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THE STANDARD OF LIVING AND ITS SPATIAL DIFFERENTIATION AMONG RURAL MUNICIPALITIES IN WARMIA-MASURIA PROVINCE

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ABSTRACT

This manuscript presents the results of the research on the spatial differentiation of the level of living among the rural municipalities of the Warmia-Masuria Province in the years 2005 and 2018. The rural areas are currently undergoing many changes, including sub-urbanisation processes and a departure from their monofunctional perception. The multi-dimensional analysis (Hellwig's development pattern method) was used to measure the level of living in selected rural municipalities. Then, the Ward's method was employed to identify the similarities in the level of living in these territorial units. The results indicate a significantly higher level of living established based on the synthetic measure value in the municipalities adjacent to the leading urban centres of the region, i.e., Stawiguda or Dywity. In turn, the relatively lowest living standards were demonstrated in the municipalities bordering the Russian Federation. Strong spatial dispersion of this phenomenon, combined with the petrification of the positions at the top and at the bottom of the ranking, indicates the need to implement a different development strategy for these specific units. The implementation of the Smart Village concept, facilitating the sustainable development of rural areas, as well as extensive cooperation of local government leaders with experts and scientists may offer practical solutions in this regard.

Key words: level of living, regional diversification, rural areas, multidmensional analysis

INTRODUCTION

Economic development is a consequence of many processes and phenomena of diverse origins. Therefore, its measurement poses multiple difficulties. Nevertheless, from the perspective of societies, the economic development should increase prosperity and living standards. Among many concepts of prosperity measurement, synthetic measures combining material and non-material elements have been the most popular in recent years (Reinsdorf 2020, pp. 9–10, Kasprzyk 2015, pp. 287–291, Drabsch 2012, pp. 9–16, Biernacki 2006, pp. 115–124). This is mainly due to the indicated flaws of the gross domestic product (GDP) as a complete measure of development (Stiglitz et al. 2009, pp. 21–41, Aitken 2019, pp. 1–12). The reservations related to operationalisation also concern living standards (Kalinowski 2015, pp. 13–25, Berbeka 2006).

At the same time, economic development contributes to radical changes in regions and populations living therein. This refers to the rural areas as well, which are currently undergoing numerous

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transformations also as a result of cohesion processes. Changes in demographic structures, delay or suspension of decisions on procreation or marriage, migrations, and diverging from the traditional monofunctional perception of the rural areas are just a few reasons that make the concept of rural areas' multifunctionality increasingly important (Jezierska-Thole 2013, pp. 25–27, Kłodziński 2008, pp. 40–56, Czarnecki 2011, pp. 88–97, Wilkin 2011, pp. 117–139, MROW 2014, pp. 37). The high spatial dispersion of the social and economic development of rural areas, depending both on location (Wiggins and Proctor 2001, pp. 432–435) and economy (Terluin 2003, pp. 331–337), may thus be emphasised (Stanny 2012, pp. 18–20).

Given Poland's membership in the European Union for over fifteen years, it seems advisable to assess changes in the level of living of inhabitants of the rural areas, particularly those at the lowest level of administrative division (NUTS 5). Over that period, the rural areas of eastern Poland (located in Lublin Province, Podkarpackie Province, Podlasie Province, Świętokrzyskie Province, and Warmia-Masuria Province), included in the catalogue of the European regions with the lowest living standards, have become the beneficiaries of numerous programmes financed from EU funds, the primary goal of which was to improve the living conditions of the population (Dudek and Wrzochalska 2017, pp. 194–197). The importance of these areas from the perspective of the European structures is undisputed, mainly due to their peripherality and neighbourhood of countries that are not EU member states. Meanwhile, these areas still suffer from the scarcity of growth factors and remain regions with a relatively low level of living according to EU classifications. Among the eastern regions of Poland, the Warmia-Masuria Province is characterised by low population density, severe depopulation of the rural areas, a considerable percentage of social welfare assistance recipients, insufficient social and economic infrastructure. Another characteristic feature of the Province is the relatively small and overcrowded flats (Kozera and Stanisławska 2019, pp. 236–241). In extreme cases, due to unfavourable socio-economic conditions, the rural areas of this region have become enclaves isolated from the integrated social spaces and settlement infrastructure. Furthermore, founding the activity on strongly dispersed farms and mono-functionality of the areas have inscribed this part of the state into the concept of remote rural areas developed by the OECD at the end of the 20th century (What future for our countryside 1993). Apart from the undeniable values of the natural environment, the living conditions of inhabitant left much to be desired (Źróbek-Różańska 2020, pp. 1–15).

When analysing rural areas, increasing consideration is given to the concept of Smart Village. Being derived from the concept of Smart Cities, it proposes solutions to the problematic issues of depopulation, maladjustment of settlement infrastructure (including health issues), and social competences, thereby having a real impact on life quality of residents (Garau and Pavan 2018, pp. 1–18, Haarstad 2017, Bibri and Krogstie 2017, Nam and Pardo 2011, Farelnik and Stanowicka 2016, pp. 359–370). While much attention is paid to the issues of management, public transport, care for the environment, and finally IT technologies in the analysis of urban areas, "shortening the distance" to cities (including in the access to services, e.g. medical care) and increasing the social competences of the population seem to be of key importance in the case of rural environments. Effective implementation of the Smart Village concept becomes an important determinant of the functioning of public administration institutions at every level (Naldi et al. 2015, pp. 90–101, Isserman et al. 2009, pp. 300–342, Orchel-Szeląg 2019, pp. 6–9, Adamowicz and Zwolińska-Ligaj 2020, Komorowski and Stanny 2020).

Considering the above, this study aimed to analyse changes in the level of living in 67 rural municipalities of the Warmia-Masuria Province over the years 2005–2018. The base year was the first full year of Poland's membership in the EU, while the last year of analysis was the most recent year the data were available for. The multidimensional analysis was employed to determine the synthetic measure of the level of living. Then, rural municipalities

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of the Province were grouped according to its value. Moreover, the municipalities with the most similar level of living have been identified with the use of hierarchical methods.

MATERIALS AND METHODS

The level of living was assessed with the so-called synthetic measure of development, which allows presenting a situation of regional differentiation in the level of living, considering numerous socio-economic categories, in an easily accessible manner (i.e., through just one numerical value). This is achieved via the transformation of a multi-dimensional set of data to a single numerical value, typically from a predefined range of values. Thus, the analysed phenomenon can be described with the utmost clarity. Next, the rearrangement of these numerical values enables scrutinising the situation in particular areas and detect mutual relationships. However, the procedure is rather complex as it comprises several steps, which will be described in greater detail underneath.

What is fundamental for the reliability of the achieved results is selecting diagnostic variables (partial factors). They must fulfill the formal and statistical requirements, but above all, they must pertain to the subject of an analysis. Variables submitted to the final analysis were distinguished by: general approval, measurability, accessibility of numerical data, relatively high quality, and very strong connection to the subject matter (Zeliaś et al. 2000, pp. 36–37). One of the attributes of the variables proposed in this study was their realness, which in turn arose from the data being made relative to the population size and from the inclusion of their importance expressed as a percent contribution of each phenomenon. This approach enabled excluding the impact of the size of a rural municipality (measured by the size of its population or in other absolute numbers) on generated values of the diagnostic variables (and consequently, on the subsequent classification of municipalities). Given the above, the empirical research included only these variables which met the requirements established in connection with the formal and statistical criteria. The following were treated as necessary conditions (Malina 2004, p. 95):

a) completeness of data in the entire analysed time series;
b) sufficient spatial variability, measured with the variability coefficient ($v_j > 10$ per cent)[1];
c) absence of excessive mutual correlation of variables[2].

Once the diagnostic properties had been chosen, the subsequent stage of the study was undertaken, which consisted of unitarisation[3]. This stage enabled transforming variables (often expressed in different units) to a state of comparability (in our case, to express them in a range from 0 to 1), using the following formula:

$$z_{ij} = \frac{x_{ij} - \min\limits_{i} \{x_{ij}\}}{\max\limits_{i} \{x_{ij}\} - \min\limits_{i} \{x_{ij}\}}$$

[1] Variables characterised by a lower variability coefficient than indicated are regarded in the literature as relatively stable and not contributing significant information about the analysed phenomenon, or not possessing discriminating abilities. Cf. Zeliaś et al. (2000), p. 127.

[2] The occurrence of strongly correlated characteristics in the set of diagnostic variables means that these characteristics assign greater importance to the data, which are replicated in the performed analysis (similar data are entered into the analysis via correlated variables). This may lead to a situation where the taxonomic analysis would yield an unreliable description of the analysed reality due to excessive weight of excessively correlated variables.

[3] Unitarisation (next to standarisation and normalisation) is one of the normalising formulas which bring variables to a certain range (to a state of comparability) while removing units of measure. This procedure helps avoiding situations in which variables with high absolute values (by an order of magnitude compared to other variables) would have a decisive contribution to the construction of the synthetic indicator of the level of living. This would mean, in other words, that the results of classification might be distorted by these variables, by accentuating their impact relative to the other ones. Compared to standarisation, unitarisation allows avoiding a situation where extreme values of certain variables would bias the final results of the synthetic indicator calculations. Unlike standarisation, unitarisation enables eliminating such situations, as it brings all data down to an interval from 0 to 1, both left- and right-bounded. Cf. M., Nardo, M., Saisana, A., Saltelli, S., Tarantola, A., Hoffman, E., Giovannini. (2005). Handbook on constructing composite indicators. Methodology and user guide, OECD, STD/DOC, no 3, Paris 2005, p. 18.

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where:

z_{ij} – unitarised value of the j^{th} variable for the i^{th} object,

x_{ij} – value of the j^{th} variable for the i^{th} object.

Once the character of each of the variables included in the research had been evaluated (which meant that they were identified as stimulants[4] or destimulants[5]), the destimulants had to be submitted to the process of stimulation, i.e., to the process of a destimulant transformation into a stimulant, to ensure that the direction of impact for all the variables was the same and that higher values of the synthetic measure represented a higher level of living. The following stimulation formula was employed to this end (Walesiak 2006, p. 18):

$$x_{ij} = \mathrm{a} - \mathrm{b}x_{ij}^{D}$$

where:

j – a variable,

i – the research object (a rural municipality),

a, b – arbitrary constants: b = 1, $\mathrm{a} = \max_i \{x_{ij}^{D}\}$,

x_{ij}^{D} – value of the j^{th} destimulant in the i^{th} object.

The consecutive step in our analysis involved the derivation of coordinates of the template composed of the most advantageous values scored by the individual variables in the rural municipalities analysed:

$$z_{0j} = \begin{cases} \max_i \{z_{ij}\}\ dla\ z_j^S \\ \min_i \{zij\}\ dla\ z_j^D \end{cases}$$

Afterwards, distances were calculated between individual rural municipalities and the template, using the Euclidean metric in the following form (Panek 2009, p. 69):

$$d_{i0} = \sqrt{\sum_{j=1}^{m} (z_{ij} - z_{0j})^2}$$

where:

d_{i0} – distance of the object to the template

z_{ij} – value of normalised variable j for the i^{th} of this object

z_{0j} – coordinates of the template object for the j^{th} variable.

The penultimate step in the research was to determine the value of the synthetic indicator, which served to arrange the rural municipalities with respect to their inhabitants' level of living. The calculations were based on the following formulas (Panek 2009, p. 69):

$$s_i = 1 - \frac{d_{i0}}{d_0}, \quad d_0 = \overline{d}_0 + 2S(d_0),$$

$$\overline{d}_0 = \frac{1}{n}\sum_{i=1}^{n} d_{i0}, \quad S(d_0) = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (d_{i0} - \overline{d}_0)^2}$$

where:

S_i – synthetic measure of development,

d_{i0} – distance of the object from the template,

$\overline{d}$ – arithmetic mean $\mathrm{d}_{0,}$

$S(d_0)$ – standard deviation $\mathrm{d}_{0.}$

Once the rural municipalities had been arranged in terms of the value of the living standard measure, the final stage of analysis was to classify individual territorial units into four clusters, depending on the synthetic indicator value. The classification was made in the following intervals:

Cluster 1: $w_i \in [\overline{w} + s_w, 1]$,

Cluster 2: $w_i \in [\overline{w}, \overline{w} + s_w)$,

Cluster 3: $w_i \in [\overline{w} - s_w, \overline{w})$,

Cluster 4: $w_i \in [0, \overline{w} - s_w)$.

where:

w_i – synthetic indicator,

$\bar{w}$ – mean value of the synthetic indicator,

S_w – standard deviation of the synthetic indicator.

[4] Diagnostic variables whose increase in the analysed time period informs about the positive influence on the described phenomenon. In this case, variables counted as stimulants informed about some improvement in the standard of living of the municipality residents.

[5] Diagnostic variables whose increase informs about an adverse effect on the analysed phenomenon. In this case, an increase in the value of any of the variables counted as destimulants proved that the level of living decreased.

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Based on the selected variables, differences in the level of living were analysed using the Hellwig's method (Hellwig 1968, pp. 304–320, Bielak and Kowerski 2018, pp. 153–158). The synthetic values of development measure achieved allowed for the linear arrangement of rural municipalities in terms of the intensity of the scrutinised phenomenon.

The above analysis was completed with the determination of similarities in the level of living of inhabitants of the discussed territorial units. The rural municipalities were grouped using the classification methods aimed at distinguishing possibly the most homogenous clusters of objects considering the similarity in terms of the structure of individual observations. In this study, these were the synthetic measures of the level of living. The distinguished groups of objects should be strongly differentiated between groups but homogenous within them as much as possible (Młodak 2006, p. 66). In brief, this method aims to minimise the sum of squares of standard deviations of two clusters, that can be formed at each stage, and employs the analysis of variance approach to estimate distances between the clusters.

Ultimately, the Ward's method was chosen to achieve a hierarchy of agglomerations, in which the starting point is the number of clusters equal to the number of objects of a study. The criterion applied to group the units into higher-order clusters (groups) was the minimum differentiation in the values of the traits (Stanisz 2007, p. 122) that served as the criteria for the segmentation regarding the values of the clusters created at the consecutive steps (Rószkiewicz 2010, p. 6). As a result, objects included into particular groups were characterised by the highest possible similarity of the analysed traits. In turn, the subsequent iterations are defined by the distance (d_{ip}) between a newly created cluster and the remaining ones, derived from the following formula (Balicki 2009, p. 278):

$$d_{ip} = \frac{n_i + n_k}{n_i + n_j + n_k} d_{ik} + \frac{n_j + n_k}{n_i + n_j + n_k} d_{jk} - \frac{n_k}{n_i + n_j + n_k} d_{ij}$$

where:

n_i – number of items in cluster i,
n_j – number of items in cluster j,
n_k – number of items in cluster k,
d_{ik} – distance from the original cluster i to cluster k,
d_{jk} – distance from the original cluster j to cluster k,
d_{ij} – distance between the original clusters i and j.

The Ward's method is widely accepted owing to its theoretical properties and satisfying results of simulation studies[6]. Its application allows achieving excellent results of clustering, where clusters are very homogeneous. Its other advantage is the clarity of presentation via dendrograms[7].

In an attempt to create a synthetic measure of development that would describe the spatial differentiation in the level of living, the first step of the taxonomic stage of the research was to select diagnostic traits. Worthy of emphasising is the highest subjectivity of this step of the research. A scientist needs to design such a range of characteristics that would best represent the analysed phenomenon. Our choice of diagnostic variables to calculate the synthetic measure of development was based on criteria connected with the subject matter and the formal and statistic aspects. The selected variables were characterised by the following properties (Zeliaś et al. 2000, pp. 37–38): they were commonly approved, highly relevant for the subject matter, measurable,

[6] By completing a series of simulations, Grabiński and Sokołowski (1980) proved that the effectiveness of finding the true structure of data with this method is by around 40% higher than obtained with the second most common method, one of the farthest neighbour clustering. Cf. T., Grabiński, A., Sokołowski. (1980). The effectivness of some identification procedures, signal processing. Theories and applications, in: M., Kunt, F., De Coulon, North-Holland Publishing Company, UERASIP, Amsterdam, after: J. Berbeka. (2006). Poziom życia ludności a wzrost gospodarczy w krajach Unii Europejskiej, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

[7] A dendrogram is a tree-shaped diagram showing connections between analysed objects based on the adopted criteria. In the Ward's method, a dendrogram shows subsequent steps (iterations) in the clustering process – from leaves (single rural municipalities) to the root (one cluster).

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supported by available numerical data, relatively high in quality, and were derived from a thorough review of the literature. The variables were transformed relative to the populations of rural municipalities to minimize the influence of the size of a given municipality on the achieved values of the variables.

The research sample consisted of statistical data connected with the level of living in 67 rural municipalities (Fig. 2) in the Warmia-Masuria Province (Fig. 1). The parameters chosen for the study are measurable and reliable because they were derived from the official publications issued by the Polish Statistical Office (Bank of Local Data). A comparative analysis was made for the years 2005 and 2018 to verify a hypothesis that the level of living in rural areas increased after Poland accessed the European Union.

The variables included in our research pertain to many fields of life, e.g., demography, housing, labour market, social and cultural infrastructure, environmental protection, and financial indicators of the territorial units. Some of the potential variables were eliminated at the early selection stage, mostly because of the incompleteness of data and, less often, because the aggregation of data at this level of the administrative division was impossible due to some organisational and formal obstacles. Even at this level, spatial dispersion could be observed in some of the diagnostic variables. Economic, demographic, and educational aspects of the analysis were the strongest polarizing factors of the described population. Inter-

Fig. 1. Warmia-Masuria province and its location
Source: own study

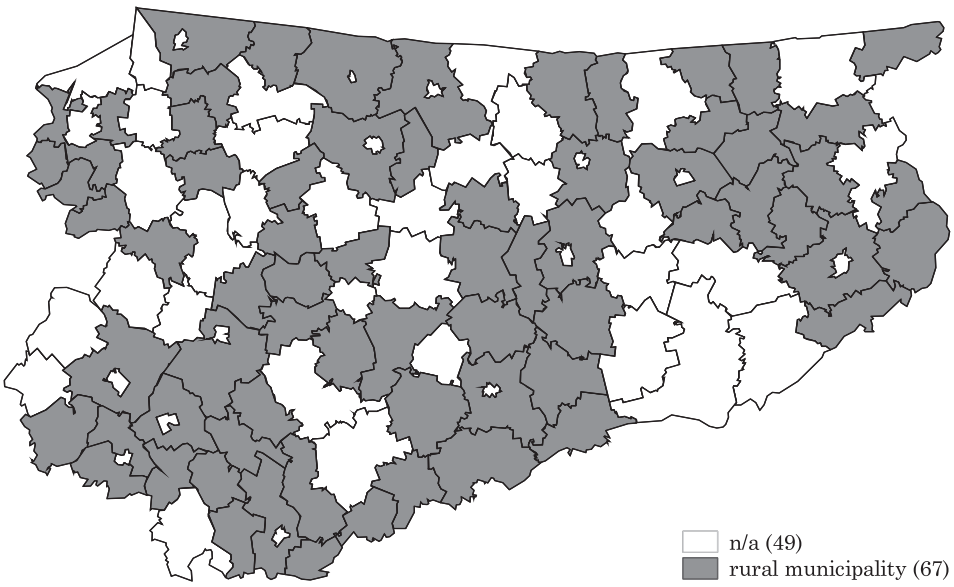

Fig. 2. Rural municipalities in Warmia-Masuria Province
Source: own study

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estingly, in many cases, the partial indicators achieved higher values in 2018 compared to the base year (2005), which was usually indicative of the improved living standards of inhabitants of the rural municipalities analysed over this period.

The formal and statistical tests allowed collating the final set of variables describing differences in the level of living in rural municipalities of the Warmia--Masuria Province (Table 1).

Table 1. Diagnostic variables considered in the synthetic indicator of the level of living

No.	Variable name	Variable character
1	population density	stimulant
2	rural municipality own incomes per capita	stimulant
3	rural municipality total expenditures per capita	stimulant
4	rural municipality expenditures on municipal economy and environment protection per capita	stimulant
5	entities entered in the REGON register per 10,000 inhabitants	stimulant
6	entities per 1000 inhabitants of working age	stimulant
7	foundations, associations, and social organizations per 1,000 inhabitants	stimulant
8	post-working age population per 100 inhabitants of working age	destimulant
9	children in pre-school education institutions per 1,000 children aged 3–5 years	stimulant
10	share of registered unemployed persons in the working age population [%]	destimulant
11	number of flats per 1,000 inhabitants	stimulant
12	average floor area of the flat per capita [m^2]	stimulant
13	inhabitants using sewage treatment plants [%]	stimulant
14	book collection of libraries per 1,000 inhabitants	stimulant

Source: own study

RESULTS AND DISCUSSION

Based on research conducted, it should first be stated that the level of living, established based on the synthetic measure value, increased in most rural municipalities surveyed. That meant the improvement in conditions for enterprises operating therein and the development of the social and economic infrastructure. The situation was, to a substantial degree, caused by the improvement in municipal infrastructure, development of education, and environmental aspects. All these elements contributed to the improvement in the living conditions of the local populations. In addition, this situation inscribes into the discussions related to the essential determinants of the intelligent development, the key ones of which include activities connected with infrastructure, mobility, and effective public management (Guedes et al. 2018, p. 10)

At the same time, results of the study confirmed the thesis on the regional polarisation of the level of living. In both the first and the last year of analysis, the same territorial units were leaders, including mainly rural municipalities adjacent to large urban centres (Table 2). A meaningful role can be attributed in this process to the growing revenues to budgets of municipalities and skillful use of European funds, including those dedicated to these areas increasing (see: OP Development of Eastern Poland, Sadowski et al. 2021) For this reason, the highest level of living, assessed based on the synthetic measure value in 2018, was recorded for Stawiguda, Dywity, Gietrzwałd, and Jonkowo municipalities, which are the backbone of the capital of the region and Province – Olsztyn. Next in the list were the units in an analogous situation (rural municipalities: Giżycko, Ełk, Purda, Jedwabno), i.e., located in the immediate vicinity of large population centres. All units listed above were included in the first group, distinguished by the highest level of living among the rural municipalities of the Province. Simultaneously, the value of the synthetic measure for Stawiguda in 2018 (0.7248) was many times higher than the respective values for the municipalities at the bottom of the list. The lowest value of the measure was recorded for Budry municipality in Węgorzewo

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Table 2. Ranking of municipalities based on the synthetic measure of the standard of living in 2005 and 2018

Municipality	Province	Ranking 2018	Ranking 2005	Value of the indicator 2018	Value of the indicator 2005
Stawiguda	olsztyński	1	1	0.7248	0.6593
Dywity	olsztyński	2	2	0.5546	0.5485
Gietrzwałd	olsztyński	3	3	0.5407	0.5263
Jonkowo	olsztyński	4	4	0.4387	0.4638
Giżycko	giżycki	5	5	0.4101	0.4045
Ełk	ełcki	6	45	0.3957	0.1596
Jedwabno	szczycieński	7	6	0.3621	0.3663
Purda	olsztyński	8	8	0.3598	0.3388
Ostróda	ostródzki	9	14	0.3446	0.2999
Kruklanki	giżycki	10	21	0.3411	0.2607
Elbląg	elbląski	11	7	0.3324	0.3553
Łukta	ostródzki	12	9	0.3289	0.3217
Piecki	mrągowski	13	12	0.3221	0.3017
Świętajno	szczycieński	14	17	0.3008	0.2855
Iława	iławski	15	36	0.2960	0.1963
Miłki	giżycki	16	23	0.2948	0.2509
Biskupiec	nowomiejski	17	15	0.2930	0.2978
Wydminy	giżycki	18	26	0.2860	0.2398
Nowe Miasto Lubawskie	nowomiejski	19	40	0.2780	0.1864
Mrągowo	mrągowski	20	39	0.2698	0.1896
Kurzętnik	nowomiejski	21	38	0.2628	0.1898
Milejewo	elbląski	22	20	0.2586	0.2624
Rybno	działdowski	23	22	0.2566	0.2553
Lubomino	lidzbarski	24	25	0.2488	0.2423
Płoskinia	braniewski	25	29	0.2425	0.2160
Sorkwity	mrągowski	26	10	0.2347	0.3140
Świątki	olsztyński	27	27	0.2346	0.2287
Płośnica	działdowski	28	30	0.2284	0.2122
Pozezdrze	węgorzewski	29	31	0.2268	0.2115
Gronowo Elbląskie	elbląski	30	18	0.2239	0.2813
Janowo	nidzicki	31	53	0.2208	0.1400
Szczytno	szczycieński	32	35	0.2111	0.2037
Kętrzyn	kętrzyński	33	55	0.2106	0.1374
Iłowo-Osada	działdowski	34	24	0.2086	0.2498
Grodziczno	nowomiejski	35	52	0.2079	0.1432
Grunwald	ostródzki	36	61	0.2044	0.1060
Dąbrówno	ostródzki	37	16	0.2038	0.2901
Kowale Oleckie	olecki	38	19	0.2037	0.2676
Małdyty	ostródzki	39	13	0.1948	0.3012

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Dźwierzuty	szczycieński	40	48	0.1940	0.1511
Świętajno	olecki	41	11	0.1886	0.3058
Prostki	ełcki	42	43	0.1882	0.1711
Stare Juchy	ełcki	43	32	0.1880	0.2111
Srokowo	kętrzyński	44	47	0.1759	0.1539
Lidzbark Warmiński	lidzbarski	45	57	0.1736	0.1200
Wieliczki	olecki	46	34	0.1724	0.2096
Dubeninki	gołdapski	47	41	0.1679	0.1740
Kiwity	lidzbarski	48	59	0.1640	0.1158
Bartoszyce	bartoszycki	49	58	0.1638	0.1181
Rychliki	elbląski	50	63	0.1537	0.1015
Kozłowo	nidzicki	51	50	0.1495	0.1455
Janowiec Kościelny	nidzicki	52	64	0.1482	0.0958
Wilczęta	braniewski	53	56	0.1464	0.1271
Lubawa	iławski	54	60	0.1456	0.1118
Banie Mazurskie	gołdapski	55	28	0.1444	0.2227
Barciany	kętrzyński	56	37	0.1438	0.1944
Rozogi	szczycieński	57	46	0.1418	0.1594
Markusy	elbląski	58	49	0.1374	0.1505
Wielbark	szczycieński	59	51	0.1365	0.1453
Działdowo	działdowski	60	44	0.1299	0.1643
Godkowo	elbląski	61	54	0.1289	0.1389
Kolno	olsztyński	62	33	0.1158	0.2098
Kalinowo	ełcki	63	62	0.1063	0.1040
Braniewo	braniewski	64	65	0.0860	0.0950
Lelkowo	braniewski	65	42	0.0796	0.1721
Górowo Iławeckie	bartoszycki	66	66	0.0663	0.0823
Budry	węgorzewski	67	67	0.0452	0.0666

Source: own study

District (0.0452). For this reason, together with five other units (Lelkowo, Braniewo, Górowo Iławeckie, Kolno, Kalinowo), it was included in the last group of municipalities with the lowest level of living.

Finally. the best group of the rural municipalities of the Province in 2018 included eight units. while the second-best group consisted of seventeen units (Fig. 4). Thirty-six municipalities were included in the largest, third group, while only six to the last, fourth group. Significant differences were noted within the extreme groups. Compared to 2005, i.e., the first year of the analysis, only small changes occurred within the clusters, which, retrospectively, reflected the improvement in living conditions (Fig. 3). Back then, the best group included seven units, the second group twenty, and the third group – thirty-two territorial units. The worst living conditions, established based on the synthetic measure value, were recorded in eight municipalities, the last of which were the same units as in 2018. Even greater stability was noted in the rural municipalities listed as those with the highest level of living because the first five of them retained the same places on the list 13 years later.

Despite the relatively well-established positions on the list, a few distinct changes were noticeable regarding positions of particular

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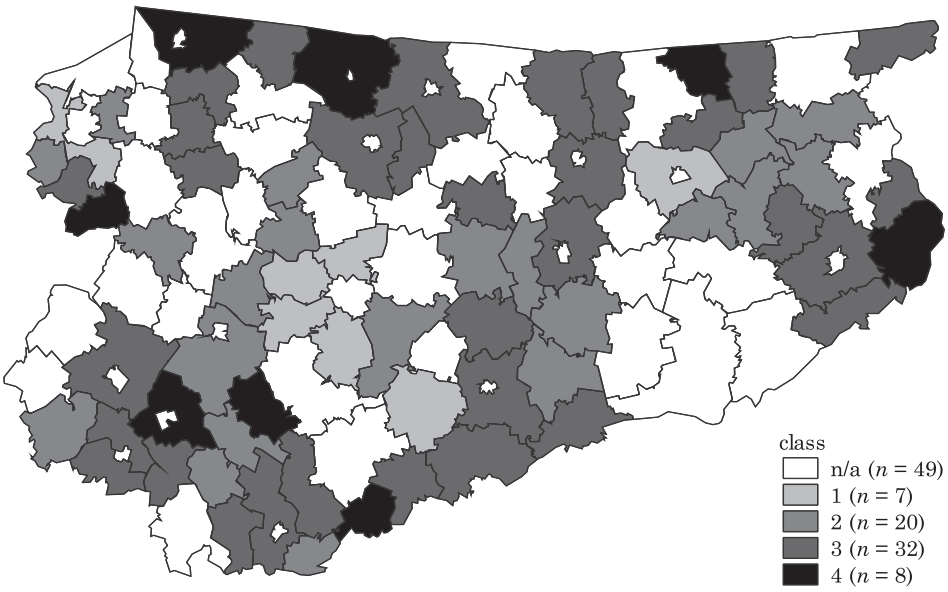

Fig. 3. Standard of living in rural municipalities of Warmia-Masuria Province in 2005
Source: own study

municipalities in the ranking. Compared to the year 2005, the greatest improvement in living conditions was recorded in the Ełk municipality (Tab. 2). This was mainly influenced by the improvement in the financial conditions of the municipality, which translated into both the higher income of the municipality per capita but also to increased expenditures on the municipal infrastructure, mainly those related to rational waste management and care for the natural environment.

More than twofold increase in the value of the synthetic indicator resulted in a significant improve-

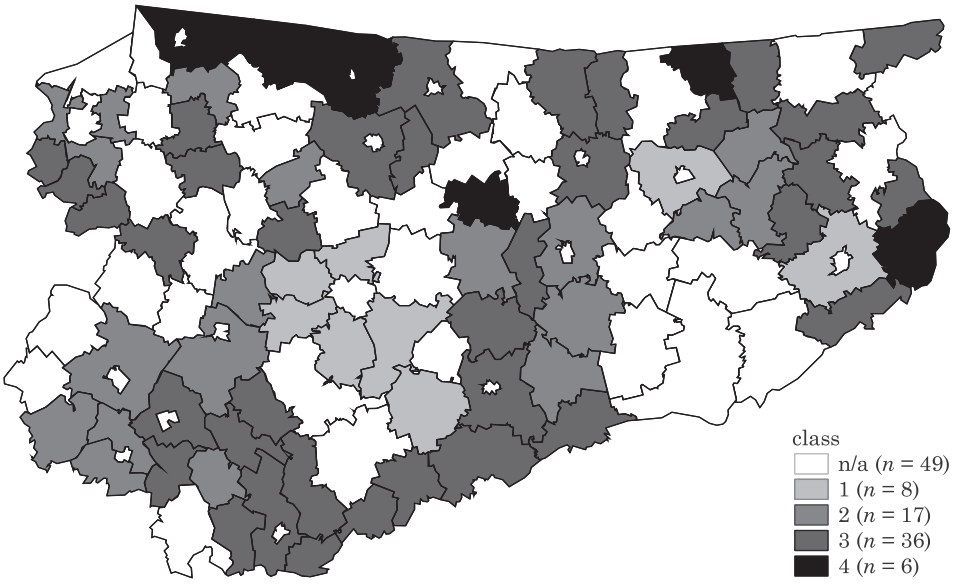

Fig. 4. Standard of living in rural municipalities of Warmia-Masuria Province in 2018
Source: own study

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ment in 2018 (in total, by as many as 39 positions up). A similar situation was observed in the following municipalities: Kętrzyn, Janowo, Grunwald, Iława, and Nowe Miasto Lubawskie (all of them moved more than twenty positions up on the list). However, during the research period, there were also opposite cases when significant decreases were noted in unit's position on the list. This was most frequently due to a slowdown in the increase in living standards measured with the synthetic indicator value or a less considerable increase compared to the other units. The municipalities that moved down the most over that period included Świętajno, Kolno, Małdyty, Banie Mazurskie (in each case, moving more than twenty positions down on the list). In addition to the above-mentioned spectacular changes in the positions of specific units, the homogeneity of individual groups and consolidation of their composition and number were observed in most cases. This seems to confirm the thesis on the leading role of endogenous potential in stimulating the economic growth and improving living conditions (Nazarczuk 2013, pp. 25–30).

This homogeneity was confirmed by the size of the clusters including the municipalities with the most similar level of living. In 2005, five initial clusters were recorded, the smallest of which were those where the level of living measured with the synthetic indicator value was the lowest (Fig. 5). The Stawiguda, Dywity, Gietrzwałd, and Jankowo municipalities were included in a separate cluster because their indicator's value was significantly higher compared to the other municipalities. The second group, including the Giżycko, Jedwabno, and Elbląg municipalities, also stood out due to the high value of the synthetic measure. However, their level of living was rather closer to the third cluster that included nineteen units. The synthetic measure value of the Wydminy municipality (0.2398) represented a peculiar dividing line, as it divided the entire catalogue of the rural municipalities of the Warmia-Masuria Province into two main clusters. Below that value, the remaining group of municipalities could be divided into another two clusters. The subsequent, fourth cluster included fourteen and the last one, the fifth, as many as twenty-seven municipalities.

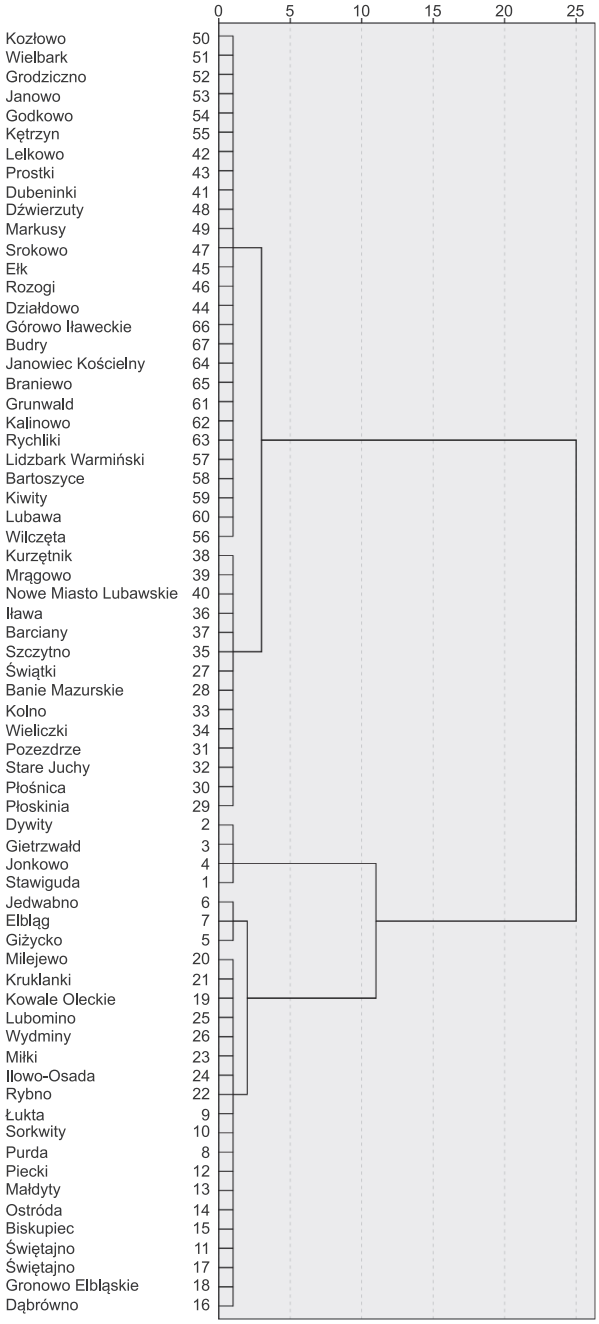

Fig. 5. Dendrogram of similarity of the standard of living (dendrogram based on Ward's connections: scaled distances; ranking in 2005) among rural municipalities of Warmia-Masuria Province in 2005

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The similarities in the level of living in 2018 allowed separating six initial clusters with diverse profiles (Fig. 6). Firstly, the level of living in the Stawiguda municipality was high enough to include it to a separate, one-element, cluster. The next two municipalities with the greatest similarity in the level of living were Dywity and Gietrzwałd municipalities, making it possible to classify them to the second created cluster. In those units, the level of living was similar, as evidenced by the link at the second level of clustering. The further similarities made it possible to create the third cluster comprising ten elements. At the fourth level of clustering, this has led to the separation of the fourth cluster comprising eighteen municipalities. This time, the synthetic measure value for the Janowo municipality (0.2208) was the cut-off point for the two remaining clusters with the level of living distinctively lower than in the other units. The fifth and the sixth clusters again included eighteen municipalities each. Compared to 2005, the level of living in these units became more similar, as evidenced, among others, by the smaller number of municipalities in the last cluster.

The results of the conducted research are in line with the common view on the leading role of the urban centres in shaping the level of living of populations. A significant improvement in the living conditions of the inhabitants of neighbouring municipalities has been empirically verified many times (cf. Głaz and Biczkowski 2012, pp. 86, Smutek 2017, pp. 141–143, Zbierska et al. 2014, pp. 309–312, Dumitrache et al. 2016, pp. 50–53, Nuissl and Rink 2005, pp. 130–133). Due to increased immigration and favourable conditions for the entrepreneurship development, such municipalities were frequently able to gather and then distribute the financial resources within their administrative boundaries (Malinowski and Smoluk-Sikorska 2020, pp. 16–22). Consequently, they have become peculiar hybrids, being a transitional form in the common city-village perception (Bański 2012, p. 11, Camarero and Oliva 2016, p. 97–98). Of all rural municipalities included in the research, these traits could be ascribed to several of the municipalities occupying the highest positions on the list.

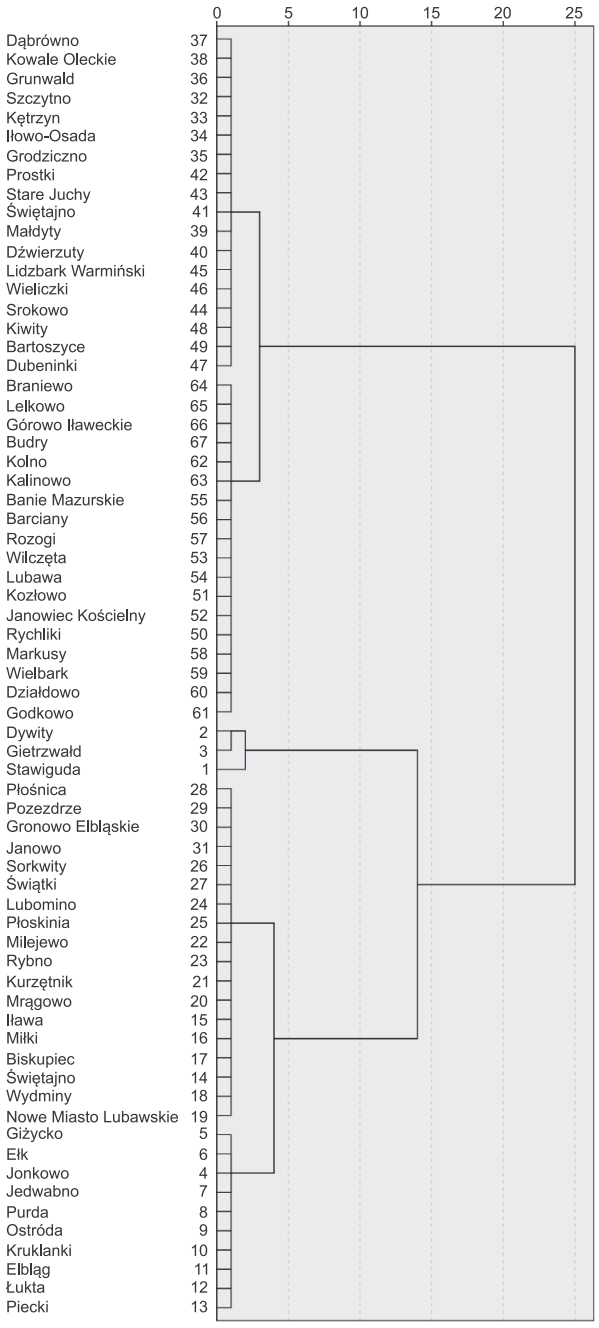

Fig. 6. Dendrogram of similarity of the standard of living (dendrogram based on Ward's connections: scaled distances; ranking in 2018) among rural municipalities of Warmia-Masuria Province in 2018

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The leaders of the ranking established based on the synthetic measure value (Stawiguda, Dywity, Gietrzwałd and Jonkowo), were included as administrative units in the concept of Olsztyn agglomeration developed by M. Bogdański in 2014 (pp. 69–70). At the same time, it seems that in its current form, a growing percentage of the immigrants has not only not changed the demographic structure (Źróbek-Rożańska and Zysk 2015, pp. 127–132, Biegańska 2013, pp. 9), but also influenced many other aspects of life, including i.a. changes related to mobility and organised transport, care for the natural environment, development of renewable energy sources, and also increased social competences of the entire communities including changes in life attitudes (Źróbek-Rożańska and Zadworny 2016, pp. 62–64).

On the other hand, relatively least favourable living conditions were in the Braniewo and Bartoszyce Districts, adjacent to the Russian Federation's border. The municipalities of that part of the Province (e.g., Górowo Iławeckie, Lelkowo, Braniewo, Wilczęta) occupied the last positions on the list. It seems that this part of the region was still struggling with the problems of social and economic nature, caused, to some extent, by the centrally planned agricultural activity (State Agricultural Farms – SAF) implemented in the communist era (Feltynowski et al. 2015, pp. 237, Biegańska et al. 2019, pp. 87). Depopulation and the extremely unfavourable demographic structure of those units combined with the shortage of the transport, educational, and municipal infrastructure, and the quality of the human resources have constituted a significant obstacle to the sustainable development. These barriers were also mentioned by the inhabitants of these areas (Uwarunkowania rozwoju… 2018, pp. 55, Sytuacja ekonomiczno-społeczna… 2019, pp. 55). The identification of the mentioned barriers to the sustainable development of the border areas in the Warmia-Masuria Province was consistent with the concept of the remote rural areas (RRA) (Dijkstra and Poelman 2008, pp. 1–2), which are problematic also to other countries of Europe (Copus and Crabtree 1996, pp. 43, Commins 2004, pp. 70–72).

The results obtained seem to be consistent with the findings of other authors discussing these issues both at the regional (Janusz 2014, pp. 178–180, Janusz 2015, pp. 294–297, Kopacz-Wyrwał 2016, pp. 93–103) and the whole-country level (MROW 2017, pp. 34, Kalinowski, 2015, pp. 194–202). The level of living, established based on the synthetic measure value, and the positions on the lists are similar in those studies, especially regarding the municipalities assigned the highest and the lowest values. The differences between these units allow expecting permanent divergence within the rural municipalities of Warmia-Masuria Province (Spellerberg et al. 2007, pp. 297–304). The high level of living in the suburban areas determined the constant influx of working-age population and contributed to both objective and subjective well-being of the citizens (Gilbert et al. 2016, pp. 38–43, Requena 2015, pp. 701–706, Shucksmith 2009, pp. 1278–1285, Sørensen 2014, pp. 1459–1462).

CONCLUSIONS

It should be underlined that the level of living is not a homogeneous category. Its diversity is largely due to the specificity of the region, its structure and, above all, its socio-economic situation. For this reason, the purpose of the analysis was to demonstrate the spatial diversity in living standards in the rural municipalities of the Warmia-Masuria Province and its changes since Poland's accession to the European Union. Hence, the years 2005 and 2018 were covered by the research. The level of living in the surveyed area was evaluated from the perspective of both demographic, social, economic, and environmental factors, employing the taxonomic method. Afterwards, the rural municipalities were classified into clusters, considering the synthetic value of the calculated measure of the level of living and mutual similarity, resulting from collating the same features in different combinations.

Therefore, the multidimensional approach allowed for the systematization of the municipalities' positions from the most to the least developed. This, in turn, showed the extent of differences in the level of living

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between Stawiguda, Dywity, Gietrzwałd, Jonkowo, and other municipalities. Thus, the relationship resulting from the location was confirmed, thanks to which the proximity of large urban centres has a positive impact on the level of living in neighbouring municipalities (Sobotka 2014, pp. 41, Gałka and Warych-Juras 2011, p. 151, Kulczyk-Dynowska 2012, p. 71–75, Mrozik 2013, pp. 94–99). On the other hand, remote rural areas were characterised by a relatively low level of living and many barriers limiting their development. Except for the municipalities listed above, the rotation was observed within the considered sample. A similar level of living was noticeable among the municipalities with relatively average synthetic measure values. The authorities of the municipalities with relatively the highest living standards may focus on continuous economic development, taking into consideration qualitative aspects. It will be possible due to the high level of satisfying needs of quantitative nature. The extensive cooperation between the local government and the world of science and business, and representatives of grassroots creative circles may prove helpful in this respect. Anyway, this cooperation is part of the Voivodeship's strategy (Strategia rozwoju… 2013). In the municipalities, where the level of living is one of the lowest in the Province, the authorities should first care for the infrastructural and technical facilities, and the quality of human resources.

However, we should remember that the created clusters can by disputable and should be treated this way. This is primarily due to the issue of the choice of indicators adequate for the analysis. In the case of taxonomic methods, their selection will always be influenced by the author's subjective evaluation. The literature of the subject emphasizes that the study of the same phenomenon conducted with another set of diagnostic features could bring different results.

Nevertheless, diagnosing the diversity of the level of living in a regional perspective and indicating its main features and determinants is extremely important from the viewpoint of the implemented economic or social policy as well as regional policy (cohesion policy) aimed at minimising differences and effective development of municipalities, districts, provinces, and the country. In view of the extensive discussion on the future of rural areas, it seems that particularly large emphasis should be put on the implementation of the concepts of smart cities and smart villages. The reliable identification of barriers, based on experiences of other countries and regions, may become an impetus for changes and, ultimately, significantly improve the living conditions of residents in many aspects. Above all, much attention should be paid to the areas struggling with the most difficult situation, measured by the value of the synthetic indicator. Both, local authorities and representatives of local initiatives play a meaningful role in this case because this concept requires a holistic approach. In addition, the use of dedicated European funds can only positively affect the living conditions of the population.

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