

ANALYSIS OF THE LEVEL OF SUSTAINABILITY WITH THE APPLICATION OF KPIS

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Purpose: The purpose of the study was to analyze the essence of the concept of sustainable development and the level of fulfillment of one of the sustainable development goals of selected countries in comparison with the European Union based on a system of indicators. The level of fulfillment of Sustainable Development Goal 8 - decent work and economic growth in Poland and Slovakia was studied.

Design/methodology/approach: The research methodology used a diagnostic survey method comparative analysis and, to gather data, content analysis and desk research techniques.

Findings: As a result of the analysis carried out, it was found that surveillance using sustainable development indicators is fraught with various difficulties. An example of an inconvenience is: the need to standardize data for European Union countries and the lack of access or difficult access to adequate data in individual countries. In addition, the indicator method is characterized by certain generalizations and is fraught with subjectivity. However, the need for control and implementation of cyclical data analysis and information on the progress of implementation of the provisions of sustainable development in the member countries of the European Union is undeniable.

Research limitations/implications: An identified limitation in the implementation of the presented research methodology is the potential shortcomings in the availability of data necessary to calculate indicators monitoring the degree of achievement of sustainable development goals and the different level of detail available within the countries of the European Union community.

Practical implications: The results of the conducted research procedure provide factual knowledge that can support the process of creating future strategic plans to further the goals of sustainable development.

Originality/value: The study completes the research gap concerning comparative analyses of the level of fulfillment of selected sustainable development goals by Poland and Slovakia in relation to the level that has been registered for the European Union.

Keywords: sustainability, sustainability management, key performance indicators, sustainability indicators.

Category of the paper: Research paper.

1. Introduction

Human activity in the economic sphere affects not only the organization of social life, but also its environment, i.e. the state of the natural environment (Czerwinska, Pacana, 2023; Ulewicz, Blaskova, 2018). The absolute domination of man over the natural world, combined with the irresistible need to satisfy immediate needs, has led to the threat to his natural environment and to an ecological crisis (Olkiewicz et al., 2019). Human economic activity also affects the progressive transformation in the area of values. Man fulfilling his needs significantly affects the dynamics of economic processes (Pacana et al., 2023). However, it is worth noting that nature also has certain limits of endurance, and the consequence of exceeding them is the degradation of space affecting the well-being and condition of humans (Ulewicz, Pacana, 2017). As presented, the interaction is coming full circle and revealing the interdependence of such areas as the economy, societies and the environment.

The progressive economic and technological development of a significant number of countries has had an undeniable impact on environmental degradation. In the second half of the twentieth century, the idea of sustainable development began to form the directions of conduct and exert a significant influence on emerging global trends (Dolega, 2022). This concept implies such management of new available technologies that it does not lead to the destruction of natural resources, and at the same time ecosystems. The theory seeks to ensure a balance between the environment in which we live, technological progress and social life (Olkiewicz, Wolniak, 2020).

The purpose of the study was to analyze the essence of the concept of sustainable development and the level of fulfillment of one of the sustainable development goals of selected countries in comparison with the European Union based on a system of indicators. The level of fulfillment of Sustainable Development Goal 8 - decent work and economic growth in Poland and Slovakia was studied.

2. The issue of the quality of the indicators used

Indicators are a basic tool for monitoring the level of sustainable development, illustrating in a measurable way the essence of the concept (Staniszewska et al., 2020). The most important feature of indicators is the comparability of the result (as opposed to characteristics, which are generally presented using absolute values), allowing to determine the position of a given object (e.g., the district of a municipality) in relation to other objects (e.g., other territorial units) (Czerwinska et. al., 2022; Mazur, 2020). Comparability is hindered not by the sheer multiplicity of proposals, but by the goals that are included in sustainable development strategies that take

into account environmental economic resources, social resources (which should be maintained and protected) and resources that depend on a particular territorial unit (which should be developed). Creating a set of sustainable development indicators allows diagnosing the current state and realizing an assessment of changes over time for a specific unit (Pacana et. al., 2020; Hajduk-Stelmachowicz, 2014). However, on the other hand, such a collection provides an opportunity to compare the conditions of different units. In addition, the verticality of the developed indicators from the level of defined upstream units to downstream units and vice versa is important (Pacana, Czerwinska, 2019; Kyaw, 2022). Sustainability indicators at the global level are created by: The Committee on Environmental Policy (OECD), the Commission on Sustainable Development (UN) and the European Commission. However, for measurement at the international level to be possible and meaningful, targets set at this level should be consolidated with those of sub-national entities with consideration (Lazar et al., 2021):

- the possibility of adding priorities that respond to the specifics of a certain territorial unit,
- the state of environmental resources in the unit,
- progress and effectiveness of development activities.

In response to the significant number of sustainability monitoring solutions, as well as the numerous stakeholders affected by measuring the progress of concept implementation (business, civil society, statistical offices), the UN is presenting a reporting modality that includes global reporting indicators (about a hundred indicators) with complementary national indicators (Garcia-Sanchez et al., 2023). In this case, monitoring of progress would be done at four levels: regional, national, global and thematic. It should be noted that reports performed at the national level on progress toward the Sustainable Development Goals need not be fully comparable - individual countries have the option of choosing complementary indicators appropriate to their specific characteristics, needs and context. However, national complementary indicators should be aligned with global monitoring principles, meaning that they should be harmonized and universal (Eustachio et al., 2019).

The reporting of progress in achieving sustainable development goals at the national level is the most relevant level of reporting (Grebski et al., 2022). Reporting at the regional scale also serves an important function, as it supports knowledge sharing, mutual learning, and at the same time provides an opportunity to compare and evaluate the performance of development goals in specific countries located in the same region. Reporting on a regional scale is a link between the global and national levels. Regional sustainable development indicators include: global indicators, complementary national indicators and, if necessary, a number of indicators on the implementation of regional tasks and priorities (Barska, Jedrzejczak-Gas, 2019). Thematic reporting addresses complex and multifaceted challenges that often affect a significant number of diverse sectors. This type of reporting can involve innovative and creative ways of collecting data, unofficial data sources, and analyzing and processing data (Kozel et al., 2015). A summary of thematic areas and leading indicators for monitoring sustainability is presented in Table 1.

Table 1.

Summary of thematic areas and leading indicators for monitoring sustainable development

Subject area	Leading indicator	Number of indicators		
		Operations	Explaining	Contextual
Socio-economic development	Real GDP per capita	3	12	-
Sustainable consumption	Resource productivity	3	15	2
Social inclusion	Threat of poverty or social exclusion	5	15	1
Demographic change	Employment rate of older workers	3	4	4
Public health	Life expectancy and healthy life years	2	9	-
Climate change and energy	Greenhouse gas emissions	3	2	-
Sustainable transportation	Renewable energy consumption	4	7	1
Natural resources	Energy consumption in transportation relative to GDP	4	5	-
Global partnership	Occurrence of common bird species	3	7	3
Good governance	-	3	3	1

Source: own compilation based on Eurostat report (2015), Sustainable development in the European Union. Monitoring report of the EU Sustainable Development Strategy. <http://ec.europa.eu/eurostat/documents/3217494/6975281/KS-GT-15-001-EN-N.pdf/5a20c781-e6e4-4695-b33d-9f502a30383f>, 10.07.2023.

Among the considerable number of ideas on the construction of a set of sustainable development indicators, one is the set published in the Eurostat database. It is a set of Sustainable Development Indicators (SDI), allows monitoring the level of achievement of the objectives of the EU Sustainable Development Strategy. The European Union, in establishing sustainable development as a priority goal, unites economic development, social justice and environmental protection, with the aim of ensuring the well-being of its citizens and improving the quality of life of those living now and in the future. This is why it is so important to measure progress in the area of sustainable development, which is carried out by the European Statistical Office (Gunnarsdottir et al., 2020).

The concept of indicatorization of the European Union can be presented using a "pyramid", consisting of three main levels of monitoring. The top of the pyramid refers to 10 leading indicators (so-called Headline Indicators). Their task is to monitor the overall goals, which are related to the core challenges of the Sustainable Development Strategy. The second level of the pyramid takes into account almost 40 indicators related to operational goals (the so-called Operational indicators), while the third - the lowest level - includes almost 80 indicators related to activities (the so-called Explanatory indicators). The lowest-ranked indicators are a refinement of the leading indicators. Also included in the set of sustainable development indicators are the so-called Contextual indicators. This group of indicators does not directly serve to oversee the goals of the sustainability strategy. These indicators are not easy to interpret in a normative way, however, they build a valuable informational background on phenomena directly related to sustainable development by which they are useful for analytical purposes (Wang et al., 2021). Figure 1 shows the structure of the thematic areas and leading indicators monitoring progress toward the Sustainable Development Goals.

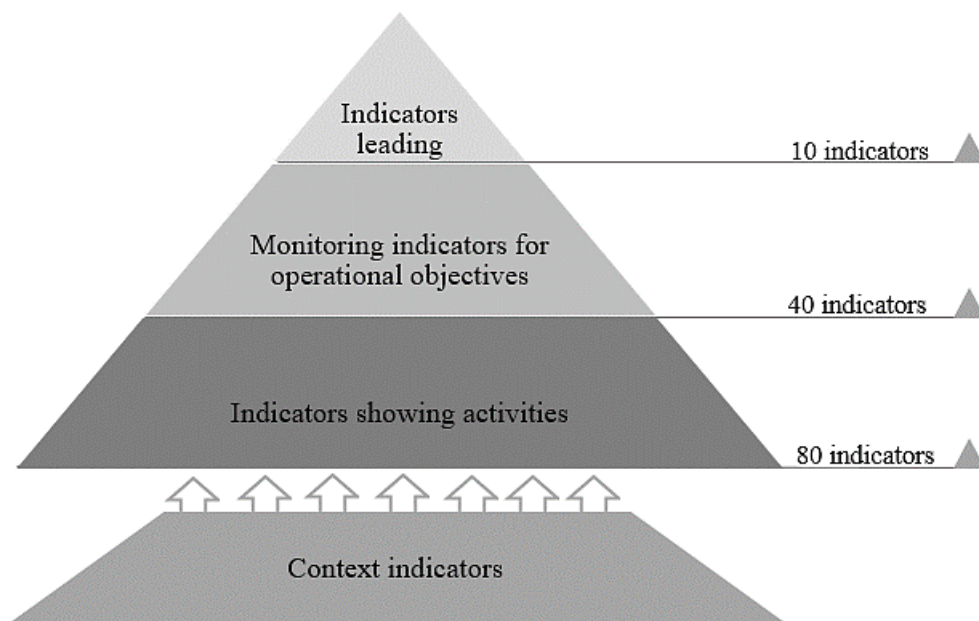


Figure 1. The structure of sustainable indicators.

Source: own study.

It is important to remember that the leading indicators of sustainable development form an overall picture of progress in the context of the fundamental challenges of the EU Sustainable Development Strategy. Wanting to get a complete and detailed view, it is necessary to undertake analysis using indicators of each area.

The purpose of sustainable development indicators is to improve the control of the degree and quality of implementation of the recommendations and goals of Agenda 2030 by creating uncomplicated information and diagnostic tools (Manero-Salvador, 2023). Indicator analysis is essential for monitoring and controlling the state, as well as managing the economic, social and environmental planes in a way that ensures a decent quality of life (de Menezes, Galvao, 2020). Which can be achieved by adhering to the principle of sustainability and the principle of intergenerational equity within all 3 orders: economic, environmental and social (some sources even state 5 orders: environmental, spatial, economic, social and institutional-political) (Novovic, 2022).

3. Research methodology

The realization of the set objective of the study was associated with the performance of systematized research steps. The scheme of analysis of the level of implementation of the objectives of sustainable development of Poland and Slovakia against the background of the European Union, presented in Figure 2, consists of the basic research steps necessary to carry out a detailed analysis of the phenomena in the area of sustainable development.

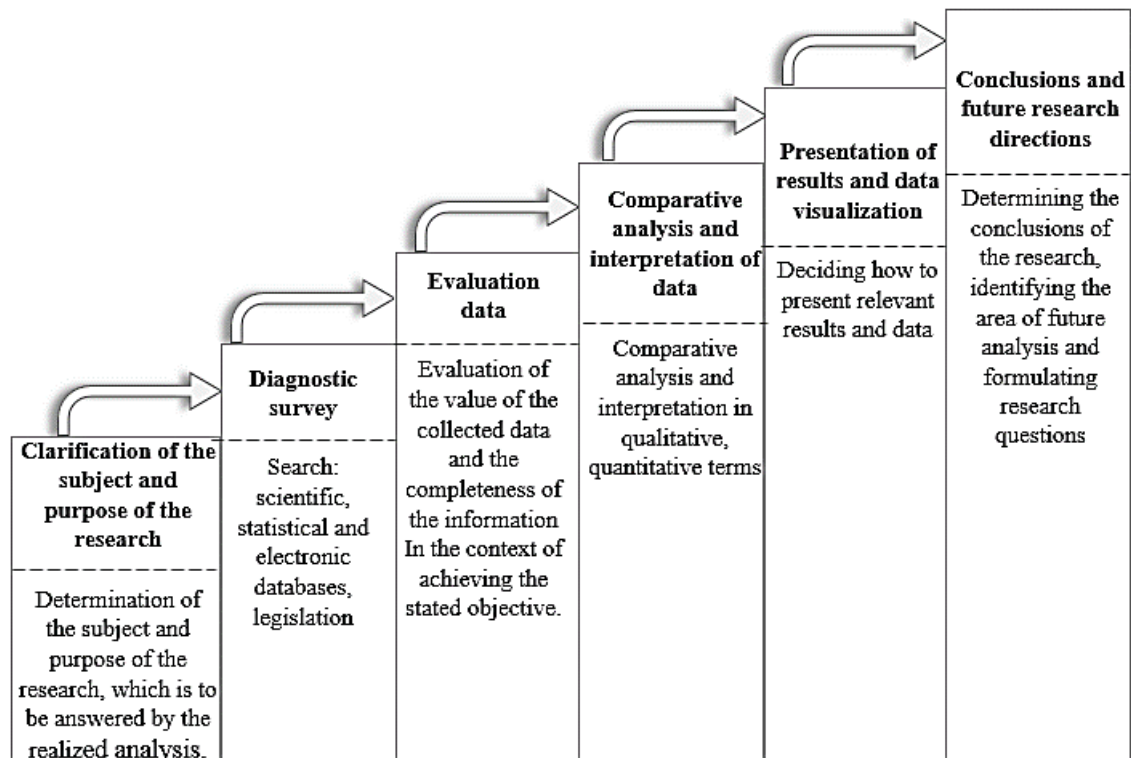


Figure 2. Schematic representation of the stages of the research procedure.

Source: own study.

The research procedure was divided into six steps, which included: specifying the subject and purpose of the research, diagnostic survey, data evaluation, comparative analysis and interpretation of data, presentation of results and data visualization, conclusions and future research directions. A cross-sectional characterization of the various stages of research implementation is as follows:

- specifying the subject and purpose of the research - this step boils down to determining the categories of objects in relation to which the research will be carried out and the cognition of reality, which involves descriptions and explanations of the phenomena and processes occurring in the studied reality;
- diagnostic survey - this step makes it possible to learn about the phenomenon specified in the purpose of the research, to determine its scope, extent, level and intensity. This activity will create a description of important processes taking place in the communities. The study used the technique of document analysis;
- data evaluation - involves understanding, performing quality assessment of the selected data in terms of achieving the research objective;
- comparative analysis and interpretation of data - analysis of the characteristics of the established subjects of the study in terms of determining similarities and differences (dissimilarities) and making sense of the collected data;

- presentation of results and data visualization - the stage of presenting the results, taking into account the principles of effective communication and the standards set for scientific research; this step also involves deciding how to organize the data and identify the relevant ones to be included in the study. Data visualization plays an important role as an element that promotes understanding and remembering of the results of the analyses carried out;
- conclusions and future research directions - defining conclusions and reflections on the completed analyses and determining the area of future scientific inquiry.

The presented model of analysis of the level of implementation of the objectives of sustainable development of Poland and Slovakia against the background of the European Union makes it possible to carry out systematized and effective diagnostic research.

4. Analysis of the implications of the concept of sustainable development of Poland and Slovakia

The 2030 Agenda is a universal development plan for the world. The implementation of the concepts contained in the 2030 Agenda requires tailoring to the prevailing realities of each country, therefore the role of countries in the implications of the concept is crucial. The complexity and permeability of the 2030 Sustainable Development Goals (SDGs) require significant commitment and appropriate cooperation. For this reason, it is important to translate the global goals to the national, regional, local level and to make them aware of their importance.

The study's analysis focuses on Goal 8 of Agenda 2030, which addresses the issue of decent work and economic growth. SDG 8 targets the achievement of full and decent employment through the promotion of economic growth, entrepreneurship, job creation, improved productivity levels and technological innovation.

In monitoring the level of achievement of Goal 8, attention has been paid to a key indicator, real GDP per capita, for this area. The indicator is calculated as the ratio of real GDP to the average population in a given year. GDP measures the value of the total final output of goods and services produced by the economy over a specified period of time. It includes goods and services that have markets (or that could have markets) and products produced by government and non-profit institutions. The values of the indicator obtained by the analyzed countries against the EU are shown in Figure 3.

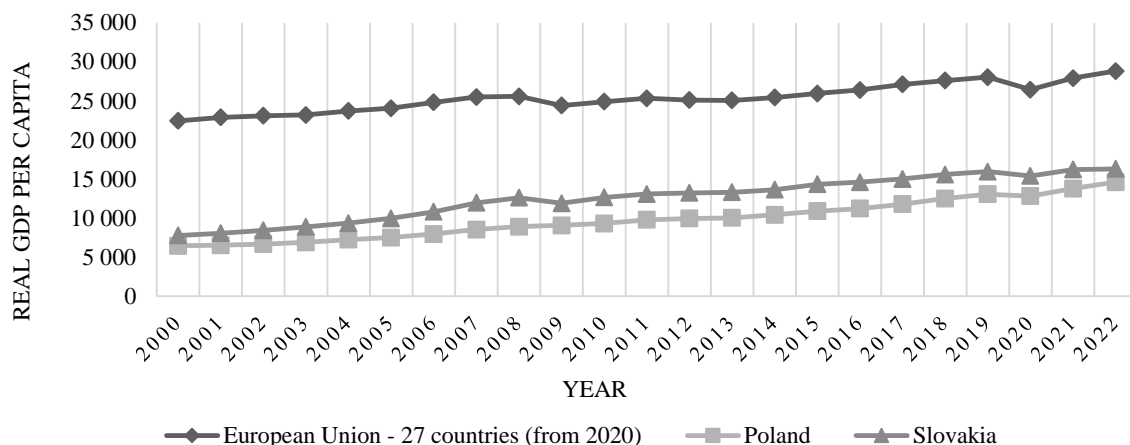


Figure 3. Dynamics of the real GDP per capita index for Poland and Slovakia against the EU.

Source: own compilation based on: <https://ec.europa.eu/eurostat>, 10.07.2023.

Real GDP per capita is calculated as the ratio of real GDP to the average population in a given year and is calculated on a rounded basis. In the period under review, the value of real GDP per capita in Slovakia increased by 109.5%. In Poland, a higher rate of growth of the indicator is observed - it amounted to 126.3%. No decline in real GDP per capita was observed in both countries over the analyzed years. In the last analyzed year - 2022 - the value of the indicator in Slovakia is 76.8% lower than the value for the EU, while in Poland the value is lower by 97.4%.

The key analysed indicator was investment share of GDP by institutional sectors. This indicator shows investment for the entire economy, government, business and household sectors. The indicator gives the share of GDP that is used for gross investment (rather than for consumption or exports, for example). It is defined as gross fixed capital formation (GFCF) as a percentage of GDP for the government, business and household sectors. Figure 4 shows the values of the indicator over the years 2000-2022 of Poland, Slovakia and the European Union.

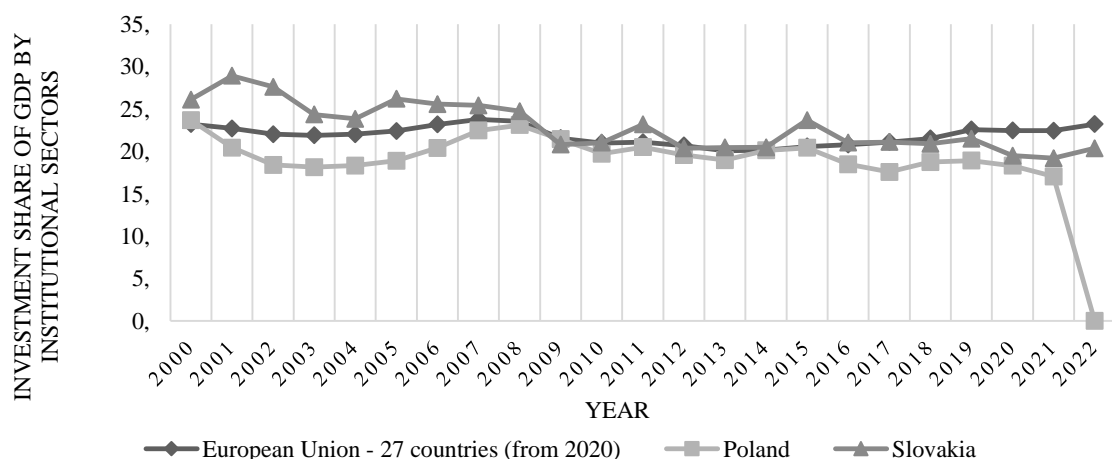


Figure 4. Dynamics of the index of investment share of GDP by institutional sectors for Poland and Slovakia in comparison with the EU.

Source: own elaboration based on: <https://ec.europa.eu/eurostat>, 10.07.2023.

In the analyzed period, both downward and upward trends were observed for Poland, Slovakia and the European Union. The most significant decreases in the value of the indicator investment share of GDP by institutional sectors in Poland took place in 2000-2004 (a decrease of 22.6%), in Slovakia in 2001-2004 (a decrease of 17.5%). In the EU there was a mild decline in the value of the indicator in question, which occurred in 2007-2013 (decline of 15.26%). As a whole, in the examined period it can be said that the level of undertaken investments for the whole economy, government, business and household sectors decreased (Slovakia - a decrease of 21.9%; Poland by 2021 - a decrease of 28.07%). No data is available on the value of the indicator for Poland in 2022.

Employment and other labor market issues are at the center of social and political debate in the EU. Paid employment is crucial to ensuring sufficient living standards and provides people with the necessary basis for achieving their personal goals and aspirations. In addition, employment contributes to economic performance, quality of life and social inclusion, making it a cornerstone of socioeconomic development and prosperity. The study also highlighted the employment rate, by citizenship. The indicator measures the percentage of the population between the ages of 20 and 64 who are employed. People who are employed are defined as those who, during the reference week, worked at least one hour for pay or profit, or did not work, but performed work in which they were temporarily absent. Figure 5 illustrates the dynamics of changes in the value of the employment rate, by citizenship.

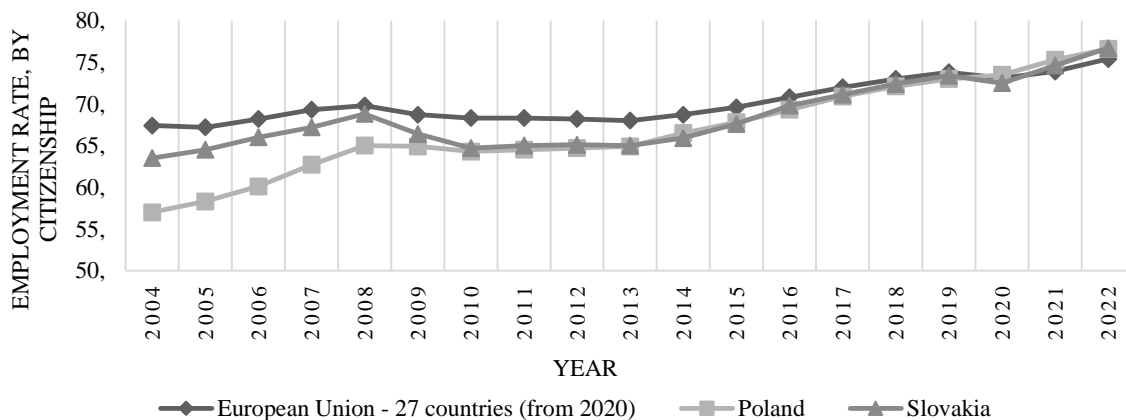


Figure 5. Dynamics of the employment rate, by citizenship for Poland and Slovakia against the EU.

Source: own compilation based on: <https://ec.europa.eu/eurostat>, 10.07.2023.

Figure 5 shows the years 2004-2022, as for 2001-2003 Eurostat indicates the unavailability of data - a break in the time series. The available data for the employment rate by citizenship indicator for the analyzed countries show a significantly increasing trend. An increase in the value of the indicator for Poland by 34.38%, for Slovakia by 20.78%, and for the EU by 11.86% was observed. Despite the fact that Poland started from a significantly lower level of the indicator than Slovakia or the EU, today both countries are at an almost identical level in terms of the level of employment measured by citizen.

Poverty and social exclusion harm individual lives and limit people's ability to realize their full potential, affecting their health and well-being and lowering their educational performance. This in turn limits people's ability to lead successful lives and further increases the risk of poverty. Without effective education, health, social systems, tax credits and employment, the risk of poverty is passed from generation to generation. This causes poverty to persist, thereby increasing inequality, which can lead to a long-term loss of economic productivity for entire social groups and hinder sustainable and inclusive economic growth. For this reason, the analysis also included the in-work at-risk-of-poverty rate. The dynamics of changes in the value of the indicated indicator is shown in Figure 6.

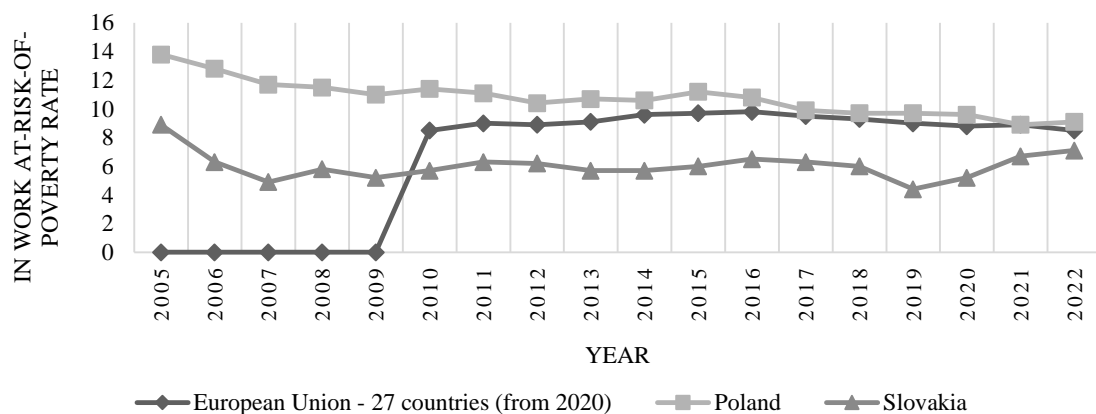


Figure 6. Dynamics of the in-work at-risk-of-poverty rate for Poland and Slovakia against the EU.

Source: own compilation based on: <https://ec.europa.eu/eurostat>, 10.07.2023.

With regard to the in-work at-risk-of-poverty rate, data from 2005-2022 are available for Slovakia and Poland, while data from 2009-2022 are available for the EU. Over the analyzed period, a desirable downward trend of 34.05% is observed for Poland. In Slovakia, there were two notable declines: between 2005 and 2007 (44.94% decline), and between 2016 and 2019 (32.30% decline). On the other hand, considering the entire research period, a decrease in value of 20.22% is observed in Slovakia. The value of the Polish and EU indicators are similar.

The analysis also included the raw material consumption (RMC) indicator. The material footprint, also referred to as raw material consumption (RMC), represents the global demand for material extraction (minerals, metal ores, biomass, fossil energy materials) caused by the consumption of goods and services in the geographic reference area. Figure 7 shows the RMC values for Slovakia and Poland and the EU.

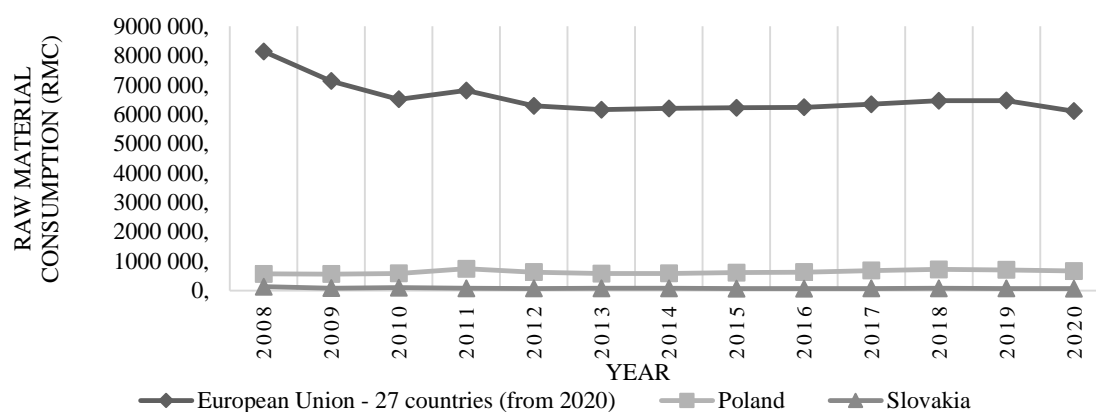


Figure 7. Dynamics of the raw material consumption (RMC) index for Poland and Slovakia against the EU.

Source: own compilation based on: <https://ec.europa.eu/eurostat>, 10.07.2023.

Data on material footprints come from material flow accounts, which model the flows of natural resources from the environment to the economy. They include domestic extraction of materials measured in gross tons of material (for example, gross ore or gross harvest), as well as imports and exports measured by the raw material equivalent of traded products (domestic extraction and foreign extraction required to manufacture products). Comparable data of Poland and Slovakia are available from the period 2008-2020. In the period under consideration, Slovakia saw a decrease of 47.21% in the index (2008 - 137303.051; 2020 - 72479.823), while Poland saw an increase of 17.16% (2008 - 569798.592; 2020 - 667610.52). With respect to the EU, a decrease of 24.97% was observed (2008 - 8,141,305.082; 2020 - 6,108,243.183). The RMC shows a significant difference between the volumes of extraction in the EU needed to produce the goods demanded by end users compared to Poland and Slovakia.

The EU supports growth, job creation and competitiveness through funding instruments such as the European Fund for Strategic Investments, the European Social Fund and its successor, the European Social Fund Plus, the European Structural and Investment Funds, Horizon 2020, the Programme for Employment and Social Innovation (EaSI), the Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME), the Emergency Support Instrument, the Connecting Europe Facility and the Creative Europe Programme (CAP).

5. Summary and conclusions

Implementation of the concept of sustainable development is one of the main goals of the European Union. The progressiveness of EU member countries in the context of the implementation of sustainable development goals is constantly monitored using a set of

indicators. The creation of an indicator system for monitoring policies (strategies, programs) of sustainable development is one of the most difficult methodological and application problems of the research on development indicators carried out not only in Poland. Therefore, the purpose of the study was to analyze the essence of the concept of sustainable development and the level of fulfillment of one of the objectives of sustainable development of selected countries in comparison with the European Union based on the system of indicators. The level of fulfillment of objective 8 of sustainable development - decent work and economic growth in Poland and Slovakia was studied.

As a result of the analysis of the collected data, it was found that supervision with the use of sustainable development indicators is burdened with various difficulties. An example of an inconvenience is the need to standardize the relevant data for the countries of the European Union. Also troublesome is the lack of access or difficult access to adequate data in individual countries. Which may be due to the different degree of detail in the reporting of member countries. In addition, the indicator method is characterized by certain generalizations and is fraught with subjectivity. However, the need for control and realization of cyclic analysis of data and information on the issue of progress in implementing the provisions of sustainable development in the member countries of the European Union is undeniable.

Further research directions will concern the analysis of the level of fulfillment of other sustainable development goals by Poland and Slovakia. The analyses will also include development forecasts for both countries.

References

1. Barska, A., Jedrzejczak-Gas, J. (2019). Indicator Analysis of the Economic Development of Polish Regions in the Context of the Implementation of the Concept of Sustainable Development. *European Journal Of Sustainable Development*, Vol. 8, Iss. 5, pp. 210-221. DOI: 10.14207/ejsd.2019.v8n5p210.
2. Czerwińska, K., Pacana, A., Grebski, M. (2022). Analysis of the fourth industrial revolution in the context of innovation and the idea of technology development. *Scientific Papers of Silesian University of Technology. Organization & Management*, Vol. 166, pp. 167-179. DOI: <http://dx.doi.org/10.29119/1641-3466.2022.166.11>.
3. Czerwińska, K., Pacana, A. (2022). Analysis of the maturity of process monitoring in manufacturing companies. *Production Engineering Archives*, Vol. 23, Iss. 3, pp. 246-251. DOI: 10.30657/pea.2022.28.30.
4. de Menezes, H.Z., Galvao, T.G. (2020). Global Politics, the 2030 Agenda and the Sustainable Development Goals. *Meridiano 47 - Journal of Global Studies*, Vol. 21, No. e21016. DOI: 10.20889/M47e21016.

5. Dolega, W. (2022). Energy efficiency of national economy - selected aspects. *Przegląd Elektroniczny*, Vol. 98, Iss. 8, pp. 118-122. DOI: 10.15199/48.2022.08.22.
6. Eustachio, J.H.P.P., Caldana, A.C.F., Liboni, L.B., Martinelli, D.P. (2019). Systemic indicator of sustainable development: Proposal and application of a framework. *Journal of Cleaner Production*, Vol. 241, No. 118383. DOI: 10.1016/j.jclepro.2019.118383.
7. Garcia-Sanchez, I.M., Amor-Esteban, V., Aibar-Guzman, C., Aibar-Guzman, B. (2023). Translating the 2030 Agenda into reality through stakeholder engagement. *Sustainable Development*, Vol. 31, Iss. 2, pp. 941-958. DOI: 10.1002/sd.2431.
8. Grebski, M., Czerwińska, K., Pacana, A. (2022). Swot analysis of individual components within the innovativeness ecosystem. *Modern Management Review*, Vol. 27, Iss. 2, pp. 57-66.
9. Gunnarsdottir, I., Davidsdottir, B., Worrell, E., Sigurgeisdottir, S. (2020). Review of indicators for sustainable energy development. *Renewable & Sustainable Energy Reviews*, Vol. 133, No. 110294. DOI: 10.1016/j.rser.2020.110294.
10. Hajduk-Stelmachowicz, M. (2014). Znaczenie strategii proekologicznych w kontekście budowania przewagi konkurencyjnej przedsiębiorstw. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, Wyd. 366. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, pp. 152-162.
11. Kozel, R., Vilamova, S., Kiraly, A., Hawrysz, L., Hys, K. (2015). *Legal aspects of environmental issues in the Czech Republic*. 15th International Multidisciplinary Scientific GeoConference SGEM 2015, Ecology, Economics, Education And Legislation, Vol. II, pp. 703-710.
12. Kyaw, K., Pindado, J., de-la-Torre, C. (2022). Disentangling the Bidirectional Relationships Across the Corporate Sustainable Development Indicators. *Social Indicators Research*, Vol. 163, Iss. 1, pp. 297-320. DOI: 10.1007/s11205-022-02899-5.
13. Lazar, S., Klimecka-Tatar, D., Obrecht, M. (2021). Sustainability Orientation and Focus in Logistics and Supply Chains. *Sustainability*, Vol. 13, Iss. 6, No. 3280. DOI: 10.3390/su13063280.
14. Manero-Salvador, A. (2022). 2030 Agenda, Global Law, and International Law. *Iberoamerican Journal of Development Studies*, Vol. 11, Iss. 2, pp. 102-125. DOI: 10.26754/ojs_ried/ijds.681.
15. Mazur, M. (2020). The process of improving the set-up time in the manufacturing process. *Conference Quality Production Improvement – CQPI*, Vol. 2, No. 1, 131-139.
16. Novovic, G. (2022). Can Agenda 2030 bring about "localization"? Policy limitations of Agenda 2030 in the broader global governance system. *Development Policy Review*, Vol. 40, Iss. 4. DOI: 10.1111/dpr.12587.
17. Olkiewicz, M., Wolniak, R. (2020). Responsible Pro-Environmental Management in an Organization: a Case Study. *Rocznik Ochrona Srodowiska*, Vol. 2, Iss. 2, pp. 763-780.

18. Olkiewicz, M., Wolniak, R., Skotnicka-Zasadzien, B. (2019). Implementation of ISO 14001 Standard in the European Union Countries. *Rocznik Ochrona Srodowiska, Vol. 21, Iss. 2*, pp. 868-880.
19. Pacana, A., Czerwińska, K. (2019). Analysis of the causes of control panel inconsistencies in the gravitational casting process by means of quality management instruments. *Production Engineering Archives, Vol. 25, Iss. 25*, pp. 12-16. DOI: 10.30657/pea.2019.25.03.
20. Pacana, A., Czerwińska, K., Bednárová, L., Džuková, J. (2020). Analysis of a practical approach to the concept of sustainable development in a manufacturing company in the automotive sector. *Waste Forum, Vol. 3*, pp. 151-161.
21. Pacana, A., Czerwińska, K., Ostasz, G. (2023). Analysis of the Level of Efficiency of Control Methods in the Context of Energy Intensity. *Energies, Vol. 16, Iss. 8, No. 3507*. DOI: 10.3390/en16083507.
22. Staniszewska, E., Klimecka-Tatar, D., Obrecht, M. (2020). Eco-design processes in the automotive industry. *Production engineering Archives, Vol. 26, Iss. 4*, pp. 131-137. DOI: 10.30657/pea.2020.26.25.
23. Ulewicz, R., Blaskova, M. (2018). Sustainable development and knowledge management from the stakeholders' point of view. *Polish Journal of Management Studies, Vol. 18, Iss. 2*, pp. 363-374. DOI: 10.17512/pjms.2018.18.2.29.
24. Ulewicz, R., Czerwińska, K., Pacana, A. (2023). A rank model of casting non-conformity detection methods in the context of Industry 4.0. *Materials, Vol. 16, Iss. 2, No. 723*. DOI: 10.3390/ma16020723.
25. Ulewicz, R., Pacana, A. (2017). Research of determinants motivating to implement the environmental management system. *Polish Journal of Management Studies, Vol. 16, Iss. 1*, pp. 165-174. DOI: 10.17512/pjms.2017.16.1.14.
26. Wang, X.Y., Song, C.Q., Cheng, C.X., Ye, S.J., Shen, S. (2021). Cross-national Perspectives on Using Sustainable Development Goals (SDGs) Indicators for Monitoring Sustainable Development: A Database and Analysis. *Chinese Geographical Science, Vol. 31, Iss. 4*, pp. 600-610. DOI: 10.1007/s11769-021-1213-9.