0	191,0
Electricity	Y/N	-	-	124,0	184,0
The tourism's natural values – the distance to the nearest:					
Vantage point	m	6396,9	4114,3	314,0	17881,4
Cultivated greenery	m	1639,9	1121,1	154,8	6757,7
Lake shore or river used for:					
Cycling and walking	m	4386,2	2386,3	19,4	11412,0
Sunbathing and swimming	m	4713,1	2517,0	34,3	11664,5
Lake	m	864,2	546,0	31,8	2926,4
Lake with high recreational and scenic qualities	m	5042,7	2725,5	34,3	11572,1
Forest	m	683,6	555,2	0,0	2554,2
Forest with high recreational and scenic qualities	m	1345,3	1026,9	14,5	4475,5

Source: Author's own study.

271 PLN, and in Komorniki rural municipality, i.e. 242 PLN. The plots situated in the eastern part of the district had the lowest prices. In Czerwonak, Pobiedziska, Kleszczewo or Kostrzyn municipalities, the prices did not exceed 150 PLN/m². Swarzędz municipality, where prices were significantly higher than average, was an exception in this part of the district. Considerable variations in terms of the municipalities' plots for development preparation can be observed. The average share of plots with LSMP or with basic utilities is slightly more than 50%, and the share of sold plots with direct access to both, electricity and water supply, as well as gas and sewage system was 22%. In this respect, the situation is worst in the Murowana Goślina municipality, and the best in Komorniki municipality.

Table 2.

Number of analyzed transactions, agricultural plots average transactional prices and shares of the plots with LSMP and basic utilities in Poznań district's municipalities during 01.01.2011-8.05.2012

Name of municipality	Number of plots analyzed	Average price [PLN/m²]	Share of the plots with LSMP [%]	Share of the plots with basic utilities[a] [%]	Share of the plots with all utilities[b] [%]
Buk	0	-	-	-	-
Czerwonak	4	103,1	50,0	25,0	0,0
Dopiewo	86	173,8	48,8	67,4	0,0
Kleszczewo	34	110,3	94,1	64,7	0,0
Komorniki	48	241,8	70,8	79,2	66,7
Kostrzyn	19	147,7	63,2	63,2	15,8
Kórnik	42	119,2	38,1	28,6	9,5
Luboń	28	270,5	35,7	50,0	25,0
Mosina	58	107,3	31,0	34,5	15,5
Murowana Goślina	12	144,4	25,0	25,0	0,0
Pobiedziska	14	104,6	42,9	50,0	0,0
Puszczykowo	4	208,4	100,0	50,0	50,0
Rokietnica	19	167,9	47,4	78,9	63,2
Stęszew	13	136	0,0	53,8	46,2
Suchy Las	17	146	88,2	29,4	0,0
Swarzędz	34	200,6	14,7	55,9	14,7
Tarnowo Podgórne	13	185,2	76,9	53,8	38,5
Average	26,2	160,4	51,7	50,6	21,6

[a] electricity and water supply, [b] electricity, water supply, sewerage and gas

Source: Author's own study.

Multiple regression results analysis allowed to identify the factors affecting the land's prices. Table 3 shows that, among technical conditions, the plot's area and its equipment in the sanitary sewage system as well as electricity has the greatest impact on land's transactional prices. Along with the plot's area increase, its price is reduced by 3 PLN for every 1000 m². Bringing sewage system to the plot's border increases its price by 46 PLN, and by 36 PLN in case of water supply. Among the tourism's natural conditions, distance to cultivated greenery and coastal areas used for hiking and cycling had the greatest importance for the vacant plots' price shaping. The first of those features reduced the plot's value by 17 PLN and the next by about 10 PLN for every thousand meters distance from it.

Table 3.
Influence of the qualities of agricultural plots traded within the Poznań district during 01.01.2011-8.05.2012 on their price, basing on the multiple regression analysis

|	Coefficients	Standard error	p-value
Intercept	118,91[a]	20,032	0,000
Technical conditions			
Plot's area	-0,003[a]	0,001	0,007
Local Spatial Management Plan	-4,639	9,600	0,629
Decision about Conditions of Development and Spatial Management	13,902	10,070	0,168
Proximity of buildings and roads	16,183	11,716	0,168
Water supply	2,159	13,966	0,877
Sewerage	45,516[a]	12,365	0,000
Gas	15,567	12,263	0,205
Electricity	35,746[b]	14,091	0,012
The tourism's natural values – the distance to the nearest:			
Vantage point	0,000	0,001	0,920
Cultivated greenery	-0,017[a]	0,004	0,000
Lake shore or river used for:			
Cycling and walking	-0,010[a]	0,003	0,000
Sunbathing and swimming	0,008	0,005	0,112
Lake	0,008	0,009	0,374
Lake with high recreational and scenic qualities	-0,001	0,005	0,892
Forest	0,019	0,010	0,067
Forest with high recreational and scenic qualities	-0,002	0,006	0,731
N = 445			
Adjusted R-square = 0.2			

[a] Significant at 1% level; [b] Significant at 5% level,

Source: Author's own study.

High spatial aggregation of land similar in price provided ground for variogram based research. It related to the changes in land prices differentiation in dependence on their distance from each other. The research shows that the influence of one plot on another is visible in the distance of up to about 800 m (Figure 1). Basing on a semivariogram, kriging method was used to estimate the market value of plots in Poznan district. Figure 1 shows that the highest land prices, exceeding even 400 PLN/m², should be expected near the south-western border of Poznań, in Luboń, Komorniki, Wiry, Sady, Plewiska and Skórzewo. The impact of other urban centres, such as Stęszew, Mosina, Kostrzyn, Swarzędz or Kórnik, on the price of plots is relatively small in comparison with Poznań.

Figure 1.

Spatial distribution of traded plots and their interpolation in the Poznań district. Below: semivariogram showing the relation between the distance between parcels of land (X-axis) and the differentiation of their transactional prices (Y-axis)
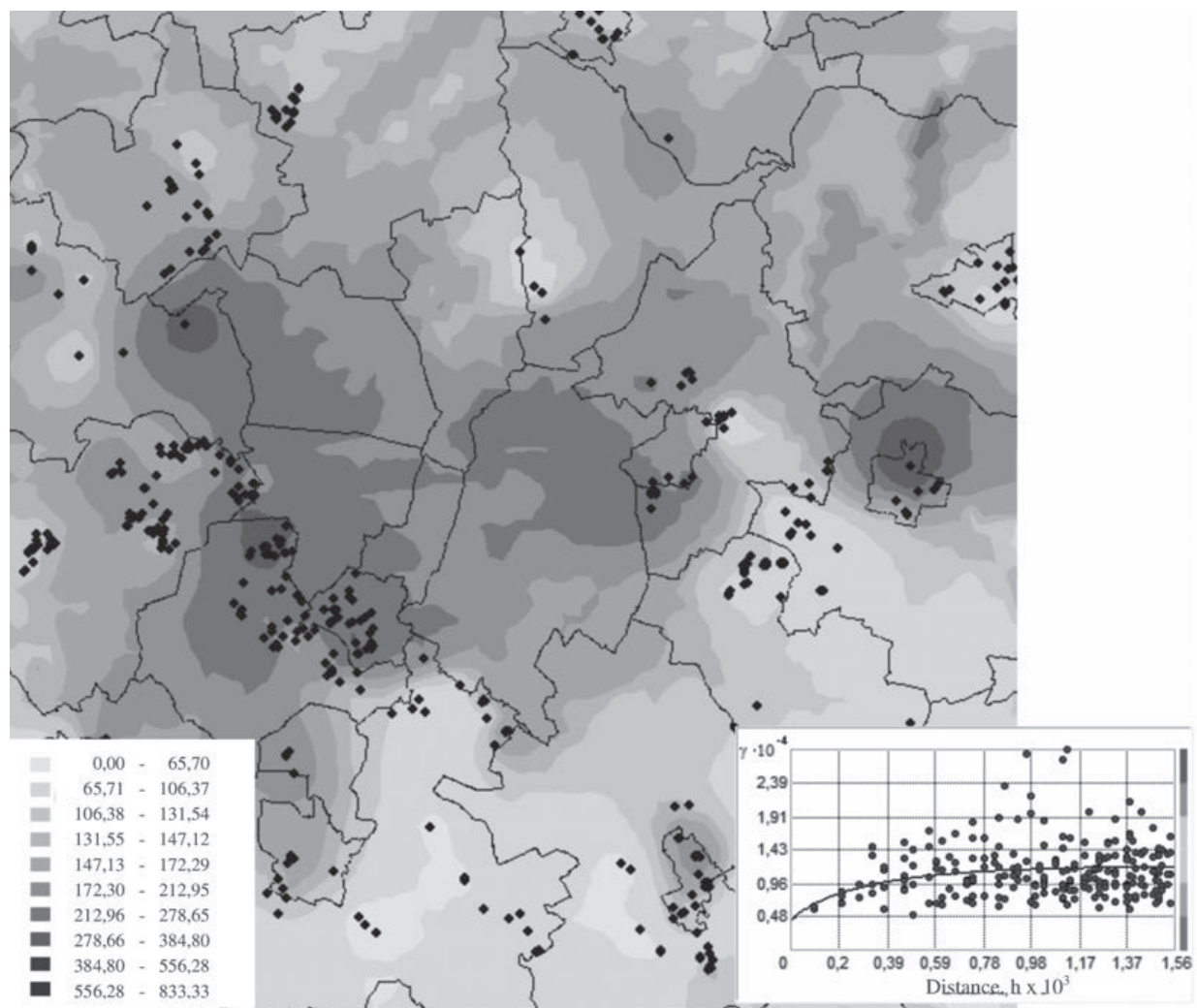
Source: Author's own study.

Figure 2.
Spatial distribution of cultivated greenery areas and projected plot prices resulting from those areas proximity. Below: semivariogram showing relation between the distance between parcels of land (X-axis) and the differentiation of their transactional prices (Y-axis) in proximity of greenery areas
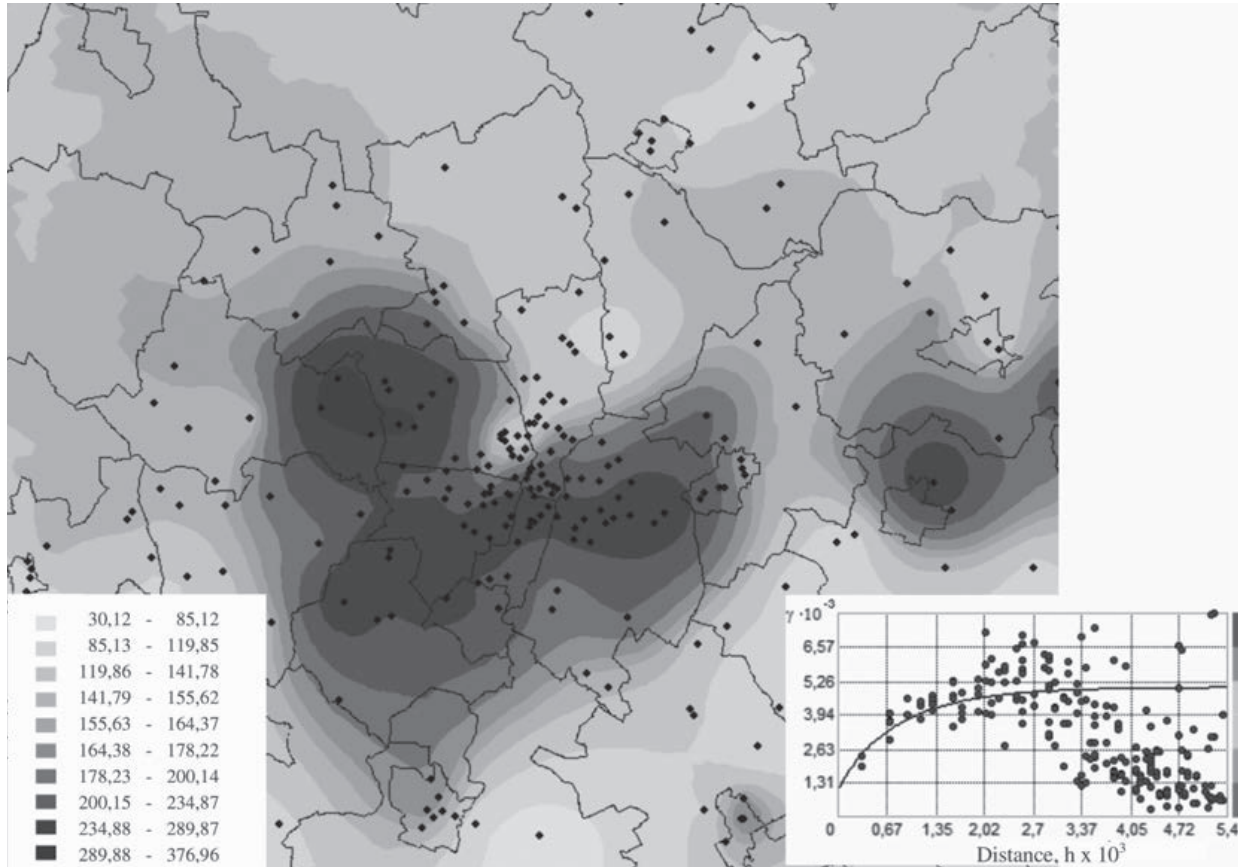
Source: Author's own study.

In the later stage of research, the relation between plot prices and the distance between them in the proximity of cultivated greenery, including urban parks, didactical gardens and allotments, was evaluated, basing on kriging, with the use of moving-windows method. Semivariogram analysis showed that the zone of those areas effect on plot prices equals over 3000 m (Figure 2).

Discussion and conclusions

The poor environmental conditions in large cities and the increasing wealth of Polish citizens have growing effects on the people's decision on changing their place of residence. One of the criteria for selecting a place in those circumstances is the active recreation possibility in the immediate surroundings. The statistical relation between the recreation areas' distance and the plots' transactional price shows that, for example the ability to walk or ride a bike in a relatively slightly transformed rural landscape is calculated into the plot's price at the moment of purchase. However, the calculations for this area are rather intuitive, since there is no methodology for the integration of environmental amenities in the process of property's valuation. Environmental conditions resulting from the legal status of valuated land, or value reduction caused by the environmental factors, such as noise or chemical pollution are currently, taken into consideration above all[10]. The research results described in this article are intended to strengthen the argumentation for the need of accounting the landscape values in the municipalities' spatial policy. On the one hand, those advantages result from maintaining the environment and landscape conditions on a satisfactory level, and on the other from providing those goods in a way that ensures permanent preservation of their values. According to Wańkowicz[11], finding balance between protections of the high landscape valued areas and making them available is the essence of spatial planning. Basing on the results of this study it can be concluded that the natural values do not have such a great impact on the real estate prices in Poznań agglomeration, as the recreational values. Hence spatial planning on the suburban areas should be particularly focused on protecting environmental amenities. The results of this research show, however, that such protection is not present. It is especially true for the legally binding land use in local land management plans and the land basic utilities equipment.

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[10] *Standardy zawodowe Polskiej Federacji Stowarzyszen Rzeczoznawcow Majatkowych*, wyd. 8 poszerzone, Warszawa 2004.
[11] W. Wankowicz, *Planowanie przestrzeni o wysokich walorach krajobrazowych, problemy ekonomiczne*, in: *Krajobraz a turystyka*, ed. Wiaczeslaw Andrejczuk, Prace Komisji Krajobrazu Kulturowego No. 14, Sosnowiec 2010, p. 352-359.