ANNALS OF THE POLISH ASSOCIATION
OF AGRICULTURAL AND AGRIBUSINESS ECONOMISTS

received: 06.10.2019
acceptance: 24.10.2019
published: 15.12.2019

Annals PAAAE • 2019 • Vol. XXI • No. (4)

JEL codes: C38, H75, O18, Q01

DOI: 10.5604/01.3001.0013.5425

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THE DEGREE OF DEVELOPMENT SUSTAINABILITY AT A LOCAL LEVEL: EVIDENCE FROM MAZOVIAN COUNTIES IN POLAND

Key words: sustainability, local development, NUTS4 units, Mazovian Voivodship, Poland

ABSTRACT. The aim of this study was to determine the sustainability degree of local development for counties of the Mazowieckie (Mazovian) Voivodship in the years 2006-2015. Research was conducted on a population of 42 counties (territorial units at NUTS 4 level), including 5 town counties (towns possessing county status) and 37 land counties. Basing on data from the Local Data Bank of the Central Statistical Office, three dimensions of development were investigated: economic, social and ecological (environmental). The author's conceptual approach, incorporating dimensional indexes of development and Euclidean distance analysis, was applied to capture the interactions between and balance across the three pillars of sustainability. Through the results of the study, it is observed that the highest degree of local development sustainability was achieved by counties located up to 50 kilometres from Poland's capital city Warsaw (i.e. grodziski, grójecki, nowodworski, otwocki, sochaczewski, wołomiński and żyrardowski), while the lowest by towns with a county status (Ostrołęka, Płock and Warsaw) and by peripheral counties of the east and south part of the Mazovian Voivodship (siedlecki, przysuski, lipski and zwoleński). In the 2015 ranking, according to the sustainability degree of counties, the first three spots were taken by ciechanowski, przasnyski and sochaczewski counties. The following town counties took the last three positions: Ostrołęka, Płock and Warsaw.

INTRODUCTION

Sustainable development, as seen from the perspective of the economy, society and state (government), is a very urgent and crucial issue. It is discussed and studied at global, international, national, regional and local levels.

The concept of 'sustainable development' appeared, for the first time in 1987, in the Brundtland Commission Report on Environment and Development (the outcome of the UN's World Commission on Environment and Development). In the above report, sustainable development is briefly defined as the "ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [Brundtland Commission 1987]. The concept of sustainable development incorporates three main components, i.e. economic, social and ecological

(environmental) dimensions[1]. The rule is that sustainability can only be achieved (in order to improve the living standard of the population) when all three dimensions are balanced[2].

Sustainable development is a priority of the European Union's cohesion policy, the main goal of which is to achieve convergence across regions and member states in terms of the development level and well-being of the European population.

A review of the literature shows that scientific papers published so far propose several different approaches to sustainability and sustainable development. These studies mainly focus on particular aspects, such as, for example, sustainable development at a national or regional level [Bal-Domańska, Wilk 2011, Borys 2011, Fura 2015, Janulewicz et al. 2016, Matuszczak 2009, Moran et al. 2008, Munitlak Ivanović et al. 2009, Nourry 2008, Rosner 2007, Roszkowska, Karwowska 2014, Wilson et al. 2007], sustainable local development [Katoła 2011, Milán-García et al. 2019], sustainable development of agriculture and rural areas [Binder et al. 2010, Czudec et al. 2018, Majewski 2008, Stanny 2011, Stanny, Czarnecki 2011, Zawojska, Siudek 2018], sustainable consumption [Borowska 2009], renewable energy [Pultowicz 2009], biodiversity [Kiełczewski 2009], and sustainable waste management [Bagieńska, Ciula 2011]. There is a significant body of research on measurement tools and assessment methods for sustainability and sustainable development [Bartniczak 2012, Borys 2010, Borys, Fiedor 2008, Hellwig 1968, Kukuła 2000, Młodak 2006, Nermend 2008, Nermend, Borawski 2004, Roszkowska, Karwowska 2010, Roszkowska et al. 2014, Strahl 2005, 2006, Strezov et al. 2017, Sulewski, Kłoczko-Gajewska 2018].

An overview of the above publications indicates that they generally consider three components of sustainable development. Most of them are focused on the diagnosis of its level within territorial units (country, region, district/county or commune). The main drawback of these works is that they do not assess the sustainability degree but rather analyze the level of development with respect to its individual components. In fact, many studies examine economic, social and environmental pillars separately (or independently of one another), ignoring the relationships (mutual interconnectedness) between them. A serious shortcoming is the lack of attempts to determine an equilibrium relation between these components which makes the assessment of the degree of developmental sustainability impossible. In our opinion, studying development in the framework of sustainability requires searching for such equilibrium and detecting any deviations from it. Considering the highlighted weaknesses and research gaps in the literature, this work aims at partially filling them and contributing to methods and approaches to research on sustainable development[3].

[1] The studies on sustainable development, except for applying the traditional three-dimensional approach to sustainability, also consider additional dimensions such as technological, spatial, institutional, ethical and other ones.

[2] It should be noted here that the state of equilibrium between the dimensions does not necessarily imply a high living standard of the population. If development components (economic, social and ecological) are balanced but low, the people's standard of living will still be poor. So, high living standard levels exist if, at the same time, both conditions are satisfied: a high level of individual components and a balance between them.

[3] Firstly, the terms 'degree of sustainability' and 'level of sustainable development' require clarification. Degree of sustainability means the relationship of three development component levels (economic, social and ecological) between each other while the sustainable development level comprises both the levels of individual components of development and the degree of sustainability. Consequently, 'sustainability' is one but not the only element of sustainable development.

RESEARCH AIMS, METHODS AND DATA SOURCES

The subject of this study is sustainable local development. The main research aim was to determine the degree of sustainability of local development on the case of counties of the Mazowieckie (Mazovian) Voivodship in Poland. The single research hypothesis states that the degree of sustainability of local development within the Mazovian Voivodship is higher in land counties rather than towns with county rights[4].

The analysis was made for 42 statistical micro-regions (NUTS-4 level units, counties), called poviats in Polish, of the Mazovieckie province over a ten-year period from 2006 to 2015. Thus, the dataset comprises 420 (42 × 10) observations. The group of counties consists of five town counties (towns possessing county status) and thirty seven other (land) counties.

Their development was examined considering the following three dimensions: economic, social and ecological (environmental). The data used in the empirical analysis was obtained from the Local Data Bank of the Polish Central Statistical Office – CSO (GUS). A detailed review of literature written by domestic and foreign authors dealing with sustainability/sustainable development helped in creating a conceptual framework of this study and choosing the variables to be included in the analysis. In total, 35 original (observable) variables for 42 counties were selected to characterize their development, and then assigned to the three groups depicted as 'economic dimension', 'social dimension' and 'ecological dimension' (Table 1). These variables or diagnostic characteristics were divided into:

– stimulants (those exerting a positive effect on the development level – their higher values indicate an improvement in development and *vice versa*): x_1-x_{15}, y_1, y_4, y_6, y_7, y_{12}, $z_{4;}$
– de-stimulants (those negatively affecting the development level – their higher values indicate development deterioration and vice versa): y_2, y_3, y_5, y_8-y_{11}, y_{13}, z_1-z_3, z_5-z_7.

When measuring the development level, stimulant variables were marked with a positive sign, while de-stimulant variables – with a negative sign, respectively.

The following methods and tools were employed: (1) principal component analysis; (2) the formula of the Euclidean-distance (straight line) in three-dimensional space between point P_{jt} (X_{jt}, Y_{jt}, Z_{jt}) that represents the j-th county's development and point P_{jt0} (X_{jt0}, Y_{jt0}, Z_{jt0}) that depicts the state of its equilibrium or sustainability each year t; (3) a review and analysis of the literature; (4) a tabular presentation of data and results.

Principal components analysis (PCA)[5] was used to compute synthetic indexes of local development for each of the three (economic, social and ecological) dimensions in the years 2006-2015. Within PCA, a linear transformation of a set of n correlated original variables X_i ($i = 1, ..., n$) into a set of l mutually uncorrelated (orthogonal) variables (called factors) F_k ($k = 1, ..., l$)[6] was performed. The principal components taken into account were those factors that explained the largest part of the information given by the primary

[4] In this article, the terms 'town counties' and 'towns with county rights/status' mean the same thing.

[5] PCA is commonly applied method for dimensionality reduction. It assumes that core properties of a high-dimensional sample of measured or observed variables are largely captured by a small number of principal components (also known as factors or synthetic indexes).

[6] The terms "principal component" and "factor" are used in this work interchangeably.

Table 1. Original variables used to identify the development level of Mazovian Voivodship counties*

	Economic dimension (*X*)
x_1	County budget revenue per capita [PLN]
x_2	County budget expenditure (Divisions: Agriculture & hunting, Transport & communication, Dwelling economy) per capita [PLN]
x_3	Average useful floor area of dwelling per 1 person [m^2]
x_4	Proportion of dwellings connected to the water supply network [%]
x_5	Proportion of dwellings with a bathroom [%]
x_6	Proportion of dwellings with central heating [%]
x_7	Household consumption of gas from gas-line systems per 1 person [m^3]
x_8	Household consumption of electricity per 1 person [kWh]
x_9	Number of completed dwellings per 1,000 inhabitants
x_{10}	Entities entered in the REGON register per 10 thous. population
x_{11}	Length of local (county & gmina) hard-surfaced roads per 100 km^2 [km]
x_{12}	County average monthly gross wages and salaries in relation to their national average level [%]
x_{13}	Number of beds in tourist accommodation establishments per 1,000 inhabitants
x_{14}	Investment outlays in enterprises per capita [PLN]
x_{15}	Gross value of fixed assets in enterprises per capita [PLN]
	Social dimension (*Y*)
y_1	County budget expenditure (Div. Education, Health care, Culture & national heritage) per capita [PLN]
y_2	Demographic dependency ratio (non-working-age population per 100 persons of working age)
y_3	Deaths per 1,000 live births
y_4	Natural population increase per 1,000 people
y_5	Registered unemployment rate [%]
y_6	Enrollment rates (primary schools) [%]
y_7	Enrollment rates (lower secondary schools) [%]
y_8	Number of inhabitants per physician
y_9	Number of inhabitants per generally available pharmacy
y_{10}	Number of persons per bed in general hospitals
y_{11}	Number of persons per 1 place in stationary health care facilities
y_{12}	Proportion of children up to three years old in nurseries [%]
y_{13}	Number of children aged 3-5 per 1 place in preschool education establishments
	Ecological dimension (*Z*)
z_1	Annual emission of air pollutant gases from plants [tonnes per 1 km^2]
z_2	Annual emission of air pollutant particulates from plants [tonnes per 1 km^2]
z_3	Annual industrial wastewater (requiring treatment) released directly into water or soil [dm^3 per 1 km^2]
z_4	Forest cover (forest area/total land area) [%]
z_5	Household waste collected annually [kg per inhabitant]
z_6	Industrial wastewater generated annually [dm^3 per 1 km^2]
z_7	Municipal waste generated annually [dm^3 per 1 km^2]

* The selection of original variables was based on theoretical support existing in the literature and was mostly determined by data set on the development of Polish counties available in the CSO Local Data Bank

Source: own compilation

variables. In the selection process, the first principal component (F_1) contributes the most to the total variance while each succeeding component (F_2, ..., F_l) accounts for decreasing proportions of the total variance in the original variables X_i. The suitability of data for PCA was tested by Henry Kaiser (eigenvalue-one) criterion which states that only those factors (components) with eigenvalues greater than one will be retained in the model. The rotation technique was Orthogonal Varimax [Kaiser 1958, 1960].

The principal component (PC) value[7] was obtained by a linear combination of original variables, as follows (formula 1):

$$F_k = a_{1k}x_1 + a_{2k}x_2 + a_{3k}x_3 + \ldots + a_{nk}x_n \quad (1)$$

where: F_k – value of the k-th principal component, $k = 1, 2,\ldots, l$, x_i – value of the i-th original variable after standardisation, $i = 1, 2,\ldots, n$, a_{ik} – PC coefficient (factor loading) – correlation of the i-th original variable with the k-th PC.

The next step was to compute the synthetic index for each dimension (economic, social and ecological) of the j-th county's development in time (year) t using formula (2):

$$DSI_{jt} = b_1F_1 + b_2F_2 + b_3F_3 + \ldots + b_lF_l \quad (2)$$

where: DSI_{jt} – county's development synthetic index for each (economic, social and ecological) dimension[8] in time t, t (years) = 2006, ..., 2015, F_k – value of the k-th principal component, $k = 1, 2,\ldots, l$, b_l – estimated weight of the k-th principal component reflecting its contribution to total variance in the original data set.

To find out the degree of development sustainability, three-dimensional (3D) geometry was incorporated in the numerical analysis. Mazovian counties were treated as objects in 3D space. First, the equilibrium or balance across development dimensions was determined for the examined counties by applying a straight line L fitted through points P_{jt0} – each with three equal coordinates corresponding to these dimensions: X_{jt0}, (economic dimension), Y_{jt0} (social dimension) and Z_{jt0} (ecological dimension). As the sustainability concept refers to achieving a balance among the three pillars of equal importance, a sensible choice was to attribute equal weights (1/3) to each dimension. Thus, these coordinates were calculated according to the following formula (3):

$$X_{jt0} = Y_{jt0} = Z_{jt0} = (X_{jt} + Y_{jt} + Z_{jt})/3 \quad (3)$$

where: $X_{jt} = DSI_{ECjt}$ – the synthetic index of j-th county's development in the economic dimension, $Y_{jt} = DSI_{Sjt}$ – the synthetic index of j-th county's development in the social dimension, $Z_{jt} = DSI_{ENjt}$ – the synthetic index of j-th county's development in the ecological dimension, $j = 1, ..., 42$; $t = 2006, ..., 2015$.

The actual development of the j-th county is represented by point P_{jt} (X_{jt}, Y_{jt}, Z_{jt}) in 3D space. The degree of development sustainability of every county was identified by Euclidean distance d between point P_{jt} and P_{jt0}, expressed by formula (4):

[7] Before determining PC values and the synthetic index, original variables were standardized. As a result of classical standardization, the average variable (arithmetic mean) equals 0 and standard deviation equals 1.

[8] Synthetic indexes for the development of poviats were estimated for each of the three dimensions separately.

$$d_t = \sqrt{(X_{jt0} - X_{jt})^2 + (Y_{jt0} - Y_{jt})^2 + (Z_{jt0} - Z_{jt})^2} \quad (4)$$

where: X_{jt}, Y_{jt}, Z_{jt} – the coordinates of point P_{jt} depicting the actual development of j-th county in time t[9], X_{jt0}, Y_{jt0}, Z_{jt0} – the coordinates of point P_{jt0} located on line L ($X_{jt0} = Y_{jt0} = Z_{jt0}$).

The shorter the distance between the pair of points (P_{jt}, P_{jt0}) in 3D space, the more balanced the development of the j-th county is and *vice versa.*

RESEARCH RESULTS

Initially, in this research, the level of local development, according to individual dimensions (economic, social and ecological) for Mazovian counties, was measured by the synthetic indexes based on original data (see section on methods)[10].

In line with our results, in 2006-2015, the most economically progressive were towns with a county status (i.e. Warsaw, Płock, Ostrołęka), while the least developed were peripheral south-Mazovian land counties (lipski, przysuski, zwoleński). In the social dimension, the best performing were town counties (Siedlce, Ostrołęka, Płock), whereas the worst performing – land counties (siedlecki, lipski and przysuski). The most advanced in the ecological sphere were land counties: siedlecki, lipski and radomski. Conversely, town counties: Warsaw, Płock and Ostrołęka had the lowest ecological scores.

Table 2. Relationships between development dimensions for counties of the Mazovian region, 2006-2015

	Pearson correlation coefficients (R)		
Dimensions	economic	social	ecological
economic	1.00	0.84***	-0.54***
social	0.84***	1.00	-0.59***
ecological	-0.54***	-0.59***	1.00

*** denote significance level of 0.01; number of observations n = 420
Source: own research

As Table 2 demonstrates, there was a positive statistical relationship between the economic and social dimensions of local development but a negative correlation of these two components with the ecological dimension. It means that counties with a high economic development level simultaneously achieved a high social but low ecological development level. The group of such territorial units comprises mainly town counties (Warsaw, Płock, Ostrołęka, Siedlce and Radom). In turn, the backward counties in terms of economic development had a low level of social development but high level of ecological development. These are primarily land counties from eastern and southern parts of the Mazovian region.

[9] Coordinates (X_j, Y_j, Z_j) represent values of synthetic development indexes for the j-th county, in economic, social and ecological dimensions, respectively.

[10] In this study, the level of local development across the Mazovian Voivodship in respect to the three dimensions is only shown in a descriptive form due to editorial limits on the length of publishable articles.

Table 3. The degree of local (counties') sustainable development in the Mazovian Voivodship, 2006-2010

County	2006			2007			2008			2009			2010		
	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}
Białobrzeski	-1.85	3.95	31	-1.95	3.44	31	-1.48	3.38	29	-1.41	3.61	32	-1.01	2.55	26
Ciechanowski	-0.21	1.30	9	-0.05	1.05	6	0.13	1.14	8	-0.01	1.10	8	0.52	0.33	2
Garwoliński	-0.99	2.99	22	-0.80	2.76	20	-0.50	2.56	19	-0.44	2.44	17	-0.13	1.92	19
Gostyniński	-0.92	2.45	15	-0.81	2.27	14	-0.64	1.94	12	-0.57	1.98	13	-0.48	1.62	14
Grodziski	0.77	0.67	3	0.85	1.11	7	1.08	1.55	11	1.32	1.39	9	1.78	2.08	21
Grójecki	-0.65	1.59	10	-0.55	1.34	9	-0.36	0.78	5	-0.22	0.83	6	0.25	0.20	1
Kozienicki	-0.76	0.95	5	-0.51	1.25	8	-0.51	0.95	6	-0.39	0.65	2	-0.01	0.51	5
Legionowski	1.49	1.27	8	1.61	1.59	10	1.92	2.52	18	1.82	2.49	20	2.26	2.57	27
Lipski	-2.46	4.91	38	-2.25	4.39	35	-1.93	4.39	38	-2.16	4.30	38	-1.60	3.62	34
Łosicki	-1.56	3.28	28	-1.55	3.13	27	-1.22	2.84	22	-1.36	2.75	23	-0.93	2.19	22
Makowski	-1.50	3.48	29	-1.36	3.16	28	-1.27	3.28	27	-1.34	3.05	25	-0.82	2.35	23
Miński	-0.65	2.13	11	-0.19	1.72	11	-0.17	1.51	10	-0.03	1.40	10	0.13	0.87	8
Mławski	-0.79	2.17	12	-0.84	2.09	13	-0.55	1.51	9	-0.64	1.65	11	-0.39	1.27	10
Nowodworski	0.08	0.92	4	0.21	0.40	3	0.35	0.15	1	0.69	0.39	1	0.98	0.60	6
Ostrołęcki	-2.20	4.07	34	-1.82	3.67	34	-1.58	3.51	30	-1.57	3.48	31	-1.20	2.61	28
Ostrowski	-1.63	2.95	20	-1.28	2.53	17	-1.07	2.37	16	-1.20	2.50	21	-0.76	1.71	15
Otwocki	0.25	0.50	2	0.42	0.23	1	0.64	0.58	3	0.64	0.73	5	1.02	1.05	9
Piaseczyński	1.75	2.51	16	1.70	2.64	19	2.65	4.26	35	2.87	4.60	39	2.98	4.67	39
Płocki	-1.53	3.02	25	-1.59	2.93	24	-1.39	2.77	21	-1.19	2.56	22	-0.76	2.02	20
Płoński	-1.24	2.97	21	-1.12	2.64	18	-0.98	2.18	14	-0.81	2.06	14	-0.53	1.56	13
Pruszkowski	1.74	3.15	26	1.80	3.59	32	1.88	3.64	33	2.05	3.80	33	2.25	4.27	37
Przasnyski	-0.98	2.70	18	-0.93	2.48	15	-0.75	2.20	15	-0.80	2.36	16	-0.39	1.88	18
Przysuski	-2.56	4.76	36	-2.28	4.39	36	-2.14	4.28	36	-2.05	4.22	35	-1.79	3.46	33

Table 3. Cont.

County	2006			2007			2008			2009			2010		
	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}
Pułtuski	-0.98	3.00	24	-0.78	2.96	25	-0.69	2.91	23	-0.66	2.45	18	-0.17	1.28	11
Radomski	-1.60	3.83	30	-1.23	3.17	29	-1.05	3.01	24	-0.96	2.90	24	-0.70	2.46	24
Siedlecki	-2.80	4.96	39	-2.73	4.70	39	-2.37	4.35	37	-2.27	4.29	37	-2.08	3.81	35
Sierpecki	-1.30	2.69	17	-1.28	2.50	16	-1.04	2.40	17	-1.07	2.26	15	-0.62	1.78	16
Sochaczewski	-0.22	1.05	6	-0.22	0.66	4	0.00	0.69	4	0.29	0.72	4	0.39	0.37	3
Sokołowski	-1.57	3.23	27	-1.35	3.11	26	-1.29	3.04	25	-1.39	3.07	26	-1.05	2.54	25
Szydłowiecki	-2.11	4.02	32	-1.92	3.36	30	-1.68	3.33	28	-1.62	3.35	28	-1.60	3.02	30
Warszawski Zach.	1.16	2.44	14	1.38	2.84	23	1.67	3.60	32	1.56	3.44	30	1.92	4.00	36
Węgrowski	-1.84	4.02	33	-1.62	3.61	33	-1.39	3.58	31	-1.42	3.43	29	-0.95	2.79	29
Wołomiński	0.55	0.10	1	0.56	0.26	2	0.84	0.30	2	1.08	0.65	3	1.25	0.80	7
Wyszkowski	-0.59	2.24	13	-0.42	1.93	12	-0.20	1.98	13	-0.04	1.78	12	0.15	1.40	12
Zwoleński	-2.56	4.85	37	-2.40	4.58	37	-2.06	4.52	39	-1.96	4.19	34	-1.29	3.24	31
Żuromiński	-1.47	3.00	23	-1.32	2.80	22	-0.96	2.56	20	-0.98	2.45	19	-0.58	1.84	17
Żyrardowski	-0.42	1.10	7	-0.19	0.91	5	-0.10	1.03	7	-0.02	0.91	7	0.38	0.42	4
Town Ostrołęka	-2.31	15.84	42	-2.41	16.25	42	-1.42	13.99	42	-0.47	13.04	42	-0.62	14.18	42
Town Płock	1.50	8.89	40	1.55	8.91	40	1.86	9.24	40	1.58	8.62	40	1.69	9.06	40
Town Radom	0.94	2.85	19	1.11	2.80	21	1.45	3.11	26	1.51	3.15	27	1.78	3.40	32
Town Siedlce	1.56	4.49	35	1.76	4.65	38	2.25	4.06	34	2.27	4.22	36	2.80	4.50	38
Town Warszawa	3.31	10.55	41	3.74	11.28	41	4.16	11.59	41	4.34	11.33	41	4.54	12.21	41

P_{j0} – the j-th county's development equilibrium point; d – the distance of the j-th county's actual development point P_j from equilibrium point P_{j0} in three-dimensional space; P_{jr} – the j-th county's position in the rank according to the degree of development sustainability (from best to worst)
Source: own research

Table 4. The degree of local (counties') sustainable development in the Mazovian Voivodship, 2011-2015

County	2011			2012			2013			2014			2015		
	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}
Białobrzeski	-0.88	2.53	27	-0.95	2.43	25	-1.00	2.47	27	-0.87	2.31	25	-1.04	2.32	26
Ciechanowski	0.38	0.34	4	0.37	0.66	5	0.36	0.40	2	0.36	0.07	1	0.39	0.02	1
Garwoliński	-0.06	1.98	19	-0.04	1.80	16	-0.05	1.74	16	0.16	1.78	19	0.09	1.77	18
Gostyniński	-0.60	1.77	16	-0.29	1.32	12	-0.42	1.69	15	-0.66	1.59	15	-0.59	1.50	14
Grodziski	1.69	2.09	22	1.79	2.44	26	1.69	2.14	22	1.91	2.62	28	1.74	2.49	27
Grójecki	0.24	0.24	2	0.22	0.47	4	0.43	0.29	1	0.46	0.46	2	0.37	0.74	6
Kozienicki	-0.05	0.36	5	-0.04	0.26	2	0.73	1.96	19	0.66	2.76	29	0.92	3.39	34
Legionowski	1.99	2.45	26	2.14	2.57	27	2.05	2.65	28	1.90	2.42	27	1.84	2.61	28
Lipski	-1.42	3.42	34	-1.43	3.46	35	-1.47	3.37	33	-1.56	3.28	34	-1.76	3.38	33
Łosicki	-0.93	2.26	23	-0.92	2.21	22	-0.88	2.18	23	-0.65	2.01	21	-0.68	1.96	20
Makowski	-0.80	2.00	20	-0.86	2.12	21	-0.82	2.09	21	-0.65	2.06	22	-0.87	2.13	24
Miński	0.24	0.96	6	0.41	0.78	6	0.40	0.94	7	0.53	0.95	5	0.35	0.68	5
Mławski	-0.30	0.96	7	-0.22	1.07	10	-0.36	1.04	9	-0.18	0.71	4	-0.18	0.66	4
Nowodworski	1.16	1.13	10	0.94	0.85	7	0.95	0.90	5	0.97	1.08	10	1.06	1.49	13
Ostrołęcki	-1.14	2.66	28	-1.09	2.61	28	-0.71	2.19	24	-0.65	2.22	24	-0.84	1.99	21
Ostrowski	-1.00	2.07	21	-0.93	2.01	20	-0.91	2.01	20	-0.75	1.73	17	-0.76	1.82	19
Otwocki	0.95	1.05	9	1.03	0.98	9	1.16	0.91	6	1.15	0.95	6	1.02	1.08	9
Piaseczyński	2.93	4.55	39	2.91	4.39	37	2.97	4.24	38	3.06	4.35	37	3.20	4.37	36
Płocki	-0.77	1.95	18	-0.79	1.96	18	-0.77	1.84	17	-0.75	1.74	18	-0.79	1.72	17
Płoński	-0.47	1.44	12	-0.43	1.63	13	-0.45	1.37	12	-0.38	1.08	11	-0.55	1.09	10
Pruszkowski	2.44	4.19	36	2.40	3.86	36	2.44	4.00	36	2.55	4.63	38	2.54	4.74	38
Przasnyski	-0.33	1.72	14	-0.49	1.79	15	-0.38	1.64	14	-0.04	1.20	12	0.05	0.63	3
Przysuski	-1.58	3.39	33	-1.56	3.37	34	-1.27	3.30	32	-1.20	3.09	33	-1.28	3.24	32

Table 4. Cont.

County	2011			2012			2013			2014			2015		
	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}	P_{j0}	d	P_{jr}
Pułtuski	-0.09	1.55	13	-0.11	1.69	14	-0.10	1.32	11	-0.18	1.54	14	-0.11	1.56	15
Radomski	-0.69	2.45	25	-0.66	2.40	24	-0.71	2.26	26	-0.70	2.17	23	-0.73	2.09	23
Siedlecki	-1.71	3.45	35	-1.59	3.34	33	-1.80	3.46	35	-1.39	2.98	31	-1.50	3.04	31
Sierpecki	-0.50	1.76	15	-0.60	1.87	17	-0.39	1.44	13	-0.43	1.40	13	-0.46	1.29	11
Sochaczewski	0.26	0.11	1	0.65	0.30	3	0.68	0.48	4	0.58	0.48	3	0.48	0.42	2
Sokołowski	-0.96	2.44	24	-0.90	2.22	23	-0.88	2.20	25	-0.69	1.92	20	-0.73	2.00	22
Szydłowiecki	-1.38	3.15	31	-1.36	3.00	31	-1.31	2.96	30	-1.23	2.90	30	-1.34	2.88	29
Warszawski Zach.	2.01	4.22	37	2.26	4.71	38	2.14	4.15	37	2.07	4.15	36	2.20	4.62	37
Węgrowski	-1.00	2.87	29	-0.95	2.75	29	-0.70	2.70	29	-0.83	2.38	26	-0.94	2.24	25
Wołomiński	1.41	1.02	8	1.33	0.88	8	1.42	1.03	8	1.31	1.06	9	1.50	1.41	12
Wyszkowski	0.06	1.37	11	0.25	1.19	11	0.27	1.09	10	0.42	0.98	8	0.31	0.88	7
Zwoleński	-1.48	3.18	32	-1.46	3.09	32	-1.20	3.01	31	-1.10	3.04	32	-1.23	2.94	30
Żuromiński	-0.58	1.84	17	-0.54	1.97	19	-0.70	1.85	18	-0.52	1.61	16	-0.71	1.60	16
Żyrardowski	0.28	0.34	3	0.29	0.23	1	0.30	0.43	3	0.32	0.96	7	0.25	1.00	8
Town Ostrołęka	-0.97	15.15	42	-0.27	15.33	42	-0.16	15.56	42	-0.94	15.49	42	0.10	13.72	42
Town Płock	1.74	9.07	40	2.03	9.80	40	1.82	9.42	40	2.46	10.25	40	2.32	10.38	40
Town Radom	1.71	2.95	30	1.71	2.99	30	1.94	3.37	34	1.90	3.35	35	1.87	3.43	35
Town Siedlce	3.00	4.53	38	3.08	4.89	39	2.93	4.94	39	2.98	5.11	39	3.13	5.65	39
Town Warszawa	4.84	12.03	41	5.00	12.49	41	4.90	12.41	41	5.28	13.31	41	5.05	13.36	41

Meaning of the symbols as in Table 3
Source: own research

The main findings of the analysis are presented in Tables 3 and 4. The ranking position of an individual county according to the development sustainability degree depends on the year of observation. In the period 2006-2015, the following ten counties were among the top three in terms of sustainability: ciechanowski (2010, 2013, 2014, 2015), grodziski (2006), grójecki (2010, 2011, 2013, 2014), kozienicki (2009, 2012), nowodworski (2007, 2008, 2009), otwocki (2006, 2007, 2008), przasnyski (2015), sochaczewski (2010, 2011, 2012, 2014, 2015), wołomiński (2006, 2007, 2008, 2009) and żyrardowski (2011, 2012, 2013). Almost all of them are situated in the central part of the Mazovian province. On the contrary, the lowest sustainability scores were obtained by towns with a county status (Ostrołęka, Płock, Warsaw, 2006-2015), and counties adjacent (from the west or south-west side) to the capital city of Warsaw (piaseczyński, pruszkowski and warszawski zachodni).

The average (across counties) degree of development sustainability did get stronger in 2006-2011 but during the next years, from 2012 to 2015, it declined. When the sustainability degree beginning from 2006 is compared with the end of 2015, it is visible that remarkable improvement (as measured by the distance d reduction) was achieved by Ostrołęka town as well as ostrołęcki and przasnyski counties. In turn, the largest sustainability deterioration occurred in Warsaw, kozienicki and warszawski counties. There were also visible shifts in the ranking of counties based on their development sustainability degree. Only three town counties (Warsaw, Płock and Ostołęka) unchanged their position in 2015 compared to 2006. The counties which considerably moved up in the ranking include przasnyski (by 15 places), ostrołęcki (by 13 places) and płoński (by 11 places). On the contrary, counties which went down in the ranking the most are: kozienicki (by 29 places), grodziski (by 24 places) and warszawski zachodni (by 23 places).

Generally speaking, in the period of 2006-2015, the greatest sustainability of local development was experienced by Mazovian counties situated some 50 kilometres away from Warsaw, the capital city of Poland, characterised by a relatively high development level in all three dimensions (economic, social and ecological). The exceptions here were three counties bordering Warsaw: piaseczyński, pruszkowski and warszawski zachodni, all with a low degree of sustainability. On the opposite side of the examined counties are those with the lowest degree of sustainability, represented by towns with a county status, having a relatively high level of economic and social development but low level of ecological development. The third group of counties consists of those in the east and south of Mazvian Voivodship where inferior economic and social development levels were accompanied by a good performance in ecological/environmental aspects.

SUMMARY

1. Taking into account the level of local development measured for Mazovian counties in the period of 2006-2015:
– in the economic dimension, the most developed were towns with a county status (Warsaw, Płock and Ostrołęka), while the least developed were lipski, przysuski, zwoleński and siedlecki counties; developmental gaps between the investigated counties increased;

– in the social dimension, the best performing were towns with a county status (Ostrołęka, Siedlce, Płock, Warsaw and Radom), while the worst performing were siedlecki, lipski, przysuski and płocki; developmental gaps between the investigated counties declined;
– in the ecological dimension, the leading counties were siedlecki, lipski and radomski, while in the bottom were kozienicki county and town counties (Ostrołęka, Płock, Warsaw, Siedlce, Radom); development differences between counties became lower.

2. The highest degree of local development sustainability was found for land counties near the capital, Warsaw (distance up to 50 kilometres), while the lowest for town counties (Ostrołęka, Płock, Warsaw) and some land counties directly adjacent to Warsaw (piaseczyński, pruszkowski, warszawski zachodni) as well as for land counties in the east and south part of the Mazovian Voivodship (siedlecki, przysuski, lipski, zwoleński). Thus, the study hypothesis was rejected. In contrast to town counties and land counties surrounding Warsaw, which were at a high level of economic and social development but low level of ecological development, peripheral south-east Mazovian counties were handicapped in economic and social dimensions but well performing in the ecological dimension.
3. The degree of sustainability constitutes one of the research elements on local sustainable development. The mere presence of balance between sustainability components when at a low level does not condition a high level of community standard or quality of life. To ensure this, both high levels of development components and a balance between them are required.
4. Adequate and objective measures of sustainable development, including composite multi-dimensional or separate indexes covering economic, social and ecological aspects as well as indicators of sustainability degree applied for assessments at a regional or local level may be useful tools for decision makers. They can help in the establishment of tailored public (economic, social and ecological) policies to improve sustainability.

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STOPIEŃ ZRÓWNOWAŻENIA ROZWOJU LOKALNEGO (NA PRZYKŁADZIE POWIATÓW WOJEWÓDZTWA MAZOWIECKIEGO W POLSCE)

Słowa kluczowe: zrównoważenie, rozwój lokalny, powiaty, NUTS4, województwo mazowieckie, Polska

ABSTRAKT

Celem pracy jest określenie stopnia zrównoważenia rozwoju powiatów województwa mazowieckiego w latach 2006-2015. Badania przeprowadzono na populacji 42 powiatów (jednostek terytorialnych na poziomie NUTS-4), obejmującej 5 powiatów miejskich (miast na prawach powiatu) i 37 powiatów ziemskich. Na podstawie danych z Banku Danych Lokalnych GUS zbadano trzy wymiary rozwoju: gospodarczy, społeczny i ekologiczny (środowiskowy). Zastosowano własne podejście koncepcyjne, obejmujące syntetyczne wskaźniki dla poszczególnych wymiarów oraz analizę odległości euklidesowej, aby uchwycić interakcje i równowagę między trzema filarami zrównoważonego rozwoju. Wyniki badań wskazują, że najwyższy stopień zrównoważenia rozwoju lokalnego osiągnęły powiaty położone do 50 km od stolicy Polski – Warszawy (tj. grodziski, grójecki, nowodworski, otwocki, sochaczewski, wołomiński i żyrardowski), natomiast najniższy, zarówno miasta na prawach powiatu (Ostrołęka, Płock i Warszawa), jak i powiaty położone peryferyjnie we wschodniej i południowej części województwa mazowieckiego (siedlecki, przysuski, lipski i zwoleński). W rankingu według stopnia zrównoważenia powiatów w 2015 roku pierwsze trzy miejsca zajęły powiaty ciechanowski, przasnyski i sochaczewski, a trzy ostatnie miasta na prawach powiatu: Ostrołęka, Płock i Warszawa.

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