

SETTLEMENT NETWORK CONCENTRATION AS DETERMINANT FOR RURAL AREAS DEVELOPMENT

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Abstract. Space planning and development play an ancillary role in relation to settlement and its geography. Residential areas were evolving over the centuries changing their shape as well as architectural forms. Observing the tendencies of the last decades, there is more scattered housing that occurs in landscapes of Polish country, which is also reflected in national spatial politics, in established planning documents, however, it does not always result from real demographic needs. Already existing buildings are less and less adapted for habitation. Together with progressive housing scattering, rural areas' functions change as well. So the question arises - is multifunctional development of rural areas the reason of decline of their agricultural function? As well as - is building concentration connected with the level of development of particular settlement units? The paper is aimed at comparing the housing concentration coefficients of the chosen settlement units and then confronting them with the calculated synthetic metha-indicators that determine the socio-economic development level. The analysis of building concentration of settlement units was performed by means of the concentration coefficient on the plane. To determine the level of socio-economic development (metha-feature), the spatial taxonomy method was used on the basis of selected diagnostic features. Cross-compliance of a qualitative nature of socio-economic development compared to building concentration indexes was determined by means of the Pearson correlation coefficient on the basis of the Guilford's classification. Analyzing the geographic phenomenon of building concentration, mathematical and statistical methods and also a monographic method of the subject literature analysis were used. The methods of spatial taxonomy as well as the method of ranking by a synthetic feature were used to survey the socio-economic development phenomenon. The researches were performed in selected rural communes from the area of Małopolska province in Southern Poland.

Keywords: residential areas, settlement geography, socio-economic development, spatial taxonomy.

Introduction

Both, the structure, functioning of rural areas and land use are considerably different across Europe. This situation is the result of cultural differences and also different land use requirements or population densities [1]. Some of premises of various stages of countries' development point to the fact that spatial planning legislation has been reacting too slowly to manage potential social and economic problems [2]. It is well known that social and economic efficiency of development of the country determines the sustainable development of its rural areas [1]. Rural areas become the most important economic and demographic component of the country [3]. The strategic role in ensuring stability of the state and strengthening food security [4-5] decided that rural areas development is at present one of the most important problems in the world [6-8].

Agricultural areas of South Poland are described as small, family-owned agricultural holdings [9]. They are characterized by an extensive land use mosaic [10]. The current stage of socio-economic development of rural areas in Poland results most of all from political changes in 1989 [11] and is conditioned by Poland's accession to the EU structures in 2004. Since that moment, local agriculture has received considerable financial assistance that enabled significant changes in the land use structure [9] including land consolidation [12]. The shape of rural areas is directly conditioned by the settlement network structure. Building density within concentration or population centres phenomenon together with their capital, buildings and infrastructure is in many countries of the world a determinant of the cities' definition [13]. Although the concept of urbanization includes the idea of concentration, defining the size and character of an agglomeration is a bit arbitrary in the context of two aspects. The first is a limit number of people in a group and the second one - the nature of grouped buildings where they live as well as connections between them. Settlement units are created by set aside groups of buildings together with buildings and devices connected with them. Their borders are determined narrowly or widely, which results from incompatibility of definitions of statistical and physical spaces. However, built-up area contains lands, which are not always really covered with buildings [14]. In the last half-century, dynamic increase of areas occupied by settlement areas and communication lands took place [15]. After the World War I, the rural area of southern Poland was characterized by high density of housing, i.e. on average 14 buildings per 1 km². The mean was higher than the one for the

whole Poland, which was 9 buildings per 1 km² [16]. Increase of built-up areas in rural regions occurred not only as a result of densification of housing and along communication routes, but also by location of dispersed settlement on the slopes and alluvial terraces [17-18].

Spatial planning determines development of settlement units according to the rule of sustainability, which is using space and environment as limited goods [19]. Spatial politics influences future directions of spatial development by planning elaborations, which permit or limit possible building on the areas that are used for agricultural purposes [20-21]. So, this is the spatial planning system, which should provide proper usage of the social and economic potential and thereby proper development of rural areas. The space limited character causes that lands are subject to strong pressure and competition [22-23] and for that reason postulates for economical management of these areas are proceeded [24-26]. Particularly negative results of urban pressure occur in case of rural production space including lands with high productive values in particular [27-28]. Evaluation of the sustainability level should be based on social, economic and environmental indications [29]. Socio-economic conditions depend on internal (endogenous) and external (exogenous) indicators. Next to the external conditions of communes functioning, the endogenous indicators are the basis for development of local economy [30-31]. The problem of socio-economic development is connected with the analysis of increase of the investments' number, values of production, employment as well as inhabitants' living standards and social and public security in a long-range period [32]. Among local determinants of development, these resulting directly from the needs of inhabitants and also connected with local resources can be found. Indicators of socio-economic development can be grouped in such categories: economic and social ones and also these, which are dependent on the infrastructure [33]. On the contrary, the phenomenon of socio-economic development itself can be described by a big number of variables [34]. However, to evaluate the socio-economic phenomena, coefficients, which allow to draw conclusions about ongoing processes, are required [35]. This is not an easy task to be realized because selection of coefficients in quantitative analyses depends on data availability and subjective assessments, but it should have substantive justification.

Materials and methods

The paper is aimed at comparing the housing concentration coefficients of the chosen settlement units and then confronting them with the calculated synthetic metha-indicators that determine the socio-economic development level. The analysis of building concentration of settlement units was performed by means of the concentration coefficient on the plane. To determine the level of socio-economic development (metha-indicator), the spatial taxonomy method was used on the basis of chosen diagnostic features.

Determining of the level of socio-economic development was performed in four stages. The first one consisted of defining the indicators that quantify the development of rural areas. Based on the definitions of socio-economic development, usage of three groups of indicators: social, economic and also technical and social infrastructure ones is proposed as in Table 1. A diagnostic feature with assumption that it should be specific for the surveyed phenomenon, it should have high variation and at the same time it should be strongly correlated with non-diagnostic features from its informative group and weakly correlated with the other features concerned diagnostics was selected in every group [36]. Being guided by these indications, such variables were selected as diagnostics features: x_2 – number of people in non-productive age per 100 of people in working age, i.e. so called coefficient of demographic dependency ratio, x_6 – expenditures of commune's budget per 1 citizen, x_7 – apartments provided for using. Further analyses were performed on the selected diagnostics features.

On the second stage, rating of the selected indicators that involved bringing dissimilar indicators measured in different units to dimensionless values ranging from 0 to 1 was conducted. They were calculated as the ratio of the difference between the indicator's value and its minimum value and the difference between the maximum and minimum values of the indicator. The indicators were calculated according to the formula:

$$X'_{ij} = \left(\frac{X_{ij} - X_{j\min}}{X_{j\max} - X_{j\min}} \right), \quad (1)$$

where X'_{ij} – variable standardized value;

x_{ij} – i value of j indicator;
 x_{jmax}, x_{jmin} – maximum and minimum values of j indicator.

Table 1

Indicators for the assessment of socio-economic development in rural areas

Indicator number	Indicator title	Mean value for indicators	Standard deviation	Coefficient of variation, %
Social				
x_1	Number of people per 1 km ² (density of population)	68.64	34.93	58.9
x_2	Number of people in non-productive age per 100 people in working age	65.04	3.10	4.8
x_3	Number of working people per 1 000 people	80.99	52.12	64.4
x_4	Percentage of registered unemployed people in the number of people in working age, %	6.05	1.16	19.1
Economic				
x_5	Total incomes of commune's budget per 1 inhabitant in PLN	3,142.70	487.56	15.5
x_6	Total expenditures of commune's budget per 1 inhabitant in PLN	3,050.18	500.71	16.4
Social and Technical Infrastructure				
x_7	Apartments provided for using per 1000 inhabitants	12.29	16.38	133.3
x_8	Entities in REGON register	627.14	820.22	130.8
x_9	Rate of people that use water supply	84.09	7.94	9.4
x_{10}	Rate of people that use waste water installation	16.34	18.79	115.0
x_{11}	Rate of people that use gas installation	5.00	7.28	145.7
x_{12}	Number of entities in the category A_01 of the Polish Classification of Activities from 2007 (arable crops, animal breeding, hunting)	17.86	8.91	49.9

Source: own study

The third stage consists of calculation of the initial set of indicators of each component of rural areas socio-economic development. The fourth stage includes calculation of a complex integrated indicator of socio-economic development to each community.

The synthetic coefficient of development was divided into four class sections [37]. Creating the class sections, arithmetic mean (R_{am}) of obtained estimations of synthetic sizes and the coefficient of development level for every commune as well as a standard deviation were used assuming that the communes are distinguished by the following levels of development:

1. **A. high**, for which the condition ($R_i > R_{am} + s$) was fulfilled,
2. **B. fairly high** ($R_{am} + s > R_i > R_{am}$),
3. **C. average** ($R_{am} > R_i > R_{am} - s$),
4. **D. low** ($R_{am} - s > R_i$),

where R_i – synthetic coefficient of development in a settlement;
 R_{am} – arithmetic mean of the synthetic coefficient of development;
 s – standard deviation of the synthetic coefficient.

Following the aim of the paper, the degree of housing in individual units (communes) was determined by means of the coefficient of concentration on the plane. Mutual location of buildings as points on the plane was taken into consideration. On the basis of assumptions of the graph theory, it is possible to study a system that illustrates points on the plane (buildings) together with their mutual locations. Such system keeps complete information about the configuration of points [38]. Passing from the graph theory to the language of analytic geometry, to calculate the concentration of a cloud of points on the plane (in two-dimensional space) the following formula was used (provided that calculations concern a big number of objects):

$$C2 = \frac{1}{Sx^2 + Sy^2}, \quad (2)$$

where C_2 – coefficient of concentration on the plane;
 Sx^2 – variance of x coordinate in examined set of points;
 Sy^2 – variance of y coordinate in examined set of points.

The surveys were carried out in the area of communes of Miechów district (Małopolska province) (Fig. 1).

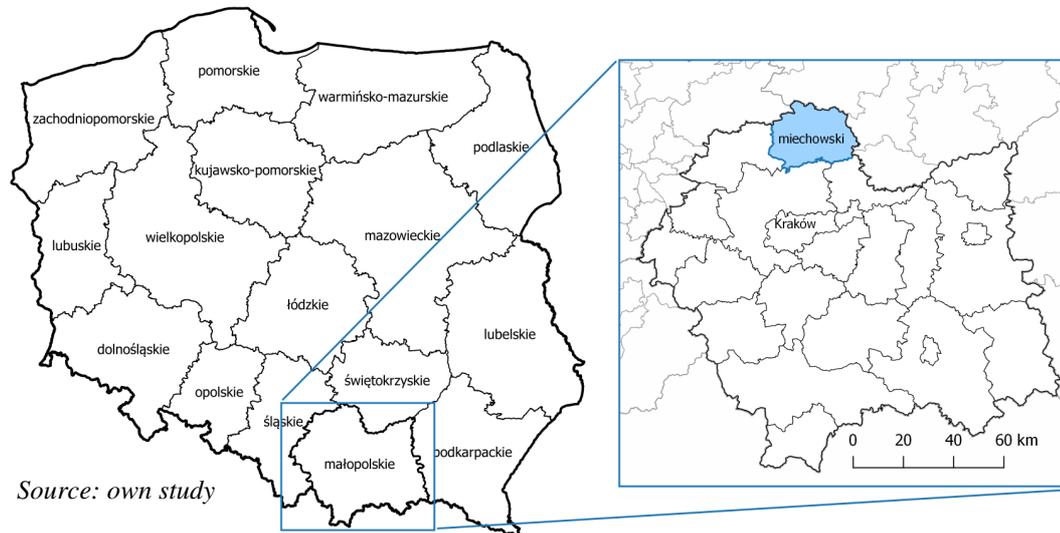


Fig. 1. Location of the case study – Miechów district in Małopolska province, South Poland

Miechów district is situated in the northern part of Małopolska province near the border with Świętokrzyskie province (Fig. 1). It contains seven communes. They are: Charsznica, Gołcza, Kozłów, Książ Wielki, Miechów, Raclawice and Słaboszów. The area of the district is 67.5 thousand ha. The area of the district is included by Miechów Upland, the region limited from the south by the valley of Vistula river and from the north with valleys of Pilica and Nidzica rivers. It is built of Jurassic limestone and Cretaceous marls covered by loess coatings. The landscape of carbonate wavy plateaus dominates here and the one of less highlands – in the southern part. Predominantly, the area is typically agricultural.

Results and discussion

The carried out calculations show that the level of the synthetic metha-indicator in three communes is on the relatively high level and in the two others – on the average level. One of the communes (Table 2) of Miechów district is characterized by a low level of socio-economic development and one – by a high level. The mean value of the calculated coefficient is 0.34, whereas the standard deviation is 0.12.

The communes of Miechów district can be divided into two groups (Fig. 2.): eastern – less developed, to which Charsznica, Gołcza and Kozłów communes can be included, and south-western, i.e. Słaboszów, Raclawice, Książ Wielki and Miechów communes.

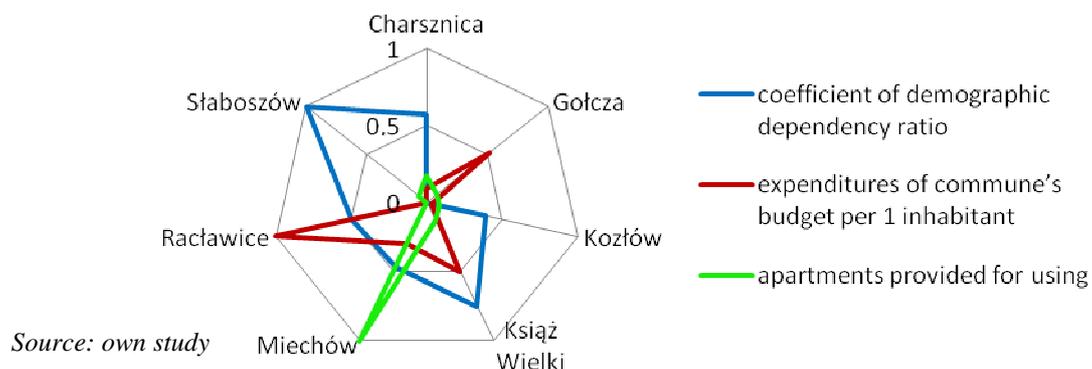


Fig. 2. Participation of individual groups of factors in socio-economic development

Learning the stages of socio-economic development of administrative units matters in making strategic decisions by local authorities that concern supporting less developed regions [39; 40]. Well-developed communes are characterized by a high coefficient of a number of people in non-productive age in relation to people in working age, high value of commune's budget expenditures per 1 inhabitant and also high percent of apartments provided for using (Fig. 2).

Table 2

Summary of metha-synthetic indicators that characterize socio-economic conditions of communes

Commune	Metha-synthetic indicator	Level of socio-economic conditions	Housing density (number of buildings per km ²)	Concentration coefficient	Relative value of concentration coefficient, km ⁻²
Charsznica	0.46	Relatively high	98.3	0.08998	0.00115
Gołcza	0.32	Average	63.4	0.05157	0.00057
Kozłów	0.13	Low	56.5	0.07316	0.00085
Książ Wielki	0.36	Relatively high	40.3	0.04848	0.00035
Miechów	0.49	High	80.4	0.04710	0.00032
Raławice	0.38	Relatively high	92.6	0.11814	0.00200
Słaboszów	0.27	Average	105.1	0.06408	0.00084

Source: own study

From among the tested communes, the greatest number of buildings per 1 km² occurs in Słaboszów and Charsznica communes followed by Raławice and Miechów ones. The smallest amount of buildings per km² is in Książ Wielki commune. Correlative relation between the housing density and housing concentration coefficient is 0.508. Correlation between the synthetic metha-indicator and housing concentration is 0.017, so its lack can be stated. Taking the Guilford's classification into consideration, only average positive correlation at the level of 0.314 between the communes' development level and the number of buildings per km² can be noticed.

Conclusions

Learning the stages of socio-economic development of administrative units matters in making strategic decisions by local authorities that concern supporting less developed regions. The level of development is a phenomenon, which differentiates communes between each other. Various factors influence the level of development. The level of socio-economic development of the examined communes is differentiated by the area of the district to the eastern and south-western parts. The most highly evaluated socio-economic conditions occur in Miechów commune and the lowest - in Kozłów one. The most numerous group of communes, i.e. 43 %, are these with the relatively high level of development (Charsznica, Książ Wielki and Raławice communes). In 28 % of the communes, the level of development is at the average level. The coefficient of housing concentration depends on mutual location of buildings in space. It is different for various communes. The analyses of the housing concentration rate in individual units (communes) revealed that the highest level concerns Raławice commune (0.11814), whereas the lowest one is in Miechów and Książ Wielki communes (0.04710 and 0.04848, respectively) with the mean level 0.07036. The relative value of the housing coefficient per km² is the highest in Raławice commune and amounts 0.002, whereas the lowest one is in Miechów commune – 0.00032 with the mean value 0.000867. The determined levels are approximate for the housing concentration coefficient as well as the relative housing concentration coefficient. Relation between the specified level of socio-economic development and the concentration coefficients was not found. It means that spatial arrangement of housing or the grade of buildings' concentration we are dealing with does not affect the level of socio-economic development reached by settlement units. One of reasons of such situation can be the fact that the housing concentration coefficients did not differentiate built-up areas in relation to the accepted function of development, which can possibly influence the socio-economic level of development. Performing other analyses in this direction could lead to revealing the aforementioned relations. However, it is the density of housing that affects the development. Greater number of buildings per km² means higher grade of socio-economic development of a settlement unit.

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