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# MULTIDIMENSIONAL ANALYSIS OF SUSTAINABLE DEVELOPMENT IN COUNTRIES OF CENTRAL AND EASTERN EUROPE

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**Abstract.** The aim of this study is to compare the situation of 10 countries in Central and Eastern Europe in terms of sustainable development. The comparison was made taking into account 10 dimensions (thematic areas) covered by the EU Sustainable Development Strategy, which include: socio-economic development, sustainable production and consumption, social inclusion, demographic change, public health, climate change and energy, sustainable transport, natural resources, global partnership and good governance. The results of the analysis allowed us to identify the leaders, followers and laggards, or countries at different points on the road to sustainable development. In addition, the study attempts to evaluate the possibility of reducing the gap between the countries of Central and Eastern Europe relative to the EU average. The values of sustainable development indicators have been obtained from the website of Eurostat with regard to 2013.

**Key words:** sustainable development; Bray-Curtis measure; Central and Eastern Europe

## INTRODUCTION

Sustainable development is undoubtedly a key challenge of the modern world. Among numerous definitions of this notion one of the most transparent and also most common is the definition created by the World Commission on Environment and Development in 1987.

It defines sustainable development as one in which the needs of the present generation can be met without compromising the ability of future generations to meet their own needs<sup>1</sup>. It should be noted that in the legal systems of many countries the discussed notion has been recognized as a constitutional principle. The aim of this study is to compare the situation of 10 countries in Central and Eastern Europe (CEE), namely Bulgaria (BG), the Czech Republic (CZ), Estonia (EE), Latvia (LV), Lithuania (LT), Hungary (HU), Poland (PL), Romania (RO), Slovenia (SI) and Slovakia (SK) in terms of sustainable development. The comparison was made taking into account 10 dimensions (thematic areas) covered by the EU Sustainable Development Strategy, which include: socio-economic development, sustainable production and consumption, social inclusion, demographic change, public health, climate change and energy, sustainable transport, natural resources, global partnership and good governance. The results of the analysis allowed us to

<sup>1</sup> Report of the World Commission on Environment and Development: Our Common Future. Retrieved June 16<sup>th</sup> 2015 from: <http://www.un-documents.net/our-common-future.pdf>. It should be emphasized that sustainable development is not a fixed state of harmony, but the process of change in which the exploitation of resources, direction of investments, technological development and institutional changes are compatible with both current and future needs.

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identify the leaders, followers and laggards, or countries at different points on the road to sustainable development. In addition, the study attempts to evaluate the possibility of reducing the gap between the countries of Central and Eastern Europe relative to the EU average. The values of sustainable development indicators have been obtained from the website of Eurostat with regard to 2013.

## EU SUSTAINABLE DEVELOPMENT STRATEGY – BASIC INFORMATION<sup>2</sup>

Sustainable development is one of the priorities of the EU. In the light of the provisions of the Treaty on European Union, its institutions work for the sustainable development of Europe based on balanced economic growth and price stability, social market economy, which is highly competitive, aiming at full employment and social progress, and a high level of protection and improvement of the environment<sup>3</sup>. The basic document, which defines the objectives and activities of the EU to achieve a fully sustainable development, and also helps in the elaboration of appropriate standards, is the EU Sustainable Development Strategy. It was approved in May 2001 by the European Council, and subsequently renovated in June 2006<sup>4</sup>.

The overarching objective of the strategy is to identify and develop actions to enable the EU to achieve for present and future generations a steady increase of quality of life by creating communities based on the principles of sustainable development, that is, communities, which efficiently use resources to tap the potential of the economy in eco- and social innovations, ensuring prosperity, environmental protection and social cohesion. The main objectives of the EU Sustainable Development Strategy include: environmental protection, social equity and cohesion, economic prosperity, implementation of the EU commitments on the international scale. In turn, the basic challenges of the strategy are: climate change

and clean energy; sustainable transport; sustainable consumption and production; natural resource protection and management; public health; social integration, demography and migration; as well as challenges of global poverty and sustainable development. Within each of the challenges the operational objectives and necessary actions are defined to allow to achieve these goals.

Implementation of the objectives of the EU Sustainable Development Strategy is monitored by a set of indicators included in 10 dimensions (thematic areas), which include: socio-economic development; sustainable production and consumption; social inclusion; demographic changes; public health; climate change and energy; sustainable transport; natural resources; global partnership and good governance (GUS, 2011, p. 8). Sustainable development indicators can be presented with the help of the “pyramid” divided into three levels reflecting their hierarchy. At the top of the pyramid there are 11 leading indicators that monitor the overall objectives related to the key challenges of the strategy. On the second level of the pyramid there are 31 indicators related to operational objectives. The third level involves 84 indicators detailing the actions of the leading indicators. The set of sustainable development indicators also includes a group of the so-called contextual indicators, which do not serve directly to monitor the strategy’s objectives, but provide valuable background information for events directly related to sustainable development and can be useful for analytical purposes (Wskaźniki..., n.d.). EU set of sustainable development indicators is systematically being developed and updated by Eurostat, that prepares monitoring reports<sup>5</sup>, which in their turn are the basis for preparation monitoring reports on the implementation of the EU Sustainable Development Strategy by the European Commission (Commission, 2005; 2007; 2009).

## MATERIAL AND TEST METHODS

Implementation of the objective of this study, which is a comparison of 10 countries of Central and Eastern Europe in terms of sustainable development (under 10 dimensions included in the EU Sustainable Development Strategy) and, consequently, an indication of the position of individual countries towards sustainable development.

<sup>2</sup> This part of the article was largely developed on the basis of the provisions contained in the EU Sustainable Development Strategy. See more broadly: Commission, 2001; Council, 2006.

<sup>3</sup> Consolidated version of the Treaty on European Union, Official Journal of the European Union C115/13, Art. 3.3.

<sup>4</sup> It should be indicated at this point that the concept of sustainable development has been included in many other EU strategic documents, namely, in the Lisbon Strategy Europe 2020 Strategy, white and green books, etc.

<sup>5</sup> The latest monitoring report was published in 2013. See: Eurostat, 2013.

Such a comparison is possible using a number of dimensions proposed by multidimensional comparative analysis. The study used one of them, namely, the Bray-Curtis dissimilarity, which helped determine the distance between a state leader and other countries in the field of sustainable development.

The starting point for calculating that measurement was to dispatch the values of variables describing the situation of individual countries in terms of sustainable development. Undoubtedly, the best solution would be to use 11 leading indicators mentioned in the previous part of the study that monitor the overall objectives related to the key challenges of the EU Sustainable Development Strategy. Unfortunately, at this stage, there were some limitations. Now, the two indicators, namely, primary energy consumption and occurrence of common species of birds, or indicators of thematic areas, respectively, climate change and energy as well as natural resources are not available for many countries in Central and Eastern Europe. In addition, Eurostat did not offer any leading indicator to the thematic area of good governance. Due to the above limitations in the availability of data, while taking into account the need to determine the situation of individual countries within the framework of all 10 dimensions (thematic areas) included in this strategy, only one leading indicator (of the three formally available) for measuring the climate change and energy as well as operational indicators for dimensions of natural resources and good governance were used. Finally, the values of the following variables (indicators of sustainable development<sup>6</sup>), which were obtained from the website of Eurostat in relation to 2013, were used:

- $X_1$  – real GDP per capita (in euro)
- $X_2$  – resource efficiency (euro per kilogram)
- $X_3$  – risk of poverty or social exclusion (%)
- $X_4$  – employment of older workers (%)
- $X_5$  – female life expectancy at birth (years)
- $X_6$  – consumption of energy from renewable sources (%)
- $X_7$  – energy consumption in transport in relation to GDP (compared to 2000, %)

<sup>6</sup> Among them were indicators that are both stimulants (S), when higher values indicate a better situation in terms of sustainable development ( $X_1, X_2, X_4, X_5, X_6, X_9, X_{10}$ ), as well as indicators, which are destimulants (D), or those, whose lower values indicate a better position ( $X_3, X_7, X_8$ ). (Bąk and Sompolska-Rzechuła, 2007).

- $X_8$  – water consumption compared to water supply from renewable sources (%)
- $X_9$  – official development assistance in relation to gross national income (%)
- $X_{10}$  – turnout in parliamentary elections (%).

The next step was to subject the selected variables to standardization in order to unify the orders of their size. This was done using the following unifying formulas (Wysocki, 2008):

$$z_{ij} = \frac{x_{ij} - \min_i \{x_{ij}\}}{\max_i \{x_{ij}\} - \min_i \{x_{ij}\}} \quad (1)$$

$$z_{ij} = \frac{\min_i \{x_{ij}\} - x_{ij}}{\max_i \{x_{ij}\} - \min_i \{x_{ij}\}} \quad (2)$$

where:

$z_{ij}$  – normalized value of the  $j$ -variable in the  $i$ -country

$x_{ij}$  – empirical value of the  $j$ -variable in the  $i$ -country

$\max_i \{x_{ij}\}$  – maximum value of the  $j$ -variable

$\min_i \{x_{ij}\}$  – minimum value of the  $j$ -variable

$i$  – country number ( $i = 1, 2, \dots, n = 10$ )

$j$  – variable number ( $j = 1, 2, \dots, m = 11$ ).

The calculation of the Bray-Curtis dissimilarity, which as already mentioned, is the determination of the distance between a state leader and other countries in the field of sustainable development, required the indication of the leader. It was a country for which the sum of the standardized values of the variables was the maximum<sup>7</sup>. Finally, the Bray-Curtis dissimilarity was calculated under this formula (Strahl, 2006):

$$d_{li} = \frac{\sum_{j=1}^m |z_{lj} - z_{ij}|}{\sum_{j=1}^m z_{lj} + \sum_{j=1}^m z_{ij}} \quad (3)$$

where:

$z_{lj}$  – normalized value of the  $j$ -variable in the leader country,

$z_{ij}$  – normalized value of the  $j$ -variable in the  $i$ -country.

<sup>7</sup> In the analysis the system unit weight was used, treating the same selected variables as an equal. Such a system is often used in practice by specialists in measuring the socio-economic development of spatial units (Cierpień-Wolan and Wojnar, 2001).

The obtained  $d_i$  values meant the distance of the  $i$ -country in relation to the leader in terms of sustainable development. Thus the  $d_i$  value closer to zero testified of greater opportunities of the country to reach the EU average in terms of sustainable development, while the  $i$ -country was less likely to achieve.

## DIAGNOSIS OF THE CEE COUNTRIES IN TERMS OF SUSTAINABLE DEVELOPMENT

In this part of the study the overall situation of the countries of Central and Eastern Europe in the field of sustainable development was diagnosed. This diagnosis was preceded by a presentation of the situation of individual countries within the aforementioned 10 dimensions for the analysed development (socio-economic development, sustainable consumption and production, social inclusion, demographic change, public health, climate change and energy, sustainable transport, natural resources, global partnership and good governance). Each measurement is described by one of the leading indicators ( $X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_9$ ), or the operating indicators ( $X_8, X_{10}$ ). The values of these indicators are presented in Table 1.

Analysing the values of the indicators included in the table, it can be concluded that the best situation for

socio-economic development, sustainable production and consumption, public health and good governance is in Slovenia. The most favourable situation in terms of demographic change, sustainable transport, and global partnership is in Estonia. The favourites in some dimensions are also the Czech Republic, Slovakia and Latvia. In turn, the worst situation in terms of socio-economic development, social inclusion and public health is in Bulgaria. The least favourable situation, when it comes to sustainable production and consumption and global partnership, is in Romania. Lithuania, Poland, Slovenia and Slovakia are the stragglers in some dimensions.

The results of the calculations made in accordance with the procedure presented in the previous section of this study allow us to conclude that Estonia reached the maximum amount of normalized values of the variables, which means that in 2013 the country was the leader in the field of sustainable development in Central and Eastern Europe. The advantage of this country over the other largely is due to the highest values of the two stimulants (employment of older workers, official development assistance in relation to gross national income), and the lowest value of one of the destimulants (energy consumption in transport in relation to GDP) of the 10 variables showing the situation in terms of sustainable development. To the countries of Central

**Table 1.** Values of sustainable development indicators in CEE in 2013

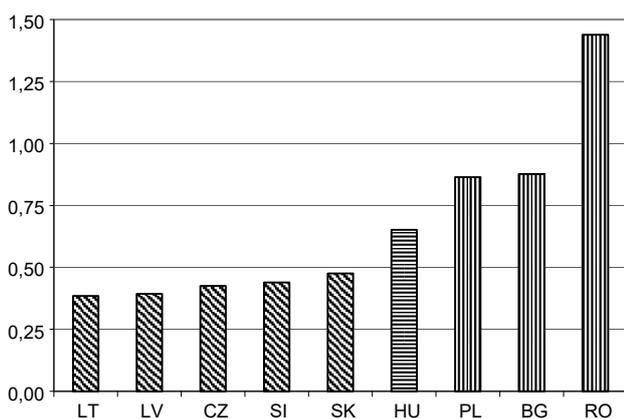
**Tabela 1.** Wartości wskaźników zrównoważonego rozwoju w krajach EŚW w 2013 roku

Indicator Wskaźnik	BG	CZ	EE	LV	LT	HU	PL	RO	SI	SK
$X_1$	5 500	14 200	13 900	11 600	11 700	9 900	10 100	7 100	17 100	13 300
$X_2$	0.22	0.80	0.32	0.37	0.55	0.87	0.51	0.21	1.23	0.85
$X_3$	48.00	14.60	23.50	35.10	30.80	33.50	25.80	40.40	20.40	19.80
$X_4$	47.40	51.60	62.60	54.80	53.40	37.90	40.60	41.80	33.50	44.00
$X_5$	77.90	81.20	81.50	78.90	79.60	78.70	81.10	78.10	83.30	79.90
$X_6$	19.00	12.40	25.60	37.10	23.00	9.80	11.30	23.90	21.50	9.80
$X_7$	89.60	99.20	78.90	86.20	85.40	90.80	103.40	95.40	117.10	95.60
$X_8$	6.00	11.80	1.00	1.10	2.60	4.70	18.90	15.60	2.60	0.70
$X_9$	0.10	0.11	0.13	0.08	0.12	0.10	0.10	0.07	0.13	0.09
$X_{10}$	52.50	59.50	63.50	59.50	35.90	64.40	48.90	41.80	65.60	59.10

Source: own elaboration based on Eurostat data.

Źródło: opracowanie własne na podstawie danych Eurostat.

and Eastern Europe, which created a relatively good situation in terms of sustainable development – in addition to Estonia – Lithuania, Latvia, the Czech Republic, Slovenia and Slovakia should also be counted. However, due to the clear gap between those countries in relation to Estonia (distance within the limits of 0.4–0.5 of the Bray-Curtis measure) it is difficult to describe them as leaders – it seems more appropriate to use the word followers as the term. Noteworthy at this point is the fact that these are the smallest countries – both in terms of demography and territories. They are characterized by relatively high values of the selected variables (in the case of stimulants), or low (in the case destimulants). In turn, the countries of Central and Eastern Europe, whose situation in terms of sustainable development looks the least favourable are – in the light of the calculations made – Romania, Bulgaria and Poland. In view of the fact that their distance from Estonia exceeds 0.8 under the Bray-Curtis measure, they can be undoubtedly described as stragglers. It should be noted that these are the largest countries in Central and Eastern Europe, which are characterized by relatively low values of the selected variables (in the case of stimulants) or high (in the case destimulants) (Fig. 1).



**Fig. 1.** Distance of the CEE countries from Estonia, which is the leader in the field of sustainable development (the Bray-Curtis measure)

Source: own study based on Eurostat data.

**Rys. 1.** Odległości poszczególnych krajów CEE od Estonii będącej liderem w zakresie zrównoważonego rozwoju (miara Braya-Curtisa)

Źródło: opracowanie własne na podstawie danych Eurostat.

## ASSESSMENT OF THE CEE COUNTRIES IN TERMS OF SUSTAINABLE DEVELOPMENT

The countries of Central and Eastern Europe lag behind the EU average in all or almost all dimensions of sustainable development. Referring to the situation in 2013, we can conclude that the greatest distance relative to the average for the EU countries under analysis is defined by five dimensions: socio-economic development, sustainable production and consumption, public health, global partnerships and good governance. This distance is, however, relatively the lowest in relation to two dimensions: demographic changes and climate change and energy. On the other hand, taking into account the results of the earlier analysis it can be concluded that out of 10 countries in Central and Eastern Europe the Baltic countries (Estonia, Latvia and Lithuania), the Czech Republic and Slovenia reached the best place on the road to sustainable development, while Romania, Bulgaria and Poland occupy the worst positions. In light of the above the fundamental question arises: could countries in Central and Eastern Europe manage to achieve the indicators of sustainable development at a level similar to “the EU average” in the coming years? In the following part of this study an attempt was made to answer that question – in particular with regard to five dimensions of the greatest distance. The two aforementioned dimensions, i.e. changes in demography, climate and energy, within which the analysed disparities are relatively the smallest, have been omitted.

Considering the fact that the value of GDP per capita in the countries of Central and Eastern Europe is more than two times lower than the EU average (with the exception of Slovenia and the Czech Republic), we can unequivocally state that the gap between the countries analysed in this regard is very big, and even impossible to overcome. Furthermore, taking into account several key statistics figures, namely the average annual growth in GDP per capita, the relation of expenditures on research and development to GDP or the unemployment rate it is difficult to expect – assuming similar socio-economic conditions – that the distance relative to the EU average may be significantly decreased in the coming years. To put it simply, for many years the EU average GDP per capita will be beyond the reach of the vast majority of countries in Central and Eastern Europe.

The level of sustainability of production and consumption in the countries of Central and Eastern Europe stated by an indicator of resource efficiency and compared with the average level for the EU leaves much to be desired. Taking into account the evolution of the value of two out of three operational indicators proposed under this dimension, that is the amount of waste produced (in kg per person) and a number of environmental organizations with Eco-Management and Audit Scheme (EMAS), it can be assumed, however, that the gap between some countries in Central and Eastern Europe, in particular, the Czech Republic, Lithuania, Hungary and Poland and the EU average will slowly but steadily decline over the coming years. The amount of waste generated per capita in these countries is formed because of the lower level, while the number of organizations registered in the EMAS system is steadily increasing.

Social inclusion, considered through the prism of the percentage of people at risk of poverty and social exclusion is a dimension of sustainable development, under which the countries of Central and Eastern Europe noted a significant progress over the last 10 years. For most countries, this percentage is still higher than what is true about a dozen or so percentage points than the EU average, but at the same time it is much lower than it was in 2004. The field of activity, which promotes social inclusion, is no doubt education. Although expenditures on education in almost all countries of Central and Eastern Europe in relation to GDP are lower than the EU average, they equal the values of two education indicators, namely the percentage of early school leavers and the percentage of people aged 30–34 with higher education. It suggests that there are good chances of further reducing the distance between the examined countries and the EU average.

Progress in the countries of Central and Eastern Europe has also been in the field of public health, which is reflected in increased life expectancy of women at birth. In 2004–2014 life expectancy increased in each country by at least two years, while the average for the EU recorded an increase of 1.8. Very unlikely, however, it seems to achieve by the analysed countries (except Slovenia) the value of this index at the level of the EU average in the coming years. This results, among other things, from the fact that mortality from chronic diseases is much higher in the countries of Central and Eastern Europe than the EU average. Unfortunately, in

almost all of the countries covered by the analysis the number of suicides is also higher.

The gap between the countries of Central and Eastern Europe relative to the EU average dimension of sustainable transport, expressed by the indicator of energy consumption in transport in relation to GDP is as big as the distance in relation to social inclusion presented above. In most countries covered by the analysis (with the exception of the Baltic countries), this ratio is at a level higher than the EU average. Taking into account the spatial conditions and location of individual countries, in particular the transit nature of some of them it can be assumed that the distance in this dimension is very difficult to overcome by Slovenia, Poland and the Czech Republic in the future.

The global partnership, analysed through the prism of use of part of the gross national income to official development assistance, is another gap between the countries of Central and Eastern Europe and the EU average. This distance should not, however, be surprising – in the context of the significant difference in relation to the GDP per capita. In addition, it should be noted that the analyzed countries are beneficiaries of the EU budget, receiving more funds than contributing to that budget. Therefore it can be assumed that the gap in this field will certainly not be eliminated, and there only will be, at most, a slight decrease.

The turnout in the parliamentary elections, which is one of the indicators reflecting the operational dimension of sustainable development known as good governance, remains at a relatively low level in the countries of Central and Eastern Europe compared to the EU average. The reasons for this should probably be attributed to the low evaluation of the activities of national parliaments and increasingly less sense of the impact of the population on public affairs. In light of these considerations the difference with respect to voter turnout will be difficult to overcome in the coming years. The distance dimension between good governance and the EU average in the countries covered by the analysis may indeed be somewhat narrowed, but it will probably still be at the level of about a few percentage points.

To sum it up, in the opinion of the authors it is unlikely that in the coming years the overall gap between the countries of Central and Eastern Europe relative to the EU average in terms of sustainable development will be significantly reduced. While some limit disparities are possible in the dimensions of sustainable production

and consumption, social exclusion and public health, whereas in the dimensions of socio-economic development, sustainable transport, global partnership and good governance the disparities are unlikely to be significantly decreased.

## CONCLUSIONS

The general reflection that comes to mind after analysing the situation of the countries of Central and Eastern Europe in terms of sustainable development, in particular assessing the possibilities of bridging the gap between these countries relative to the EU average could be included in the short formulation: there is still much to be done. As it has been already mentioned the countries included in the analysis are lagging behind the EU average in all or almost all dimensions of sustainable development. A very large distance, in particular in relation to five dimensions, three of which – according to the authors – have little chance of a significant decline in the coming years (socio-economic development, global partnership, good governance), makes comparing the situation of the countries of Central and Eastern Europe to the EU average somewhat “comparing incomparable things”. Probably over the next few years, the average EU value of sustainable development indicators will be for many of the countries considered as unachievable value. It therefore remains nothing for the countries of Central and Eastern Europe but to come to terms with this fact and at the same time to learn from the better countries, and draw from their experience, in particular in terms of integrity and commitment of the governing bodies at various levels. It is necessary for the citizens to join the cooperation for sustainable development (Venkatesh, 2013). It is also not without significance to use the possibility of the support provided from EU funds – in order to reduce the existing gap in terms of sustainable development.

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## WIELOWYMIAROWA ANALIZA ZRÓWNOWAŻONEGO ROZWOJU KRAJÓW EUROPY ŚRODKOWO-WSCHODNIEJ

**Streszczenie.** Celem niniejszego opracowania jest porównanie sytuacji 10 krajów Europy Środkowo-Wschodniej w zakresie zrównoważonego rozwoju. Porównania tego dokonano przy uwzględnieniu 10 wymiarów (obszarów tematycznych) ujętych w Strategii Zrównoważonego Rozwoju UE, na które składają się: rozwój społeczno-gospodarczy, zrównoważona produkcja i konsumpcja, włączenie społeczne, zmiany demograficzne, zdrowie publiczne, zmiana klimatu i energia, zrównoważony transport, zasoby naturalne, globalne partnerstwo, dobre rządzenie. Wyniki przeprowadzonej analizy pozwoliły na wskazanie liderów, naśladowców i maruderów, czyli kraje znajdujące się na różnych etapach drogi do zrównoważonego rozwoju. Ponadto w opracowaniu podjęto próbę oceny możliwości zmniejszenia dystansu dzielącego kraje Europy Środkowo-Wschodniej względem średniej dla UE.

**Słowa kluczowe:** zrównoważony rozwój; miara Braya-Curtisa; Europa Środkowo-Wschodnia

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