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LEVEL OF SUSTAINABLE DEVELOPMENT OF COUNTIES IN POLAND

Key words: sustainable development, local, county, multivariate analysis

ABSTRACT. The aim of the study was to determine and evaluate the level of sustainable development of counties in Poland. Counties were divided into four types – voivodship cities, other cities, land counties in the immediate vicinity of voivodship cities and other land counties. Statistical data from the Local Data Bank of the Central Statistical Office of Poland for 2018 were applied. A set of indicators of sustainable development was defined. Using methods of multidimensional comparative analysis, synthetic indicators of economic, social and environmental development were determined. The measure of cohesion was used to assess the level of sustainable development of counties. It enabled dividing counties into five groups: a very low, low, medium, high and very high level of sustainability. The results show that only 20% of counties in 2018 was classified as a very high level of sustainable development class. Relatively, the highest level of sustainability was observed in land counties, both those bordering large cities and other ones. It was found that the environmental aspect may be a barrier in shaping the sustainable development of counties.

INTRODUCTION

The concept of sustainable development appeared in the 1970s under the influence of global challenges such as environmental pressure and growing social inequalities. Since then, its importance in development theory and policy has been increasing [Borys 2011, Poskrobko 2013]. The key objective of this concept is to harmonise three main spheres: environmental, economic and social [Hopwood et al. 2005, UN 2015]. This involves such social and economic development, wherein the needs of the present generation are met without compromising the ability of future generations to meet their own needs [Bruntland 1987]. The biggest challenge for policy makers is the implementation of the concept of sustainable development and its assessment at a level country or regional level [Hugé et al. 2013]. Currently, the concept of sustainable development is interpreted differently, and often these definitions and interpretations are contradictory [Harwood 1990, Rogers et al. 1997, Lempert, Nguyen 2011].

Sustainable development is the primary goal of the European Union. The first Earth Summit held in Rio de Janeiro in 1992 finally resulted in developing a Europe-wide sustainable development strategy adopted by the European Council in Goteborg in June

2001. The major role in implementing sustainable development in practice is played by local and regional authorities. Local actions would constitute a key element in achieving the principles of sustainable development.

The objective of the article is to determine and assess the level of sustainable development in its three aspects at the level of counties (NUTS 4), in Poland, in 2018. The reference system of counties allows the research objective to be achieved with a lower generalization level than the regional one. Counties, due to a much smaller area compared to voivodships, can be treated as a relatively uniform unit [Czyż 1971].

MATERIALS AND METHODS

The concept of sustainable development requires relevant measures and measurement methods to be applied. In both Poland and abroad it has not been possible to develop a comprehensive set of features employed to evaluate the level of sustainable development.

The starting point for consideration was to determine a set of indicators that evaluate the level of sustainable development of counties. In the first stage of selecting variables, meritorical criterion was used. It was based on studies of literature related to regional development [Zeliaś 2000, Strahl 2006, Rosner, Stanny 2007]. A list of indicators basing on three spheres: environmental, economic, and social, was applied. Statistical data derived from the 2018 Local Data Bank of the Central Statistical Office [BDL 2018].

Taking formal criteria into consideration, the study took diagnostic variables which are measurable, universal, high quality, interpretable, complete and available into account.

Preliminary statistical analysis of empirical data eliminated quasi-stable variables. For this purpose, the coefficient of variation was calculated for each *i-th* variable. From the set of variables there features consistent with inequality are removed: $Vi < V^*$, where V^* indicates the critical value of the coefficient of variation. The critical value is $V^* = 0.10$. For all the selected features, the coefficient of variation exceeded 10%.

Then, the strength of the relationship between variables was examined. For this purpose, Pearson's linear correlation coefficient was used. Features showing a strong correlation, i.e. for a correlation coefficient value equal to or greater than 0.7, were not included in further studies.

As a result, 25 features representing three dimensions of sustainable development were selected. The social dimension related to demographic changes, education, access to the labour market, consumption patterns, factors determining health and road accidents, i.e. natural increase per 1,000 population (x_1), the population of post-working age per 100 people of working age (x_2), deaths of infants per 1,000 live births (x_3), the share of children in pre-school education in the total number of children aged 3-5 (%) (x_4), the registered unemployment rate (%) (x_5), the number of passenger cars per 1,000 population (x_6), clinics per 10,000 residents (x_7), road fatalities per 100,000 registered vehicles (x_8), the share of expenditure on education in total expenditure (%) (x_9), expenditure on social assistance per capita (PLN) (x_{10}) as well as expenditure on health protection per 1,000 inhabitants (PLN) (x_{11}). As part of the economic aspect, there were features related to economic development, employment, economic instruments and transport, i.e. the average monthly gross salary (PLN) (x_{12}), the share of employees in services (%) (x_{13}), the employed per

1,000 population (x_{14}), the share of investment expenditure in total expenditure (%) (x_{15}), entities of the national economy registered in REGON per 10 thousand of the population (x_{16}), the length of municipal and county roads with a hard surface per 100 km^2 (x_{17}) as well as the number of beds in tourist accommodation facilities per 1,000 people (x_{18}). The environmental dimension related to land use, biodiversity of waste management and air protection, i.e. forest cover (%) (x_{19}), the share of legally protected areas in total area (%) (x_{20}), the emission of particulate air pollutants from plants especially noxious to air purity during the year (t/km^2) (x_{21}), the emission of gas air pollutants from plants especially noxious to air purity during the year (t/km^2) (x_{22}), the share of municipal and industrial wastewater treated in total wastewater requiring treatment (%) (x_{23}), municipal mixed waste generated per year per capita (kg) (x_{24}) as well as electricity consumption per capita (kWh) (x_{25}).

In order to ensure comparability of variables, normalization of data is required [Zeliaś 2002]. This means, among others, that it is necessary to strip variables of their natural units, through which diagnostic characteristics are expressed. Normalization is conducted according to the following formulas [Kukuła, Bogocz 2014, Chrzanowska, Drejerska 2016]

for stimulating factors and positive features:

$$z_{ij} = \frac{x_{ij} - min_i\, x_{ij}}{max_i x_{ij} - min_i x_{ij}}$$

for destimulating factors:

$$z_{ij} = \frac{max_i\, x_{ij} - x_{ij}}{max_i x_{ij} - min_i x_{ij}}$$

where z_{ij} is a standardised value x_{ij}, and x_{ij} constitute a value of the *j-th* feature for the *i-th* object, $min_i\, x_{ij}$ is a minimal value of the *j-th* feature, and $max_i\, x_{ij}$ is a maximum value.

It was assumed that eight variables are destimulants (x_2, x_3, x_5, x_8, x_{21}, x_{22}, x_{24}, x_{25}) while the remaining ones are stimulants.

The synthetic factor was calculated according to the following formula:

$$Q_i = \frac{1}{m}\sum_{j=1}^{m} z_{ij}$$

where Q_i is a synthetic value for the *i-th* object and *m* is a number of features. The taxonomic measure of development (Q_i) ranges from 0 to 1. An increase in the value of the analysed county causes an increase in the level of development. The values of the discussed factor for three elements of sustainable development allowed to classify the analysed counties into five groups:

1st group, very high level: $Q_i \geq \bar{Q} + 0.9 s_Q$,

2nd group, high level: $\bar{Q} + 0.9 s_Q > Q_i \geq \bar{Q} + 0.3\, s_Q$,

3rd group, medium level: $\bar{Q} + 0.3\, s_Q > Q_i \geq 0.3\, s_Q$,

4th group, low level: $\bar{Q} - 0.3\, s_Q > Q_i \geq 0.9\, s_Q$,

5th group, very low level: $Q_i < \bar{Q} - 0.9\, s_Q$.

The synthetic indicators were applied to rank each county in each aspect and determine spatial similarities that may be observed in those rankings. The comparison of two order arrangements marked with p and q comprising an n number of objects enables measure m_{pg} to be used [Kukuła 1986].

$$m_{pq} = 1 - \frac{2\sum_{i=1}^{n}\left|d_{i(pq)}\right|}{n^2}$$

where $d_{i(pg)}$ is the difference in ranking positions for the *i-th* county. This measure is valued from 0 to 1, where 0 is for identical order arrangements and 1 for completely dissimilar rankings.

The synthetic indicators allowed to determine the level of sustainability of three spheres of sustainable development of counties in Poland. For this purpose, the measure of cohesion defined as the standard deviation of ranks for three indicators was applied according to the following formula:

$$SDi = \sqrt{\frac{1}{2}\sum_{j=1}^{3}\left(R_{ij} - \bar{R}_{ij}\right)^2}$$

where SD_i is a measure of the county's sustainability level, R_{i1} is a rank of economic indicator in the test, R_{i2} is a rank of the environmental indicator in the test, R_{i3} is a rank of the social indicator in the test, and R_{ij} is an average rank for the *i-th* county. A decrease in the value of this indicator makes the level of sustainability more favourable.

It was also specified which three spheres most considerably affect a lack of sustainable development. This sphere was determined on the basis of the largest distance from the average of the *i-th* county.

In order to distinguish the types of counties in Poland, the study identified four types: 1 – the largest city in terms of population in the voivodship (voivodship city), 2 – other cities, 3 – land counties located in the immediate vicinity of voivodship cities, 4- other land counties.

RESULTS AND DISSCUSION

In consideration of the synthetic measure for each analysed aspect of sustainable development, it can be stated that, in the economic dimension, the largest number of counties (38%) occurred in the low development level group. In the environmental aspect, the classes with a low and medium development level contained the largest number of counties (22% each), and in the social aspect – the class with a high development level (25%) (Table 1).

Taking into account the identified types of counties, it can be stated that large cities clearly show a high level of both economic and social development, but a low level of environmental development. In turn, land counties, not lying close to large cities have higher levels of environmental development. Similar results could be observed in the studies of

Andrzej Radwan and Łukasz Paluch [2011], Aleksandra Łuczak and Izabela Kurzawa [2017] and Tomasz Siudek [2019].

In terms of economy, in the 1st class – the highest level of development included all voivodship cities, 72% of other cities and 14% of type 3. Among other land counties, only 3% had a very high level of economic development. On the other hand, every fifth of other land counties (type 4) was in class 5 with the lowest level of economic development and these type of counties constituted the entire community of class 5. A low level of economic development occurred in every fifth land county bordering the city and in every second county of type 4.

A slightly larger variation could be seen in the level of social development. 70% of voivodship cities and 46% of other cities were characterized by a very high level of social development, while in land counties bordering the cities every fourth was found to be in the class with the highest social development level, and in the remaining land counties - every tenth. The lowest level of social development occurred in 2% of cities, other than the voivodship city, in 8% of land counties bordering voivodship cities and in 27% of other land counties.

As for the environmental aspect a very high level of development occurred only in counties of types 3 and 4, while no city was in this class. A high and very high level of environmental development could be observed in every fourth land county bordering a voivodship city and in half of the remaining land counties.

Table 1. Number of counties as per their development level in three aspects in 2018

Development level	County type				
	total	1	2	3	4
Economic dimension					
Very low	49	0	0	0	49
Low	145	0	0	7	138
Medium	80	0	3	14	63
High	40	0	11	10	19
Very high	66	16	36	5	9
Total	380	16	50	36	278
Environmental dimension					
Very low	66	10	25	13	18
Low	84	2	16	7	59
Medium	85	3	6	7	69
High	81	1	3	7	70
Very high	64	0	0	2	62
Total	380	16	50	36	278
Social dimension					
Very low	80	0	1	3	76
Low	65	0	1	4	60
Medium	68	1	5	9	53
High	97	4	20	11	62
Very high	70	11	23	9	27
Total	380	16	50	36	278

Source: own calculation

It is worth mentioning that, in the case of economic development, the indicator value of all cities and almost half of all land counties bordering cities was above average, whereas such an indicator value was characteristic for 18% of other land counties. As for the environmental aspect, the value of the synthetic indicator above the average was achieved by less than 20% of the largest cities, 12% of other cities, almost 30% of land counties bordering cities and 63% of other land counties. For the social aspect, the above average indicator occurred in all voivodship cities, in 92% of other cities, in 75% of land counties bordering cities and in 40% of other land counties.

To determine the similarity of developed rankings, fixed similarity measures for order arrangements, creating the following *M* matrix, were applied:

$$M = [m_{pq}]\begin{bmatrix} 1 & 0{,}144 & 0{,}221 \\ & 1 & 0{,}537 \\ & & 1 \end{bmatrix}, \ (p, q = 1,\ldots,3)$$

The data of the M matrix show that the highest similarity is between the following ranking pair: economic development and social development. Whereas, the least similar is the ranking pair: economic development and environmental development. It is also noteworthy that none of the ranking pairs are highly similar to each other, which proves weak sustainability of three spheres of development in the analyzed counties.

Only 3% of the analysed units, mostly land counties, showed a compatible level of development in all three aspects (i.e. they were in the same group of environmental, social and economic development). It is worth mentioning that, to the greatest extent, this compatibility referred to communes included in the group with a medium level of all development dimensions. None of the analysed units with the highest level of sustainability were contained in the 1st group in each of the aspects of sustainable development. Compatibility between economic and environmental aspects equalled almost 15%, between environmental and social dimensions it amounted to 15%, whereas the greatest compatibility (32%) was between economic and social aspects.

The level of sustainable development of three aspects was calculated in particular counties. The calculated value allowed to conduct the classification to keep a group of counties with a similar sustainability level. Two parameters: the arithmetical mean and standard deviation were employed to establish five groups of sustainability: The 1st group has a very high level of sustainability, whereas the 5th one has a very low one. A decrease in the value of this indicator makes the level of sustainability more favourable.

The group with the highest level of sustainability comprised 78 counties, which is 20.5% of total analysed counties. This group included one voivodship city – Kielce, 4 other cities, 9 land counties bordering cities and 64 other land counties (Table 2).

Relatively, the highest level of sustainability was observed in counties bordering a large city. Every fourth one of them was found to be in the class with the highest level of sustainability. Almost a similar percentage - 23% occurred in other land counties. Almost every fifth land district bordering the city and almost every fourth remaining land district was characterized by a high level of sustainability. In turn, the lowest level of sustainability occurred in type 1, i.e. in voivodship cities, where almost every second one of them was found to be in the lowest sustainability class. This means that the high level of economic development that this group was characterized by was not primarily conducive to a high level of environmental development. In the group of other cities, half of them were in the lowest sustainability class.

Table 2. Level of development sustainability of county types in Poland in 2018

Sustainability level	County type				
	total	1	2	3	4
Very high	78	1	4	9	64
High	82	2	6	7	67
Medium	69	1	4	4	60
Low	69	2	9	10	48
Very low	82	10	27	6	39

Source: own calculation

In the group with the highest level of sustainability, 2.6% of counties were in the group with the highest level of economic development, 3.9% were classified in the group with the highest level of environmental development, and 10.3% were included in the group with the highest level of social development. In the highest sustainability class, the most numerous were counties with a low level of economic development (46.2%), a medium level of environmental development (39.7%) and a medium level of social development (26.9%).

21.6% of total counties were found to be in the group with the lowest sustainability level, and by type: 56% cities, 17% land counties bordering cities and 14% other land counties. Districts from this group were not located in the Opolskie Voivodship, and every third county from the Mazowieckie Voivodship had the lowest level of sustainability. In the group of counties with the lowest sustainability level, 25% of them belonged to the group with the lowest level of economic development, 69% were found to be in the group with the lowest level of environmental development, and 33% were included in the group with the lowest level of social development.

This analysis allowed to identify the aspect that hinders sustainability to the greatest extent. For 18% of counties it was the social aspect, for 56% of counties it was the environmental aspect and for 26% of counties it was the economic aspect. Analysis was based on an assumption also shared by Danuta Kołodziejczyk [2015], but at a different territorial level. Danuta Kołodziejczyk conducted research at a commune level, the aspect that hindered the level of sustainability to the greatest extent was the environmental aspect and it concerned over 38% of communes. In other studies, the factor that most hindered sustainability was not identified.

CONCLUSIONS

The concept of sustainable development envisages sustainability among economic, social and environmental development. In Poland, the level of sustainability of counties is considered unsatisfactory. In 2018, only every fifth county showed a high level of sustainability of three development aspects. Mostly, these counties can be defined as medium-developed in each of the three aspects of sustainable development.

Relatively the highest level of sustainability was demonstrated by land counties bordering a large city and other land counties. Cities, in turn, showed a high level of economic development that did not go hand in hand with the level of environmental development.

The environmental aspect turned out to be the biggest barrier in shaping the sustainability of counties. The highest similarity of order systems occurred between economic and social aspects, although its level was not very high.

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POZIOM ZRÓWNOWAŻONEGO ROZWOJU POWIATÓW W POLSCE

Słowa kluczowe: rozwój zrównoważony, lokalny, powiat, analiza wielowymiarowa

ABSTRAKT

Celem opracowania jest ocena poziomu rozwoju zrównoważonego powiatów w Polsce. Badaniami objęto powiaty oraz miasta na prawach powiatów. Powiaty podzielono na cztery typy – miasta wojewódzkie, pozostałe miasta, powiaty ziemskie w bezpośrednim sąsiedztwie miast wojewódzkich oraz pozostałe powiaty ziemskie. Do badań empirycznych wykorzystano dane pochodzące z banku Danych Lokalnych GUS za 2018 rok. Określono zestaw wskaźników zrównoważonego rozwoju. Za pomocą metody wielowymiarowej analizy porównawczej określono syntetyczne wskaźniki rozwoju społecznego, gospodarczego i środowiskowego. Następnie określono poziom zrównoważonego rozwoju i podzielono powiaty na pięć klas: o bardzo niskim, niskim, średnim, wysokim i bardzo wysokim poziomie zrównoważenia. Badania pokazały, że jedynie 20% powiatów charakteryzowało się w 2018 roku wysokim poziomem zrównoważonego rozwoju. Relatywnie najwyższy poziom zrównoważenia zaobserwowano w powiatach ziemskich, zarówno tych graniczących z dużymi miastami, jak i w pozostałych. Zrównoważenie w największym stopniu utrudniał aspekt środowiskowy.

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