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VALORISATION OF INFRASTRUCTURE IN RURAL AREAS OF LOWER SILESIA

Summary

Due to the significant role that infrastructure plays in the mobilization and development of rural areas, the aim of this paper was to examine infrastructure in Lower Silesia, South Western Poland. A detailed study was carried out in 2004 and involved 133 communes. General information was obtained from a publicly available database of the Central Statistical Office in Poland. The information gathered on the level of technical, social and economic infrastructure in individual rural communes of Lower Silesia was used to calculate coefficients which, after standardization, were analysed using two statistical methods. First, cluster analysis was used in order to isolate relatively homogeneous groups of communes with regard to the level of their infrastructure. Then points were assigned to the communes using a multiple correspondence analysis. Based on the performed analyses, infrastructure in individual communes was assigned point values and commune infrastructure was evaluated with an additional division into functional regions and individual types of infrastructure. Our results show considerable differences between the examined communes and between the functional regions in Lower Silesia.

Key words: infrastructure, valorisation, cluster analysis, multiple correspondence analysis, rural areas, Lower Silesia, Poland

INTRODUCTION

An adequate level of infrastructure in rural areas not only increases living standards of the local population but also the economic attractiveness of the areas. Therefore infrastructure should be seen as a system which to a great extent dictates the function of rural structures and influences the status and productivity of rural populations. Clearly, infrastructure is one of the most important factors yielding an adequate quality of life and work of villagers [Kołodziejczyk 1992].

Studies on infrastructure are well-justified by the fact that, despite a significant acceleration of infrastructural development in rural areas over recent years, large disparities between urban and rural areas still exist. The level and availability of infrastructure are still insufficient compared to demand; the acuteness of this deficiency is even greater considering the infrastructure gap within Poland and even in individual regions [Lira and Dolata 2003].

The decapitalization of infrastructure assets additionally increases the rural infrastructure gaps. In many cases, these defunct assets will have to be restored at considerable cost. Not only will the quality of infrastructure services decrease as a result of decapitalization but also their range [Wilczyńska 1997].

AIM AND RANGE OF THE STUDY

Bearing in mind the special role of infrastructure in rural development, this paper examines infrastructure level in rural areas in Lower Silesia. To this end, the following aims were determined:

– application of the cluster analysis and multiple correspondence analysis to assign point values to the infrastructure of rural areas in Lower Silesia;

– determination of differences in infrastructure of rural areas in Lower Silesia, based on the assigned point values;

The data for this study was obtained from all rural communes and rural areas of urban-rural communes of Lower Silesia. The analysis included technical, social and economic aspects of infrastructure in 2004[1]. The results of the analysis were used to evaluate the state of the infrastructure of rural areas, using the cluster analysis and multiple correspondence analysis.

The availability of technical infrastructure elements, such as water supply system, sewer system and gas supply, was evaluated using the rate of connections per 1000 people, and in km per 100 km^2. The length of roads with hard surfaces was measured in km per 100 km^2, and the percentage of all the roads. Sewage treatment plants were presented as the number of plants per 100 km^2 along the percentage of treated sewage. The elements of economic infrastructure (shops, permanent and seasonal markets) were presented through determining the elements of infrastructure per 1000 citizens, and per 100 km^2. Entities registered in the REGON system were also presented per 100 km^2, and per 10,000 citizens of an economically productive age. Social infrastructure was presented as the number of infrastructure elements per 1000 citizens and per 100 km^2; this

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criteria involved kindergartens, primary schools, junior high schools, pharmacies, clinics and health centres, and libraries.

METHODS

The detailed study involved Lower Silesia communes that covered rural areas, altogether 133 communes in 2004. Basic data was collected using common statistical methods. Of particular use was the information found in the publicly accessible regional database of the Central Statistical Office in Poland. The aim of this study was to obtain some more detailed information on the infrastructure in Lower Silesia, allowing for the division into 5 functional regions of Lower Silesia found in its regional development strategy[2]. The Lower Silesia Development Strategy divides the region into the following five functional areas: I - intensive farming, II - farming and recreation, III - industry-recreation-tourism, IV - farming and industry, V - farming-industry-recreation. This division was very important in a study on infrastructure level - differences found between these areas helped foster a more thorough analysis of the examined problem.

The analysis of the collected materials used a descriptive method [Kopeć 1983], and a comparative method in the comparison of the obtained results in the communes [Kopeć 1983, Ryznar 1999, Stachak 2006]. The analysis of data also used two following statistical methods:

1. Cluster analysis, used for clustering objects - communes, based on the following elements of technical, social and economic infrastructure: water supply system, sewer system, gas supply, length of roads with hard surfaces, sewage treatment plants, shops, permanent and seasonal markets, entities registered in the REGON system (companies), kindergartens, primary schools, junior high schools, pharmacies, clinics and health centres, and libraries.

Before clustering, the aforementioned variables (elements of infrastructure) that the classification was based on were standardized, which allowed a polynomial classification. In the applied standardization method, all the variables had the variance equal 1 and arithmetic mean equal 0. After the formation of statistical series, cluster analysis was performed with two steps of data clustering. The first step used the agglomerative method in order to establish the number of clusters based on the obtained dendrogram. During the second step, the objects were clustered using the *k*-means method, in which one should provide the number of clusters one wants to obtain. In this case, it meant the number obtained using the agglomerative method.

[2] Studies on the development of Lower Silesia. Lower Silesia Marshall's office, no 5, Wroclaw 2001, pp. 21–22.

In the agglomerative method, the distances between the clusters were determined using the method of the 'closest neighbours' between the clusters, i.e. a single linkage method. The distances between the individual objects were measured using a Euclidean distance, that is a geometric distance in a multiple space [Sagan 2001].

2. Multiple correspondence analysis was applied to determine the value of infrastructure in rural areas of Lower Silesia on a point scale. Points were assigned to the following types of infrastructure: technical, social and economic, and were related to the state of infrastructure in the examined areas.

The multiple correspondence analysis is a simple correspondence analysis performed on a code matrix, where individual rows correspond to subsequent observations, and columns correspond to variant variables. For each observation of a case (here a commune), 1 is recorded in the category (variant) to which the case belongs, and 0 for the remaining categories. In the measurement of the quality of an analysis results with a selected number of dimensions, additional statistics are required.

The most important element in the estimation of the obtained results of the correspondence analysis is the square of cosine. This column includes four measures of quality for each point with correspondence to each dimension. The total of values in these columns, calculated after all measurements, is equal to the total quality value. This value may also be interpreted as a correlation of a given point (a commune) with a given dimension.

The elements of infrastructure were calculated using their respective units and then standardized, which enabled their classification. The relationship between the cluster analysis and the multiple correspondence analysis is as follows. In the cluster analysis, communes were assigned to clusters with different states of infrastructure: better, average and worse. This classification was the basis for the Burt matrix used in the multiple correspondence analysis. The clusters were used as the basis for assigning values to the examined values in the matrix. Communes which belonged a to certain cluster (a certain level of infrastructure) were given value equal 1, and those that did not belong to a given cluster were given value equal 0.

Then in the multiple correspondence analysis coordinates were calculated for the representative dimensions and the communes were assigned points, depending on a cluster they belonged.

Because four dimensions (measures) explained 77% of the variability observed in the group of examined communes, the obtained coordinates for these dimensions were totaled in order to obtain one coordinate. The minimum value that described the lowest level of infrastructure was 0, and the maximum was 100. With this assumed range, computations were made to find function values of individual coordinates for 4 dimensions and within the three quality levels of technical, social and economic infrastructure (better, average and worse).

RESULTS

The performed statistical analysis served to realize the aim of this paper, namely the evaluation of rural areas in Lower Silesia and its functional regions with regard to the selected elements of technical, social and economical infrastructure. It also showed the differences in the infrastructure between rural areas in Lower Silesia (Table 1). The evaluation used a point scale applied for each type of infrastructure. According to the applied methodology, the calculation of the point totals used co-ordinates for four dimensions that showed the greatest differences between the analysed cases (communes). The minimum point value was 0 and the maximum 100. A point evaluation involved the calculation of a function value for individual co-ordinates (sum of co-ordinates) for 4 dimensions and for individual qualitative categories of technical, social and economical infrastructure.

Table 1 presents the point values for infrastructure for 15 randomly selected communes of Lower Silesia. It includes the number of total points and the division into types of infrastructure. The level of infrastructure was assigned point values ranging between 29 and 276 points. The minimum value (communes with the worst infrastructure) was achieved by 6 communes, i.e. 4.5% of the examined communes (out of 133), and the maximum value was found for 7 communes, i.e. 5.3% of the population.

Table 1. Point values of the infrastructure for demonstration communes in Lower Silesia

Communes	Functional region	Points			
		Total	Technical	Social	Economic
Lądek-Zdrój	III	276	100	84	92
Stronie Śląskie	III	276	100	84	92
Szczytna	III	228	100	36	92
Miłkowice	IV	218	42	84	92
Kobierzyce	I	217	100	25	92
Twardogóra	II	182	100	36	46
Długołęka	I	170	42	36	92
Święta Katarzyna	I	159	42	25	92
Góra	II	129	100	25	4
Bolesławiec	V	124	42	36	46
Brzeg Dolny	II	82	42	36	4
Wołów	II	82	0	36	46
Domaniów	I	71	0	25	46
Jordanów Śląski	I	40	0	36	4
Gromadka	V	29	0	25	4

Source: Own research

Assigning point values to individual types of infrastructure enabled examination of its internal differences. For example, Twardogóra commune obtained
a total of 182 points, with the greatest share of technical infrastructure (100 points), and relatively lowest level of social infrastructure (36 points). A distinctly different situation can be found in the Długołęka commune. The sum of points (170) is very similar to the value obtained by Twardogóra, but here the technical infrastructure is not as developed (42 points) and social infrastructure received a greater total of 92 points.

In conclusion, this study shows distinct differences in infrastructure among the studied communes, with regard to the individual elements of technical, social and economic infrastructure.

A similar point evaluation was performed for individual functional regions of Lower Silesia. The level of infrastructure for the communes of functional region I was between 94 and 258 points. Six communes (12.5% of the total number of communes) attained the minimum and another six communes (12.5%) reached maximum values. The assigned point values for the three types of infrastructure enabled the examination of infrastructural differentiation within
a functional region. For the region II, the point evaluation ranged from 59 to 260 points. In the case of this region, both the minimum and maximum values were obtained by 1 commune, i.e. 5.3% of the communes in the region. In the region III, the point values ranged from 69 to 247. The minimum value was obtained only by 1 commune, 3.8% of the examined population, and the maximum was found for 3 communes, 11.5% of the analysed population. The infrastructure for region IV ranged between 69 and 260 points. The minimum value was obtained only by 1 commune, 5.6% of the examined communes in the region, and the maximum by 3 communes, that is 16,7%. In region V, point values ranged between 45 and 218. Both the minimum and maximum values were obtained by 1 commune each, 4.5% of communes in the region.

Next, the assigned point values were used to establish a general assessment of the infrastructure in Lower Silesia and in individual functional regions. The communes were divided into those with the lowest level of infrastructure (below 100 points), medium level (100-200 points), and the highest level (above 200 points). Detailed information is presented in Table 2. Our results show that almost 20% of the examined communes obtained more than 200 points. However, the group with the lowest level of infrastructure was greater, with ca. 28% of the studied communes. The medium level, between 100 and 200 points, was obtained by almost 53% of the Lower Silesia communes.

The functional regions had different compositions of communes with regard to their infrastructure level. The lowest share of the worst equipped communes (11%) was found in regions III and IV, and the best equipped communes in these regions included 23% and 39% of the commune number. The percentage of communes at a medium level of infrastructure in regions I, II and IV was similar to their share for the entire Lower Silesia. In region III, 65% of communes had a medium level, in region V - 45%.

Table 2. The distribution of the Lower Silesia communes with different levels of infrastructure [% of commune number]

Levels	Lower Silesia	Functional region				
		I	II	III	IV	V
to 100 points	27.82	18.75	31.58	11.54	11.11	40.91
100 – 200 points	52.63	52.08	47.37	65.38	50.00	45.45
above 200 points	19.55	29.17	21.05	23.08	38.89	13.64

Source: Own research

Table 3 presents the medians, maxima and minima for the examined infrastructure in Lower Silesia communes, also the percentage of communes with the median level, and the percentage below and above the median.

Table 3. Differences in infrastructure in rural communes of Lower Silesia and in individual functional regions

Parameters	Lower Silesia	Functional region				
		I	II	III	IV	V
Median [points]	130	172	123	172	174	126.5
Maximum [points]	276	258	260	247	260	218
Minimum [points]	29	94	59	69	69	45

Source: Own research

CONCLUSIONS

This study of the infrastructure in rural areas of Lower Silesia indicates the following:

1. The applied cluster analysis enabled the division of communes with regard to technical, social and economic infrastructure. Qualitative categories were created in order to describe the levels of infrastructure on a point scale.

2. The applied multiple correspondence analysis enabled the assessment of infrastructure in the rural areas, through assigning point values to the examined communes, both for the infrastructure in general and considering the division

into technical, social and economic, and allowing for the previously established qualitative categories.

3. The point values of communes may also be helpful for entrepreneurs who plan to start businesses in the region. Investors will favour communes with the higher levels of infrastructure at the expense of those with lower point values.

4. Assessment based on the point value corresponding to the state of infrastructure can be performed for any number of communes and thus can be applied when planning infrastructure development in any region or even the entire country.

Our diagnosis of infrastructure in rural areas of Lower Silesia and the proposed point values assigned to the state of infrastructure may be useful in realization of the regional strategy. Due to a common lack of financial resources for modernization of rural areas and immense competition among communes to obtain these resources, the proposed method of assessment could increase the effectiveness of plans and strategies concerning infrastructure development.

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