

SUSTAINABLE DEVELOPMENT OF PROVINCES IN POLAND IN THE YEARS 2005–2016

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ABSTRACT In Poland, the need to implement regional policy by local government units in accordance with sustainable development principles results directly from the rules of law. Taking into account specific environmental and economic conditions in individual regions, local authorities, having the right to give preference to different aspects of socio-economic development when creating regional strategies of regional development, are obliged to implement the concept of sustainable development in those strategies. The aim of the article is to specify the degree of changes in the level of sustainable development in individual provinces in Poland in the years 2005–2016 in general and in the area of social, economic, environmental as well as institutional and political order.

Introduction — The importance of the sustainable development policy in Poland

The notion of sustainable development was first defined in the UN document entitled “Our Common Future” in 1987. It states that sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987, p. 16). The obligation to follow the balanced and sustainable development principle in Poland results primarily from the Constitution of the

Republic of Poland (CRP, 1997) which states in chapter I, article 5 that: The Republic of Poland shall safeguard the independence and integrity of its territory and ensure the freedoms and rights of persons and citizens, the security of the citizens, safeguard the national heritage and shall ensure the protection of the natural environment pursuant to the principles of sustainable development. However, the notion of “sustainable development” was defined in article 3 of the Environmental Protection Act (Act, 2001), which states that sustainable development shall mean such socio-economic development which integrates political, economic and social actions, while preserving the natural equilibrium and the sustainability of basic natural processes, with the aim of guaranteeing the ability of individual communities or citizens, of both the present and the future generations, to satisfy their basic needs. The importance of sustainable development was also underlined in art. 77, which provides that: The issues of environmental protection and sustainable development shall be covered in the basic curricula of general education for all types of schools. This obligation shall also apply to the organisers of training courses leading to the acquisition of vocational skills. However, article 405 states that the resources of the National Fund, the Voivodship Funds and Gmina Funds shall be allocated to finance environmental protection and water management with the aim of implementing the principle of sustainable development.

The role and importance of local government units in the process of planning and controlling the implementation of sustainable development principles in the area of individual provinces was stressed in the Spatial Planning and Spatial Development Act (Act, 2003). Article 1.1 of the Act specifies the principles of spatial policy to be followed by local government units and central government administration as well as the scope and manner of proceedings in matters of designating land for specific purposes and determining the principles of its development and buildup, adopting spatial order and sustainable development as the foundations for these activities. In the process of building regional strategies, implementing the concept of sustainable development, a specific challenge consists in building development plans, taking into consideration uneven distribution of economic, social and environmental factors, which decide about attractiveness of individual areas being part of the regions as well as uneven level of development of these areas. In general, regions build their own development strategies, allowing economic aspects to be developmental priorities in some areas of the region, whereas in other areas – the social or environmental ones (Czarnecka, Słocińska, Dunay, Kabukcu, 2017, p. 265).

The aim of the conducted study is to specify the degree of changes in the level of sustainable development in individual provinces in Poland in the years 2005–2016 in general as well as in the area of social, economic, environmental as well as institutional and political order.

Source of data and research methodology

The study of sustainable development level in individual provinces in Poland will be conducted in four areas: in the area of social, economic, environmental as well as institutional and political order. Taking into account data availability and substantive requirements related to variables in such types of studies, the set of diagnostic variables includes the following features:

- a) in the area of social order – the number of physicians licensed to practise the profession per 10 thousand inhabitants (X_1), the number of passenger cars per 1,000 inhabitants (X_2), the number of adults participating in education and training (X_3), the average monthly disposable income per capita in a household (X_4), population growth rate per 1,000 population (X_5), unemployment rate (LFS) (X_6), the share of children

- in pre-school education in the general number of children aged 3–5 years (X_7) and the number of infant deaths per 1,000 live births (X_8);
- b) in the area of economic order – the length of railway lines exploited per 100 km² (X_9), investment outlays by sectors per capita (current prices) (X_{10}), outlays on research and development activity as a share of GDP (X_{11}) and the use of mineral fertilisers per 1 ha of agricultural area (X_{12});
- c) in the area of environmental order – carbon dioxide emissions from particularly onerous plants (X_{13} – mln t); forest cover (X_{14}), selectively collected municipal waste in relation to the total municipal waste collected during a year (X_{15}), the share of renewable electricity production in total energy production (X_{16}), the share of areas under legal protection in the total area (X_{17}) and electricity consumption per 1 million PLN of GDP (X_{18});
- d) in the area of institutional and political order – the number of registered foundations, associations and social organisations per 10 thousand inhabitants (X_{19}), the share of investment expenditures of local government units in total expenditures (X_{20}) and revenues from environmental fees and other revenues for environmental protection and water management funds per capita (X_{21}).

The information concerning the values of the above variables in individual provinces in Poland in the years 2005–2016 was obtained from the website <http://wskaznikizrp.stat.gov.pl/> (access 29.04.2018), but on account of the lack of information related to the outlays on research and development activity as a share of GDP (X_{11}) and electricity consumption per 1 million PLN of GDP (X_{18}) in 2016, their value was assumed to be the same as in 2015.

Following the choice of diagnostic variables, the construction of synthetic development measure involves the following steps:

1. the unification of the variables being the subject of aggregation, with the use of the postulate of uniform preference of variables as well as the unification of orders of magnitude of individual variables with the aim to make them comparable. In addition to the choice of the appropriate normalization formula, it is equally important to choose normalization parameters that are present in this formula. In this scope, depending on the purpose of the conducted study, the author can use formulas with constant or variable normalization parameters (Frodyma, Pawelek, 2008, p. 36). On account of the adopted objective of the study, diagnostic variables were normalized on the basis of constant normalization parameters in accordance with the following formulas:

- in the case of stimulants:

$$z_{ij} = \frac{x_{ijt}}{\max_{\substack{i=1, \dots, 16 \\ t=1, \dots, 12}} \{x_{ijt}\}} \quad (1)$$

- in the case of destimulants:

$$z_{ij} = \frac{\min_{\substack{i=1, \dots, 16 \\ t=1, \dots, 12}} \{x_{ijt}\}}{x_{ijt}} \quad (2)$$

Based on the analysis of the desired direction of changes of the sustainable development indicators adopted in the study, it was assumed that variables of the character of destimulants are the following ones: X_2 , X_6 , X_8 , X_{12} , X_{13} , X_{18} and X_{21} , whereas all other variables will be treated as stimulants.

2. Weighting the normalized diagnostic features, which means assigning weights to individual variables which specify their importance for the general criterion in comparison with other features. Adopting the assumption of the equal importance of sustainable development in all of the analysed areas for the general sustainable development of the given area, and taking into consideration a different number of variables describing individual areas, it was assumed that in the case of variables describing social order their weight amounts to $w_j = 1/32$, in the area of economic order – $w_j = 1/16$, in the area of environmental order – $w_j = 1/24$, whereas in the area of institutional and political order – $w_j = 1/12$.
3. The choice of aggregation formula and determination, on its basis, of the value of the synthetic development measure. In this scope, the author will use the TOPSIS method (*technique for order preference by similarity to ideal solution*) (Hwang, Yoon, 1981, pp. 130–132), which states that the ranking of objects is created based on C_i values designated according to the following formula:

$$C_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (3)$$

where:

$$d_i^+ = \sqrt{\sum_{j=1}^{21} w_j (z_{ij} - z_0^+)^2}, \quad i = 1, \dots, 16$$

$$d_i^- = \sqrt{\sum_{j=1}^{21} w_j (z_{ij} - z_0^-)^2}, \quad i = 1, \dots, 16 \quad (4)$$

$$z_0^+ = \begin{cases} \max_i z_{ij} & \text{in the case of stimulants} \\ \min_i z_{ij} & \text{in the case of destimulants} \end{cases}$$

$$z_0^- = \begin{cases} \max_i z_{ij} & \text{in the case of stimulants} \\ \min_i z_{ij} & \text{in the case of destimulants} \end{cases} \quad (5)$$

On the basis of the Kendall's tau coefficient (τ), the author will assess the significance of the changes in positions of individual provinces in the ranking of sustainable development level during the period under analysis. The said coefficient has values in the range $<-1, 1>$, where 1 refers to perfect agreement, 0 means that two random variables are independent, whereas the value -1 stands for perfect disagreement. The Kendall's tau rank correlation coefficient is used to verify the hypothesis about ranks agreement, for which test statistics defined as:

$$Z_\tau = \frac{\tau}{\sqrt{\frac{2(2n+5)}{9n(n-1)}}} \quad (6)$$

for $n > 10$ has asymptotic normal distribution (Abdi, 2007, pP. 508–510) (in the case of the study of socio-economic development of provinces in Poland $n = 16$).

Results of the study

The initial analysis of diagnostic variables adopted in the study indicates significant changes in their values during the period under study. The most significant changes were observed among others in the case of the share of selectively collected municipal waste X_{15} , whose average level increased almost sixteen times, whereas the median value almost twenty seven times. Even higher increase in the median value (M) was observed in the analysed period in the case of the share of areas under legal protection (X_{17} – 5286% increase), the share of renewable electricity production in total energy production (X_{16} – 6542% increase), the number of registered foundations, associations and social organisations per 10 thousand inhabitants (X_{19} – 6616% increase) as well as in the case of revenues from environmental fees and other revenues for environmental protection and water management funds per capita (X_{21} – 18213% increase). Detailed information concerning the changes in the values of variables adopted in the study is presented in Table 1.

Table 1. Basic statistics describing values of the selected diagnostic variables in individual provinces in the years 2005 and 2016

	Mean		Median		Min.		Max.	
	2005	2016	2005	2016	2005	2016	2005	2016
X_1	31.250	35.563	34.50	37.50	20.00	25.00	45.00	49.00
X_2	316.060	555.819	408.80	548.85	263.30	485.20	374.20	626.60
X_3	4.506	3.406	4.40	3.05	3.40	2.00	5.90	5.80
X_4	678.503	1,433.310	1,014.58	1,421.65	619.02	1,134.10	801.08	1,780.88
X_5	-1.860	-0.406	1.53	-0.60	-3.40	-3.00	2.20	2.00
X_6	16.191	6.481	6.60	5.65	14.30	4.70	22.80	9.60
X_7	35.029	79.725	46.20	79.05	29.50	70.70	59.40	88.00
X_8	5.381	4.169	5.45	4.15	4.90	3.30	7.40	5.90
X_9	6.724	6.575	6.90	6.25	3.40	3.20	17.20	15.90
X_{10}	2,788.763	5,812.875	4,987.25	5,501.50	1,992.00	3,505.00	5,634.00	10,533.00
X_{11}	0.385	0.788	0.30	0.71	0.08	0.22	1.10	1.74
X_{12}	76.784	122.422	127.40	116.83	66.10	62.98	141.80	201.54
X_{13}	8.062	13.089	3.43	9.63	1.49	1.58	40.12	40.12
X_{14}	16.427	30.256	13.92	29.25	20.70	21.40	48.70	49.30
X_{15}	1.552	24.200	0.87	24.10	1.80	16.90	6.20	34.70
X_{16}	6.254	27.256	0.30	19.70	0.20	3.90	40.10	83.70
X_{17}	10.776	33.586	0.59	31.65	16.40	18.63	61.95	64.63
X_{18}	0.332	0.091	0.43	0.09	0.09	0.06	0.60	0.13
X_{19}	3.719	36.375	0.54	36.50	16.00	27.00	26.00	46.00
X_{20}	3.099	11.669	0.69	11.60	14.30	8.80	20.10	13.60
X_{21}	5.589	68.369	0.32	58.15	13.40	36.20	53.30	152.50

Source: author's own elaboration.

On the basis of the information from Table 1, it can be stated that the major changes in values of the analysed variables were observed in the area of environmental as well as institutional and political order. However, they did not result in significant changes in the rankings of sustainable development level of individual provinces in these areas. In the area of environmental order in the analysed period of 12 years, the leader of sustainable development

was always Warmia-Masuria Province, whereas Łódź Province practically always took the last place (see Table 2). In turn, far greater changes related to sustainable development were observed in the area of institutional and political order. The most positive change in this area was reported in Lower Silesia Province, which in 2005 took 14th position in the ranking, whereas in 2015 – 2nd position, and in Mazovia Province, which in the same period climbed from 9th position to a leading one. In both cases, the key element was the increase in the number of registered foundations per 10 thousand inhabitants (in the case of Lower Silesia Province from 21 to 40 and in Mazovia Province from 26 to 46). In case of the analysis of institutional and political order, particularly interesting were considerable changes in the positions of West Pomeranian Province, which in 2007 took 16th place, in 2012 climbed to 6th place and in 2016 finally took 11th place, as well as of Lubuskie Province, which had 3rd position in 2009 in the ranking of provinces and in 2013 it fell to 15th position. Table 3 provides detailed information on the positions in the ranking of sustainable development in the area of institutional and political order.

Table 2. The ranking of provinces in Poland in terms of sustainable development in the area of environmental order in the years 2005–2016

Provinces	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Łódź (ŁD)	16	16	16	16	16	16	16	16	16	14	15	16
Masovian (MS)	11	11	10	9	9	9	9	9	9	10	10	10
Lesser Poland (LP)	6	7	8	8	8	7	8	8	8	8	8	8
Silesian (SL)	14	13	13	14	14	14	13	14	14	13	12	11
Lublin (LU)	12	12	11	12	12	12	12	12	12	12	14	13
Subcarpathian (SC)	4	4	4	4	4	4	4	4	4	4	4	4
Podlasie (PL)	3	3	3	3	2	2	2	2	2	2	2	2
Świętokrzyskie (ŚK)	5	5	5	5	5	6	6	6	6	6	6	6
Lubusz(LB)	2	2	2	2	3	3	3	3	3	3	3	3
Greater Poland (GP)	10	10	12	10	10	10	11	10	11	11	11	12
Western Pomeranian (WP)	9	9	9	11	11	11	10	11	10	9	9	9
Lower Silesia (LS)	15	14	14	13	13	13	14	13	13	16	16	15
Opole (OP)	13	15	15	15	15	15	15	15	15	15	13	14
Kuyavian-Pomeranian (KP)	7	6	6	6	7	5	5	5	5	5	5	7
Pomeranian(PM)	8	8	7	7	6	8	7	7	7	7	7	5
Warmian-Masurian (WM)	1	1	1	1	1	1	1	1	1	1	1	1

Source: author's own elaboration.

Table 3. The ranking of provinces in Poland in terms of sustainable development in the area of institutional and political order in the years 2005–2016

Provinces	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	2	3	4	5	6	7	8	9	10	11	12	13
Łódź (ŁD)	15	16	14	13	12	15	15	14	15	13	12	13
Masovian (MS)	9	8	7	5	6	6	8	4	3	5	5	1
Lesser Poland (LP)	8	9	8	8	11	10	9	10	9	8	9	10
Silesian (SL)	13	15	15	16	16	16	16	15	13	12	15	16
Lublin (LU)	4	4	4	4	5	5	5	7	5	3	4	7

1	2	3	4	5	6	7	8	9	10	11	12	13
Subcarpathian (SC)	3	2	2	1	2	2	3	8	4	4	3	8
Podlasie (PL)	1	1	1	2	1	1	1	1	1	2	2	5
Świętokrzyskie (ŚK)	6	7	10	14	10	7	11	9	10	10	10	14
Lubusz(LB)	5	5	5	7	3	4	12	13	7	15	11	4
Greater Poland (GP)	11	11	9	9	7	9	6	12	11	11	13	9
Western Pomeranian (WP)	12	14	16	12	13	12	7	6	12	9	7	11
Lower Silesia (LS)	14	13	12	10	8	11	10	5	8	6	6	2
Opole (OP)	10	10	11	15	14	14	14	16	16	16	16	12
Kuyavian-Pomeranian (KP)	16	12	13	11	15	13	13	11	14	14	14	15
Pomeranian(PM)	7	6	6	6	9	8	4	2	6	7	8	6
Warmian-Masurian (WM)	2	3	3	3	4	3	2	3	2	1	1	3

Source: author's own elaboration.

Pomorskie Province was a leader in the ranking of sustainable development in the area of social order for a continuous period from 2005 to 2016, whereas two last positions in this scope were occupied alternately by Łódź Province and Świętokrzyskie Province. The greatest change in this area was reported in Warmia-Masuria Province, which took the third position in 2006, whereas in 2016 it fell to the thirteenth one. The main reason may be the lack of changes in this period in the number of infant deaths per 1,000 live births. In this scope, Warmia-Masuria Province took 5th position with the general average decline in this rate from 6 in 2006 to 4.2 in 2016 (the decline in this rate was reported in all other provinces, including among others in Silesian Province from 7.3 to 4.4, in Lower Silesia Province from 6.9 to 3.8 and in Lublin Province from 6.4 to 3.5). In the area of economic order, the high level of sustainable development compared to other provinces was observed in Mazovia Province, Małopolskie and Silesian Province, which always took first four positions in the said period. In this respect, the weakest provinces turned out to be Kujawsko-Pomorskie Province, Warmia-Masuria Province and West Pomeranian Province, which took the positions between 10 and 16 in this period. Table 4 and table 5 provide detailed information on the positions of provinces in the ranking of sustainable development in the area of social and economic order.

Table 4. The ranking of provinces in Poland in terms of sustainable development in the area of social order in the years 2005–2016

Provinces	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	2	3	4	5	6	7	8	9	10	11	12	13
Łódź (ŁD)	16	16	16	16	16	15	15	16	15	15	15	15
Masovian (MS)	9	7	3	5	4	3	2	2	2	2	2	2
Lesser Poland (LP)	3	4	4	3	3	4	4	3	3	3	3	3
Silesian (SL)	14	11	11	11	11	11	12	12	11	13	13	12
Lublin (LU)	11	10	12	13	12	13	13	10	12	12	12	11
Subcarpathian (SC)	6	6	7	7	7	7	6	5	5	7	5	7
Podlasie (PL)	10	12	10	10	10	10	9	9	10	10	9	6
Świętokrzyskie (ŚK)	15	15	15	15	15	16	16	15	16	16	16	16
Lubusz(LB)	7	5	6	6	6	6	7	6	7	6	7	5
Greater Poland (GP)	2	2	2	2	2	2	3	4	4	4	4	4
Western Pomeranian (WP)	5	8	8	9	8	9	10	11	9	9	10	10

1	2	3	4	5	6	7	8	9	10	11	12	13
Lower Silesia (LS)	12	13	13	12	13	12	11	13	13	11	11	8
Opole (OP)	13	14	14	14	14	14	14	14	14	14	14	14
Kuyavian-Pomeranian (KP)	8	9	9	8	9	8	8	8	6	8	6	9
Pomeranian(PM)	1	1	1	1	1	1	1	1	1	1	1	1
Warmian-Masurian (WM)	4	3	5	4	5	5	5	7	8	5	8	13

Source: author's own elaboration.

Table 5. The ranking of provinces in Poland in terms of sustainable development in the area of economic order in the years 2005–2016

Provinces	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Łódź (ŁD)	8	7	7	8	9	9	9	7	7	8	10	12
Masovian (MS)	2	3	3	2	3	3	4	4	2	1	1	1
Lesser Poland (LP)	3	2	2	3	2	1	3	1	1	2	2	2
Silesian (SL)	1	1	1	1	1	2	1	3	3	4	4	4
Lublin (LU)	11	14	10	12	10	11	12	9	12	7	7	8
Subcarpathian (SC)	5	4	4	4	4	4	2	2	4	3	3	3
Podlasie (PL)	15	10	11	10	13	15	11	13	8	10	8	10
Świętokrzyskie (ŚK)	10	15	14	9	7	5	7	10	14	13	12	11
Lubusz(LB)	14	12	12	15	14	7	8	12	15	12	14	13
Greater Poland (GP)	6	8	8	7	8	10	10	8	9	9	9	9
Western Pomeranian (WP)	16	13	15	13	15	16	15	16	11	14	15	16
Lower Silesia (LS)	4	5	5	6	6	6	5	6	6	6	6	6
Opole (OP)	9	9	9	11	12	13	14	14	13	11	11	7
Kuyavian-Pomeranian (KP)	12	11	13	14	11	14	16	15	16	16	16	15
Pomeranian(PM)	7	6	6	5	5	8	6	5	5	5	5	5
Warmian-Masurian (WM)	13	16	16	16	16	12	13	11	10	15	13	14

Source: author's own elaboration.

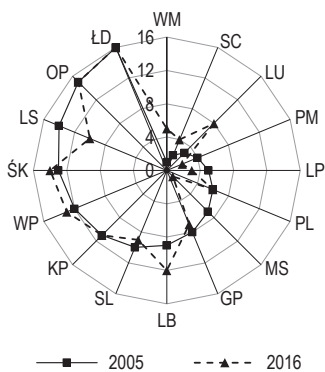


Figure 1. Positions of provinces in Poland in terms of the level of sustainable development in 2005 and 2016

Source: author's own elaboration.

However, the changes observed in terms of sustainable development in respective areas were not reflected in statistically significant changes in the general ranking of sustainable development of provinces in the years 2005–2016. The value of the Kendall's tau coefficient, comparing the order of provinces in 2005 and in 2016, amounted to 0.65, which means that it is statistically significant for $p\text{-value} = 4.45\text{E-}4$ and, therefore, there is no reason to reject the hypothesis about non-significant changes in the ranking of sustainable development of provinces in Poland in both years under comparison. Figure 1 shows a graphic presentation of the changes in the positions in the said rankings.

Conclusions

On the basis of the conducted study, the author can draw the following conclusions:

1. Despite considerable and mainly positive changes in the values of diagnostic variables adopted in the study during twelve analysed years, no significant changes were observed in the positions of individual provinces in Poland in the rankings evaluating the level of sustainable development. This may mean that, in general, provinces develop equally in this respect.
2. In turn, the analysis of four distinguished areas of sustainable development in individual provinces leads to two following conclusions: firstly – there are considerable differences in the rankings for the same period (e.g. for 2016, the value of the Kendall's tau coefficient for the ranking of sustainable development in the area of social and economic order amounted to 0.2, which means that it is not statistically significant at the level $p\text{-value} = 0.2799$). This may result from specific political-social-economic-environmental conditions in individual provinces (e.g. in Silesian Province and Warmia–Masuria Province). Secondly – there are major changes in individual subrankings in the period of e.g. two or three years. This may mean a great influence of individual diagnostic variables on the final result, arising from either significant changes in the values of these variables within a short period of time, or from their too much impact due to a small number of the set of diagnostic variables adopted in the study.

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