

ANALYSIS OF TRANSACTION PRICE OF UNDEVELOPED REAL ESTATE OF KOŁOBRZEG WITH THE USE OF GIS TECHNOLOGY

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Summary

The expansion of geographic information systems contributes to the development of an information society that increasingly uses geoinformation data in all areas of life. GIS also enters the economic and scientific realm of the real estate market, slowly displacing analogue price registers and real estate values. With the use of GIS tools, many issues in this area (e.g. sales / purchase, rental, average sales prices) can be presented on maps, and the wide database provides many possibilities for carrying out a variety of analyses.

The aim of this article is to use the selected GIS technology to analyse the value of real estate in Kołobrzeg. Using the secondary data from the price and property register spanning the years 2013–2016 the value of undeveloped land has been analysed. The analysis was presented by two different methods: cartodiagram and cartogram, and then the results were compared and interpreted. The maps that were developed during the process of analysis provide accessible information about the distribution of real estate values for property valuers as well as potential buyers and sellers.

Keywords

undeveloped land • real estate market • GIS • analysis • geovisualisation

1. Introduction

GIS applications for real estate market started to be used around the world in the early 80's [Thrall 1998]. In Poland however the use of GIS for analysis of the real estate market has only started getting attention a few years ago. On one hand it is the result of a short-term free-market tradition (whose formation only began in the 1990s) and on the other hand the analysis carried out in the field, prior to this period, was mainly based on statistical-econometric methods. Taking into consideration that the property is spatial in nature and it can be presented on the map, while displaying its traits and attributes, it is well justified to apply GIS technology for this purpose [Całka and Bielecka 2014, Branna et al. 2012, Ciechoński and Parzych 2005]. GIS technologies not only facilitate visualisation but also make full use of the information contained in databases. This is

the main cause of the statistical and econometric methods to be supported by GIS functions which together form the so-called spatial statistics and spatial econometrics that can successfully be used in analyses of real estate markets [Anselin 1998]. GIS provides location and topological requirements, providing information for spatial statistics and the ability to analyse and model econometric data [Can 1998]. Geovisualisation is a way of presenting geospatial information that facilitates thinking, understanding, and contributes to building knowledge about the environment and creating visualisations of phenomena related to the natural and anthropogenic environment [MacEarchen 2004]. Presenting the topic with the use of geovisualisation can become an activity supporting the development of future analyses such as investment planning as well as spatial planning.

Real estate market research is carried out periodically by the government agencies responsible for construction, planning and spatial planning and housing [Law 1997]. The particular focus of this research is aimed at the real estate sector used for residential purposes. The possibility to carry out a thorough and proper market analysis leads to a proper and precise valuation survey. The valuation survey is a document, a property valuer's estimation of the value of a property and as such it is generally used by people intending to invest in a given property or willing to take a mortgage. Knowing the value of land is a very important element in spatial planning. It affects the land's purpose and its usage [Gwamma and Wan Yusoff 2015]. Those interested in real estate development in particular are the following: the investors, the real estate developers, the real estate agents, the property valuers, local governments and people wishing to invest into real estate [Zydroń 2011]. Highly developed cities mainly rely on large transactional datasets to assess land values. These datasets include property attributes such as location and the property purpose in the local spatial planning as well as technical infrastructure available, all of this data is very helpful to potential investors and developers [Kolowe 2014]. The evaluation method creates a correlation between the sale price (property value) and the attributes of real estate that are estimated [Wakaba Gatheru and Nyika 2015]. It is possible for the features included in the evaluation of a property such as the location to be depicted and presented as a map. The map is the result of the final cartographic modeling, which can serve in subsequent stages of data processing and subsequent analysis. Such visualisation or graphical representation of a particular location is more accessible to the recipient than tabular data that is most often found in real estate data registers (Figure 1).

The above image shows a significant difference in data visualisation. Presenting the data using a table setting does not carry meaningful information to neither the prospective buyer nor the property values. Presenting data in graphical form (such as maps) is more accessible to the recipient who is able to locate the object (here depicted a land property) with relative ease. Based on the presented reasoning it is plausible to conduct real estate value analysis for a given area (Kołobrzeg) utilizing the GIS technology. Any potential buyer of the land property using the data provided by GIS such as exact location of the real estate [Wakaba Gatheru and Nyika 2015] could invest their equity in order to make a profit. The value of undeveloped land is influenced by many

factors such as location, size, destination in the local spatial development plan, state of development or environmental conditions [Kucharska-Stasiak 2001]. The location of Kołobrzeg, due to its proximity to the sea, makes attractive the plots of land both near the shore and away from it. Research has shown that the value of undeveloped land near the sea doubles the price of a property. Undeveloped real estate market in the town of Kołobrzeg is very specific mainly owing to the town's location. It is safe to conclude that proximity to the sea location influences the real estate market immensely.



b)

No.	Plot number	Transaction date	Unit price 1 m ²	Precinct
1	550	2015	151,27	16
2	551	2015	155,32	16

Source: authors' study

Fig. 1. Comparison of objects presented in the form of spatial data (a) with information presented only in tabular form (b)

2. Characteristics of the research area

The real estate evaluation was carried out for the coastal town of Kołobrzeg. It is situated in the north-western part of Poland, in the West Pomeranian Voivodeship (Figure 2b), and covers an area of 25.67 square km. It is one of 45 health resorts in Poland and is abundant with natural resources: mud deposits, mineral water sources. The proximity

of the sea increases the number of tourists and visitors. The city is subdivided into 20 register divisions (Figure 2a), of which 8 are directly adjacent to the shoreline. One of the important features of Kołobrzeg is the status of the spa town, which was granted in 1972 [Uchwała 1972]. The boundaries of the spa are administrative boundaries of the town of Kołobrzeg. The town has commercial, fishing, yachting and passenger ports [Studium 2013]. The attractiveness of Kołobrzeg is appreciated by developers, who make a lot of investments in the city, building hotels, resorts and apartments which are popular investment not only for the inhabitants of the city but also for other people from all over Poland.



Source: authors' study

Fig. 2. Location of Kołobrzeg displaying its boroughs (a) and general location against the backdrop of Poland (b)

The town of Kołobrzeg, owing to its location, creates good conditions for an investor who intends to invest his money in a land property or apartment. Investing in real estate market is generally a long-term endeavour. The main benefit of investing in real estate is primarily the relative durability of such investment in place and time [Gołąbeska 2011]. The location of the town in the seaside area provides such investment opportunities to both residents and businessmen.

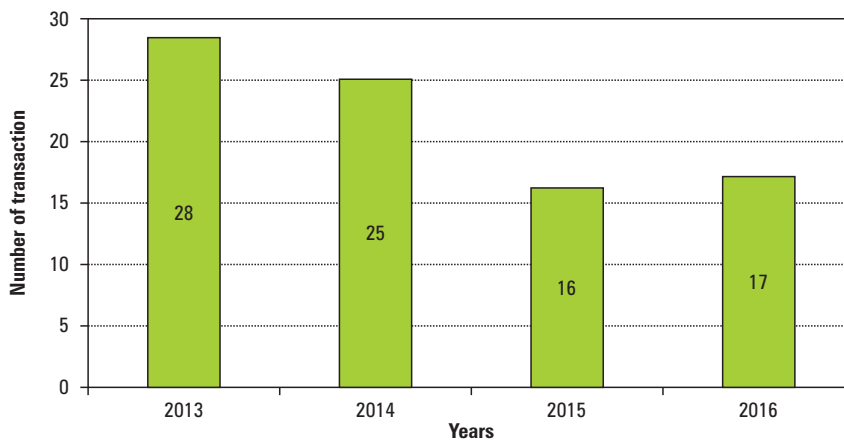
3. Data

Property is a part of the land surface (land) as well as permanently connected buildings or parts of such buildings where, under special provisions, they are separate property from the land [Ustawa 1964]. Based on this definition, there are three basic properties:

- land property – land with components, excluding buildings and premises if they are a separate property [Ustawa 1997, art. 46],
- buildings, if under special provisions separate land property [Ustawa 1997, art. 235],
- residential property – independent residential property as well as other purpose property, which constitutes a separate property [Ustawa 1994].

The analysis was carried out for the price of undeveloped land. The demand for this kind of property in the town of Kołobrzeg is very high. The land has an exquisite value. It has special physical characteristics such as: complexity, permanence, durability, diversity, indivisibility [Kucharska-Stasiak 2006]. The data for research was obtained from the Register of Prices and Values of the District Real Estate Office (RCiWN) in Kołobrzeg. For the purposes of the analysis, the transactions included in the period 2013–2016 were taken into account – in this period, the city's substantial development of technical infrastructure not only in the city centre and in the coastal area, but also in neighbouring inland areas was noted and highlighted. The areas not covered by the local spatial development plan contributed to the decrease or increase in the value of undeveloped land. Many new car parks as well as roads connecting the western and the eastern part of the town have been built. The Port-Kołobrzeg orbital motorway was completed which lessened the traffic and had a positive impact on most residential areas where residential investment is taking place and since there are still many undeveloped properties there, the potential investors have more opportunity to make profitable investments.

From the acquired data, real estate's with an area of 300,00 m² to 1400,00 m² and those which can be used for residential, service and recreational development were selected. In the years 2013–2016 there were nearly 60 transactions of sale of undeveloped land, which met the established criteria (plot size). In 2013 there were 28 transactions, in 2014 there were 25 transactions, in the following years there were 16 and 17 transactions respectively (Figure 3).



Source: authors' study

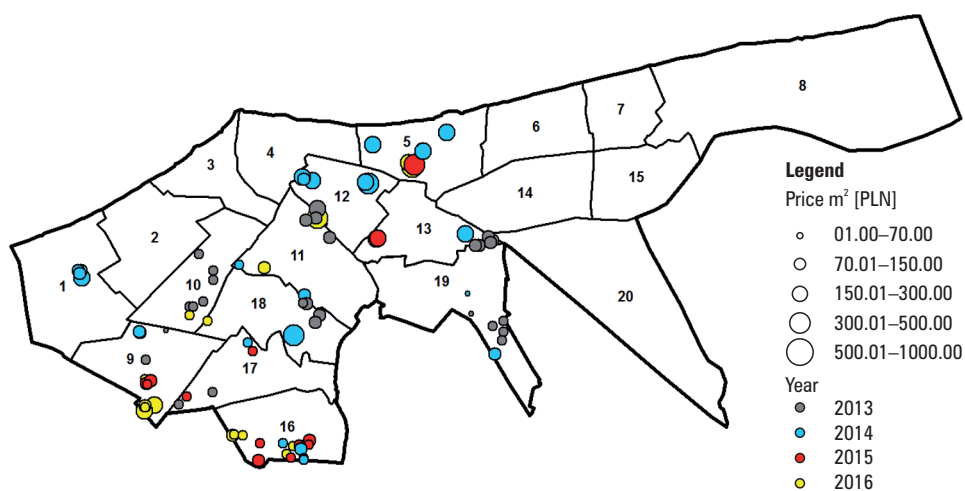
Fig. 3. Number of land sale transactions in 2013–2016

Two main basic datasets used by property valuers in their evaluations are: price and market value of real estate [Bydłosz et al. 2010]. However, the price is recognized as a conditional measure of the value of the goods assigned to them by the particu-

lar buyer or seller in the actual circumstances [Wycena 2005]. E. Kucharska-Stasiak emphasizes that value should not be equated with price nor the price should be equated with value [Kucharski-Stasiak 2001]. RCiWN introduces data to the system from notarial deeds and the value of real estate from the estimates made by property valuers. Transactions conducted in the local market are subject to error, a defect that arises on the day of signing the notarial deed. Properties are often undervalued due to the existence of VAT [Kowalski 2012]. Detailed studies may contribute to carrying out analyses which could detect the trends of undervaluing or overvaluing an investment in a land property.

4. Spatial analysis of the investigated transactions

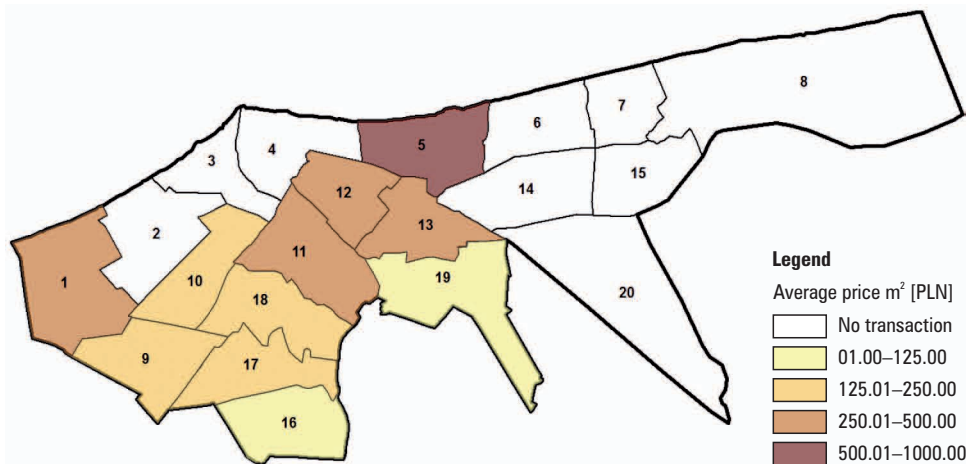
There are many methods of cartographic presentation of data. In the traditional division there are two types: qualitative – to represent objects and phenomena in nominal and order scale and quantitative – to present numerical data [Ratajski 1989, Kowalski 2013]. Because the data describing the value of real estate of undeveloped land can be treated as a measurable feature of an object, hence to present the value of the real property of undeveloped land in a specific area (Kołobrzeg), the cartogram and cartodiagram were used. The cartographic method was used to present the value of the property using the scaled circles (Figure 4). The magnitude of the figure (the radius of the circle) maps the magnitude of the phenomenon. These objects (values of undeveloped plots in determining the price of real estate presented in PLN per m²) were assigned circles of variable sizes divided into five classes. In addition, the symbols were given a variable colour to assign the time value. This allowed the spatial location of the non-developed land, including the price and the year in which the transaction was made.



Source: authors' study

Fig. 4. Distribution of undeveloped land value

The number of transactions and observed prices allowed to determine the average price of land measured in PLN for $1 \cdot \text{m}^{-2}$ for individual boroughs of Kołobrzeg (Figure 5). This phenomenon was presented using a cartogram. This is a method of presenting the phenomenon with reference to a particular reference unit. In the case of maps showing real estate values, such units with a specific spatial delimitation may be: plot, administrative division or any other zone [Cafka and Bielecka 2014]. In this paper, the average prices of undeveloped land properties were presented in relation to the boroughs of Kołobrzeg.

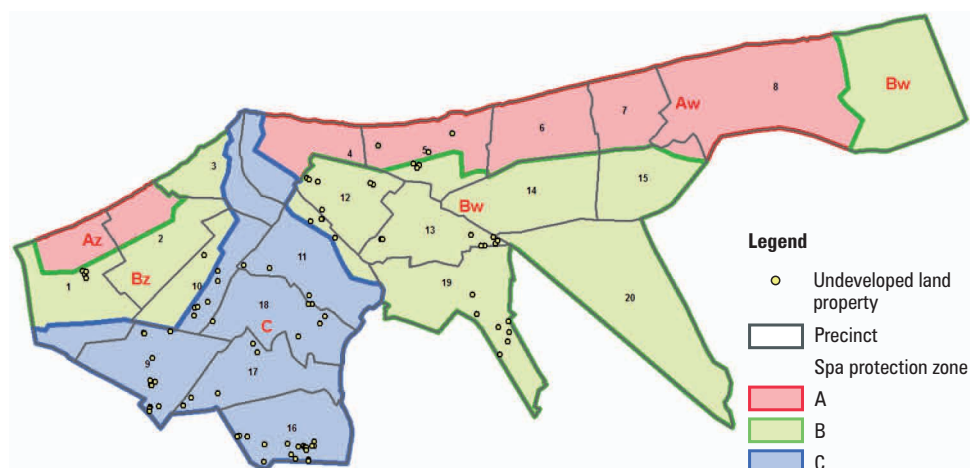


Source: authors' study

Fig. 5. Average price of land for 1 m^2

In the analysed period the transactions were carried out only in 11 precincts of Kołobrzeg. Among the data obtained from RCiWN no transactions were conducted for properties located in 9 precincts. Areas 3 and 4 are situated in the seaside strip, where are the main attractions of the city – pier promenade, passenger and yacht port. These areas are already built and developed through numerous tourist attractions. These areas are dominated by hotels, guest houses and tourist accommodation. In addition, part of the area 3 (also lying in the seaside area) is located in the military area – which is closed. Precinct 2 is a beautiful landscape park, an object of cultural heritage registered by the Voivodship Office for Preservation of Objects of Cultural Heritage. In the series discussed there were no transactions noted in the outskirts of eastern part of the city. Most of the areas are not attractive to the individual investor. There are green areas – the forests, the Eastern Ekopark, the mining areas, as well as the fragment of the airport of the former military training Bagicz. According to the analysis, the highest average value of land ($\text{PLN} \cdot \text{m}^{-2}$) of undeveloped real estate was in borough 5 which is located closest to the coastal strip. The lowest average asking price of land ($\text{PLN} \cdot \text{m}^{-2}$) was observed within boroughs 16 and 19 which are located in the southern part of town and the furthest away

from the sea and the city centre. This is the area where the development of technical infrastructure has only been observed in recent years. The local government also started investing in new roads, bicycle paths and bus lines, which allow for easier communication with the city centre. Currently, this area is characterized by single family housing, multi-family housing and services. In addition there are many undeveloped land properties here. A more detailed visualisation of the distribution of transactions of undeveloped land properties of the city of Kołobrzeg was obtained by presenting the location of the phenomenon against the background of the spa protection zones (Figure 6). The spa town of Kołobrzeg has three such zones, which were created on the basis of the Law of 28 July 2005 regarding spa treatment, spa and health resorts and health resort regions [Ustawa 2005]. According to the law, the separation of them is aimed at the protection of natural healing raw materials, environmental values and spa facilities.



Source: authors' study

Fig. 6. Distribution of transactions against the backdrop of the health resorts zones of Kołobrzeg

Each zone is of a different character. Spa zone A is designed to protect the seashore, therefore in accordance with the current spatial planning the construction of new facilities is forbidden. Zone B is used primarily by holiday and tourist facilities, service facilities designed to meet the diverse needs of patients, holidaymakers and tourists. It is a zone adjacent to zone A. The zone C serves as a single-family residential area with a series of services on the ground floor [Law 2005]. The above analysis confirms statutory assumptions. The clear advantage in the spatial distribution of the transactions can be seen in zone C, where 49 transactions have been conducted. The lowest number of transactions was recorded in zone A – just 3, undoubtedly an effect of a small amount of “empty” land, very high prices, problems with obtaining building permits for new buildings. In addition, coastal areas are used for recreational, medical and sanitary purposes, which are of little interest to potential investors.

5. Conclusions

The presentation of data regarding analysis of transaction prices of undeveloped land properties using GIS technology allowed for a clear flow of information concerning both the location of the discussed occurrence and the presentation of specific data. Visualisation simply conveys the message to the senses and improves cognitive perception of the world [Medyńska-Gulij 2012]. The use of GIS tools allowed to create a visualisation showing the exact spatial distribution of undeveloped land in the town of Kołobrzeg with the presentation of information on the prices of these real estate plots and the year when the transaction took place. By applying the method of spatial analysis in the real estate market it is possible to perceive the events that occur on the market in question (e.g. lack of seafront transactions), which we do not notice in the traditional analysis of the real estate market. As a result, a potential investor who does not know the city will be able to decide in advance if he or she would like to invest in Kołobrzeg, whether it has sufficient funds for a particular investment or whether it has paid off the location of the investment. According to the analysis presented, differences in transaction prices of undeveloped real estate can be observed, which results from the following conditions:

- the price of undeveloped land depends on the location in the spa protection zones A, B or C, located in the town of Kołobrzeg,
- the highest transaction prices are in vicinity of the seaside,
- the analysis of prices and the number of land transactions showed that the majority of transactions are on the outskirts of the city, where the price of 1 m² is lower compared to the seaside area,
- lower prices (unit) of land are more attractive to potential buyers, hence more transactions were made for investment in which m² was valued at 150 PLN,
- undoubtedly, the presented analysis indicates that the value of real estate increases with limitations, but also due to the greater environmental and natural values maintained in these areas.

Real estate market analysis using GIS also provides many opportunities for real estate valuers. Using Figure 3, for example, the valuers know that evaluating a plot of undeveloped land in borough 16 they cannot refer to a real estate located in borough 5 in the analysis because the attractiveness of the location is different. Other value-added buyer receive property close to the sea – higher, and another – lower real estate away from the seaside. The local real estate market is inhomogeneous. There are plots of land, buildings and residential properties in which both residents and foreign investors can invest. In this article special attention was paid to undeveloped real estate, where potential investors could invest their money. The investor makes a profit, the inhabitants have new jobs and the newly built housing estates such as apartments become a good place to invest for foreign investors [Zaremba 2009].

The real estate market can be described and shown in many ways. The authors decided to use methods of presentation of cartographic data: cartodiagram and

cartogram. Cartodiagrams are a universal method of presenting statistical data and various aspects of one phenomenon [Kowalski 2013]. The adopted method showed the spatial distribution of the value (sale) of the land property, including the time span of the transactions. On the other hand, the cartographic method, which does not reflect the actual distribution of transaction and refers only to their average value in a given territorial unit [Suchecka 2014], has allowed to identify the areas of greater interest to the buyers. Both methods demonstrated a close correlation between the real estate prices and the location of the sites. Geovisioning can in many cases help local governments and ordinary citizens to plan purchases of real estates for residential, recreational or service purposes. The presented data visualisation allowed for a clear information on prices and showed that the seaside area is more expensive as it is undoubtedly more attractive to potential investors. This type of analysis will be a very useful tool especially for those unfamiliar with the local real estate market in the spa town of Kołobrzeg. Proximity to the sea, environmental values and fresh air are the factors that, in the case of real estate purchases, come out as the main argument when choosing a location for investment purchases and visualisation improves the decision to invest.

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