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REGIONAL DIVERSITY OF THE ENVIRONMENTAL QUALITY OF LIFE IN POLAND

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Purpose: The paper aims to assess the variation in the environmental quality of life in Poland's voivodships in 2021. The study uses indicators to monitor the links between the natural environment and society. They indicate how environmental conditions affect the quality of life and well-being of the population.
Design/methodology/approach: The study used one of the taxonomic methods - the TOPSIS method, based on which the voivodships were divided into four classes characterised by similar levels of environmental quality of life.
Findings: The study results showed that Podkarpackie, Lubuskie, Małopolskie and Warmińsko-Mazurskie voivodships, characterised by high natural values and relatively low environmental impact ratios compared to other voivodships and the national average, were in the best group due to the environmental quality of life. The last places belonged to the Pomorskie, Opolskie, Łódzkie and Śląskie Voivodships. Most of them are industrial, which means that the indicators of environmental impact, especially air pollution and collected waste, are relatively high and exceed the national average.
Social implications: The research results presented in the article may be useful for the diagnosis of current results and the revision of the environmental policy of the entire country as well as their individual regions in the future.
Originality/value: The article fits into contemporary debates on the effectiveness of implementing the concept of green economy as a tool for sustainable development.

Keywords: environmental quality of life, sustainable development; green economy; TOPSIS method.

Category of the paper: Scientific paper.

1. Introduction

An important determinant of socioeconomic development and quality of life is the natural environment, whose resources are the foundation of economic activity and the integrity of societies (Kryk, 2015). Increasingly, the societies of many countries, including highly

developed ones, are experiencing the effects of growing crises (ecological and energy) and the consequences of global warming in the form of extreme climatic events (Łącka, 2022). The deterioration of living conditions and food production is unfolding in many countries (Carayannis, Barth, Campbell, 2012). The negative effects of unsustainable consumption of natural resources and emissions are being felt in virtually every country (Hall, Mynick, Wiliams, 1991; Kumar et al., 2020). Therefore, society should consciously manage the resources of the natural environment, maintaining their high biodiversity, landscape, aesthetics, "health", and cultural values to maintain balance in ecosystems. In this way, it is possible to use the natural environment and thus meet human needs, resulting in a reasonable quality of life.

The growing awareness of the human impact on the environment and the irreversibility of climate change, as well as the responsibility of present societies for the living conditions of future generations, resulted in the concept of sustainable development and the green economy. The use of the adjective "green" in relation to economic phenomena signifies symbolic attention to the importance and need to protect the natural factor in the economy (Adamowicz, 2022).

The term "green economy" was popularised due to the economic crisis experienced from 2008 to 2010. It happened mainly as a result of the involvement of countries that, through the adopted recovery programmes, initiated projects related to the transformation of economies towards environmentally friendly solutions. The green economy is believed to best express all three aspects of sustainable development: economic, social and environmental. It aims to improve people's well-being while reducing ecological risk and the scarcity of natural resources (Ryszawska, 2013). Several definitions of the green economy can be found in the literature, all of which incorporate respect for the environment and address environmental costs in economic activity. It is most often monitored by indicators, which can be classified into four thematic areas, i.e. (Daniek, 2020; Bąk, Cheba, 2020):

1. natural capital, including indicators describing the state of the natural environment,
2. environmental and resource productivity of the economy– indicators showing the links between the natural environment and the economy have been included in this group,
3. the environmental dimension of quality of life of the population – presenting indicators to monitor the links between the natural environment and society,
4. economic opportunities and policy responses – including indicators that characterise economic and social impact instruments, creating the desired development directions to greening the economy.

In terms of the considerations presented in this article, the attention is drawn to the third group, which includes indicators related to air pollution, municipal waste, land management, population access to essential water and wastewater services, and natural values.

This study aims to assess the diversity of environmental quality of life in Polish voivodships. The research presented in this article contributes to contemporary debates on the effectiveness of implementing the green economy concept as a tool for sustainable development. The analysis was conducted on the voivodships of Poland in 2021. The statistical

data were taken from the Local Data Bank of the Central Statistical Office (GUS) in Poland (www.stat.gov.pl). One of the taxonomic methods - the TOPSIS method – was used to achieve the research objective.

The layout of this article includes an introduction, which outlines the main purpose of the paper and explains the authors' main motivations for researching the environmental dimension of quality of life in Poland's voivodships. In addition, a review of the literature concerning the issue under study is included. The following section discusses the statistical data used in the article and describes the research procedure. Finally, the results of the research and the conclusions of the research are presented.

2. Quality of life and the environment

Quality of life is a category increasingly present in the studies and research of representatives of many sciences: economics, sociology, psychology, medicine, and pedagogy, but also in the statements of politicians and social development strategy documents. This issue goes beyond the material dimension, and it is a relative and complex concept (Keles, 2012) that addresses many aspects of human existence, including the environment (Baran, 2018). It is also recognised as the essence of sustainable development. According to Kusterka-Jefmańska (2010), the essence of sustainable development is to permanently improve the quality of human life by forming the right proportions using three strengths of capital: ecological, economic and social. Extreme environmental events such as natural disasters (earthquakes, cyclones, floods, droughts and volcanic eruptions) and epidemics can cause increased death, injury and disease levels. In the long term, drastic environmental changes can also worsen human health through climate change (Streimikiene, 2015). The conflict between human needs and environmental sustainability has led many governments to introduce the concept of sustainable development in planning future development activities (Jusoff, 2020). Improving the quality of life has become the main goal of sustainable development and is assessed using various factors and indicators (Streimikiene, 2015).

It cannot be denied that, in material terms, the quality of life has improved over the last 50 years. Nowadays, we have access to many amenities, purchase more luxury goods and live longer. However, other areas of life have deteriorated; for example, there has been a significant increase in the number of people suffering from allergic and civilisation-related lifestyle diseases, including cardiovascular diseases caused by being overweight, the lack of exercise or stress. The quality of the local environment directly impacts people's health and well-being. An unpolluted environment gives satisfaction, improves mental well-being, and allows people to unwind from the stresses of daily life and be physically active. Access to resources such as green areas, forests and rivers is an important aspect of the quality of life.

Air pollution is also vital for public health (Ryńska, 2011; Han, 2020). Exposure to PM 2.5 concentration is associated with increased respiratory symptoms (Pirozzi et al., 2018) and has a harmful effect on mental health (Genc et al., 2012). It has also been confirmed that exposure to air pollution reduces enthusiasm for participation in outdoor physical activity (Roberts, Voss, Knight, 2014).

Intensive development generates many environmental requirements. According to Jusoff (2020), development is often cited as one of the major agents that have led to the transformation of the four main components of the natural environment - land, water, air and biological aspects. The ecological crisis made people aware of the scale of threats that concerned both the objective and subjective quality of life. For this reason, in evaluating the quality of life, attention is paid to protecting the environment and conducting economic activities following the principles of sustainable development. The positive aspects of the environmental impact on the general well-being of the population are often cited. Studies by many authors clearly indicate a positive relationship between the number of green spaces and health (De Sousa, 2006; Van Dillen et al., 2012; Dadvand et al., 2016; Van Den Berg et al., 2016). Chang et al. (2020) identify access to nature and scenic beauty as an important factor influencing health, which affects both physical and mental health. According to De Sousa (2006), brownfield redevelopment and creating green spaces in cities are two initiatives gaining support in the U.S. because they are seen as important elements in fostering urban revitalisation and more sustainable development.

The main factor affecting the quality of environmental services provided (Osbaldiston, Sheldon, 2003) is environmental responsibility implemented through activities such as energy saving, the use of renewable resources (Bąk, Cheba, 2023) and sustainable consumption. To help offset the progressive degradation of the environment in the 21st century, people will need to significantly change their habits (Howard, 2000; Winter, 2000) to move towards environmentally oriented behaviour. Environmentally friendly behaviour involves saving natural resources and energy, using renewable energy sources instead of fossil fuels, recycling waste, and properly managing and disposing wastewater. It will be beneficial to societies that also directly use environmental resources and services, such as water, clean air, land, forests and the previously mentioned access to green spaces, which allow for the satisfaction of basic needs and influence the meaningful use of leisure time (Balestra, Dottori, 2012).

3. Statistical material and method

Table 1 presents a list of diagnostic features used in the study. They concern indicators describing aspects related to the environmental quality of life. The influence of each feature on the analysed phenomenon was also indicated by classifying it into a set of characteristics

stimulating development in the area (symbol S) or destimulating this development (symbol D). It should be noted that over 56% of the indicators adopted for the study are stimulants.

Table 1.
Base of indicators

Symbol	Name	$\bar{x}$	V_s (%)	*As*
X_{1D}	Emissions of particulate pollutants from plants which are particularly onerous on air purity in tons per 1 km^2	0.08	91.26	3.00
X_{2D}	Emission of gaseous air pollutants (without carbon dioxide) from plants of particular concern to air purity in tonnes per 1 km^2	785.39	103.95	1.48
X_{3D}	Municipal waste collected per capita in kg	212.98	17.57	-0.49
X_{4D}	Industrial and municipal wastewater in % of wastewater requiring treatment	96.86	4.97	-2.18
X_{5D}	Wastewater discharged to waters or land containing substances particularly harmful to the aquatic environment hm^3 per 1 km^2	0.08	144.87	2.24
X_{6S}	Share of treated wastewater in wastewater requiring treatment (%)	91.84	12.78	-1.86
X_{7S}	Population using wastewater treatment plants as % of the total population	74.85	9.08	-0.77
X_{8S}	Urban population using water supply as % of the total population	96.84	1.56	-0.39
X_{9S}	Urban population using sewers as % of the total population	90.91	2.50	0.25
X_{10S}	Urban population using mains gas as % of the total population	71.84	12.94	-1.23
X_{11S}	Share of legally protected areas in the total area %	33.46	37.77	1.09
X_{12S}	Area of parks, greens and neighbourhood green areas as % of the total area	0.21	70.83	2.82
X_{13S}	Forest cover (%)	30.34	22.68	1.24
X_{14S}	Share of green areas in % of the total area	0.63	71.51	1.73
X_{15D}	Agricultural and forestry land excluded from agricultural production in ha per 1 km^2	2.11	53.14	0.47
X_{16D}	Share of devastated and degraded land requiring redevelopment as % of the total area	0.21	45.31	0.54

Source: own elaboration.

The preliminary analysis of the diagnostic characteristics shows significant disparities between surveyed voivodships in terms of the environmental quality of life. These are indicated by high values of the coefficient of variation (Vs) and the asymmetry coefficient (As). The coefficient of variation ranges from 1.56% ($X_{1.8S}$ – urban population using the water supply in % of the total population) to 144.87% ($X_{1.5D}$ – wastewater discharged to waters or land containing substances particularly harmful to the aquatic environment hm^3 per 1 km^2), with values exceeding 30% for most features (Table 1). Most destimulant indicators show moderate to high right-sided asymmetry. It means that the indicators adopted for the study for most voivodships assume values below the average, which is a favourable situation. Only the decomposition of two destimulant features is characterised by moderate and strong left-sided asymmetry. It means that for most voivodships, municipal waste collected per capita in kg (X_{3D}) and industrial and municipal wastewater in % of wastewater requiring treatment (X_{4D}) are above the national average.

The distributions of most stimulant indicators are also unfavourable, with as many as five of them having a distribution with right-sided asymmetry. It follows that in the case of most voivodships, their values were below the average. High right-hand asymmetry is particularly relevant to environmental indicators. These include the share of legally protected areas in % of the total area (X_{11S}), the area of parks, greenery and green areas in % of the total area (X_{12S}), forest cover (X_{13S}) and the share of green areas in the total area (X_{14S}).

The paper uses one of the methods of multivariate statistical analysis - the TOPSIS method - to classify Poland's voivodships in terms of environmental quality of life.

The TOPSIS method, i.e. Technique for Order Preference by Similarity to an Ideal Solution, proposed and described by Hwang and Yoon in 1981, is one of the multi-criteria methods of decision-making (Yoon, Kim 2017; Parida Sahoo, 2013; Roszkowska, 2019; Zulqarnain et al., 2020), it is often used for the linear ordering of multivariate objects (Dmytrów, 2018; Galik et al., 2022). The procedure of TOPSIS method proceeds in the following steps:

Stage 1. Determination of the matrix:

$$X = [x_{ij}] \tag{1}$$

where:

i – the number of the object (i = 1, 2, …, n),

j – the number of the diagnostic feature (j = 1, 2, ..., m),

x_{ij} – the value of the jth feature diagnostic for the i-th object.

Stage 2. Normalisation (ensuring comparability) of diagnostic feature values based on the formula:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{2}$$

where:

z_{ij} – the value of j-th of normalised feature diagnostically for the i-th object.

Stage 3. For each standardised diagnostic feature, the determination of two reference points that determine the coordinates of the Positive Ideal Solution and the Negative Ideal Solution, respectively – a pattern and an antipattern:

$$v_j^+ = \begin{cases} \max\limits_i v_{ij} & \text{for stimulant} \\ \min\limits_i v_{ij} & \text{for destimulant} \end{cases} \tag{3}$$

$$v_j^- = \begin{cases} \min\limits_i v_{ij} & \text{for stimulant} \\ \max\limits_i v_{ij} & \text{for destimulant} \end{cases} \tag{4}$$

where:

v_j^+ – the j-th coordinate of the Positive Ideal Solution,

v_j^- – the j-th coordinate of the Negative Ideal Solution.

Stage 4. For all objects, the calculation of Euclidean distances from the pattern and the antipattern, respectively:

$$d_i^+ = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^+\right)^2} \tag{5}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^-\right)^2} \tag{6}$$

where:

d_i^+ – Euclidean distance of the *i*th object from the Positive Ideal Solution,

Stage 5. Determination of the value of the aggregate variable denoting the relative proximity of the ith object to the Positive Ideal Solution according to the formula:

$$R_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{7}$$

where:

$0 \leq R_i \leq 1$.

The preferred object has the smallest distance from the pattern and, at the same time, the largest distance from the antipattern, i.e. it assumes the largest value of the coefficient R_i.

Stage 6. Linear ordering of objects due to the non-increasing value of the aggregate variable (7).

Stage 7. The three-median method divides objects (voivodships) into four classes characterised by a similar environmental quality of life (class I has the highest level, class IV – has the lowest). This method consists in determining the median coordinates of the vector $R = (R_1, R_2, \ldots, R_n)$, which is denoted by $\mathrm{med}(R)$, and then dividing the group of objects into two groups: those for which the values of the meter exceed the median and those with values not exceeding it. Subsequently, the intermediate medians are defined as $\mathrm{med_k}(R) = \underset{i:\Gamma_i \in \Omega_k}{med}(R_i)$, where $k = 1,2$.

As a result following object groups are created:

$$Class\ I\colon R_i > \mathrm{med}_1(R) \tag{8}$$

$$Class\ II\colon \mathrm{med}(R) < R_i \leq \mathrm{med}_1(R) \tag{9}$$

$$Class\ III\colon \mathrm{med}_2(R) < R_i \leq \mathrm{med}(R) \tag{10}$$

$$Class\ IV\colon R_i \leq \mathrm{med}_2(R) \tag{11}$$

4. Results

The values of the aggregate variable determined using the TOPSIS method were ordered in non-increasing order, and on their basis, the ranking of voivodships in Poland by the environmental quality of life was created. The results are presented in Table 2 and Figure 2.

Table 2.
Ranking and typological classes of voivodships due to the environmental quality of life

Rank	Voivodships	R_i	Class
1	Podkarpackie	0,7074	I
2	Lubuskie	0,6351	
3	Małopolskie	0,6241	
4	Warmińsko-mazurskie	0,6126	
5	Dolnośląskie	0,6092	II
6	Lubelskie	0,5952	
7	Wielkopolskie	0,5951	
8	Podlaskie	0,5951	
9	Mazowieckie	0,5839	III
10	Świętokrzyskie	0,5506	
11	Kujawsko-pomorskie	0,5495	
12	Zachodniopomorskie	0,5491	
13	Pomorskie	0,5425	IV
14	Opolskie	0,5196	
15	Łódzkie	0,5063	
16	Śląskie	0,3612	

Source: own elaboration.

Upon analysing the information in Table 2, it can be noted that the division of voivodships using the three-median method results in separating four equal classes. The first of these includes two voivodships in the south of the country and one in the west and the north-east part. These provinces can be evaluated positively for most of the indicators adopted for the study. Podkarpackie Voivodship had the highest environmental quality of life in 2021. It was decided by low values (below the average) of indicators related to environmental pollution, the share of devastated and degraded land in need of redevelopment in % of total area (the lowest indicator in the country), as well as high values of indicators related to natural attractiveness, including the highest indicator of the share of green areas in the total area among voivodships (X_{14s}).

Another group relates to voivodships located in different parts of the country and with a varying surface areas. They are characterised by good air quality (the indicators for particulate and gaseous pollutants are below the average in the country), low indicators related to wastewater management, and a low share of devastated and degraded land in need of redevelopment in % of total area, except for Dolnośląkie Voivodeship.

The voivodships belonging to the third class can be assessed positively, mainly due to the below-average indicators of particulate and gaseous pollutants (except for Świętokrzyskie) and the share of agricultural and forest land excluded from agricultural production in the total area (the lowest level of this indicator in the country applies to the Kujawsko-Pomorskie

Voivodship). However, indicators related to the share of legally protected areas in the total area are unfavourable, apart from Świętokrzyskie, in which this share is the highest in the country.

The fourth group included voivodships, which should be assessed negatively in the case of most of the indicators adopted for the study. Śląskie Voivodship occupied the last position in the ranking as a result of the highest indicators among the voivodships regarding particulate and gaseous pollutants from particularly onerous plants, the share of devastated and degraded land, and wastewater discharged into waters or land containing substances, particularly harmful to the aquatic environment. In addition, in this voivodship, the share of legally protected areas in the total area is below the average (X_{11S}), but there is a good situation due to another indicator related to natural attractiveness. These include the share of parks, green areas and community green areas in the total area (X_{12S}), which in the Śląskie Voivodship is the highest among the studied voivodships.

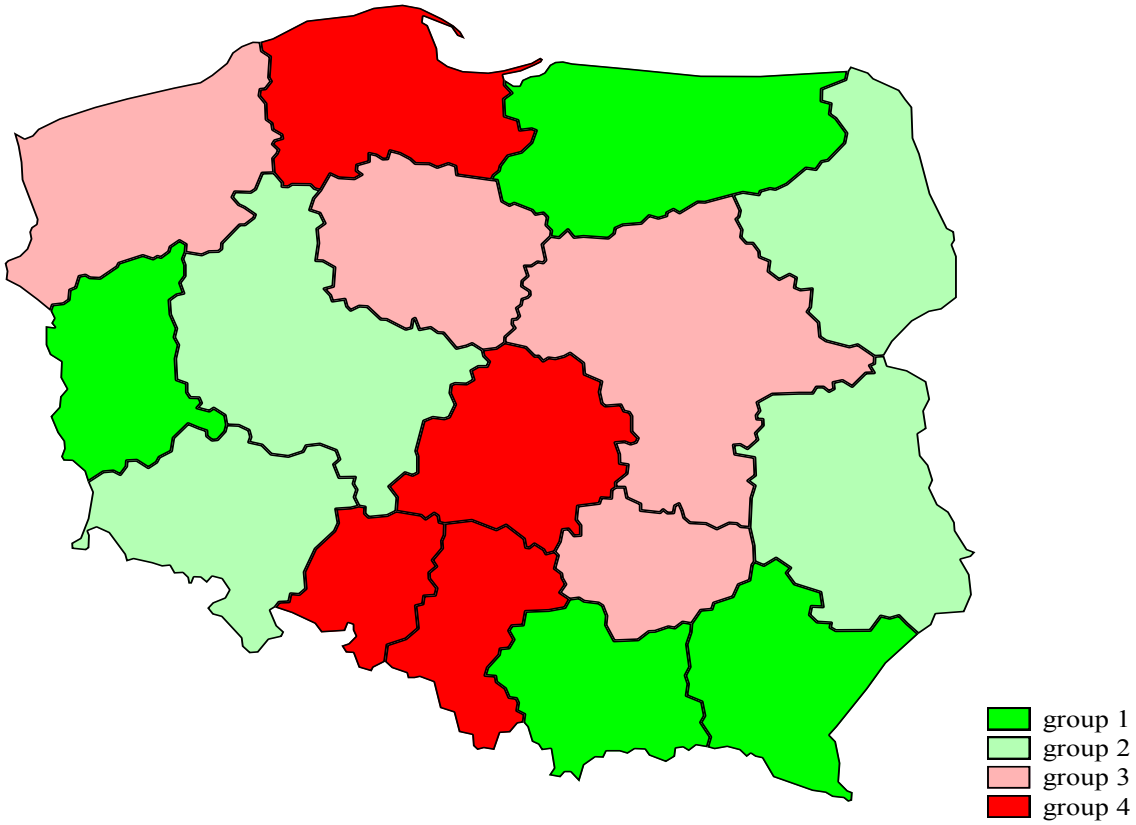

Figure 1. Spatial distribution of Polish voivodeships by topological groups.
Source: own elaboration.

5. Conclusions

Protecting the environment and natural resources is one of the most critical factors in ensuring sustainable well-being. However, measuring environmental indicators is difficult: first, the magnitude of the impact of current environmental factors on future well-being is uncertain, and second, few comparable indicators meet agreed-upon standards. However, it should be remembered that high quality of life as the ultimate goal of the concept of sustainable development should be the result of conducting development policy at all levels of governance, i.e. national, regional and local. The standard of living depends not only on income and possession of material things; it is also determined by external conditions, including the qualities of the natural environment in the immediate or distant surroundings of a man. The quantitative and qualitative state of the environment should be considered not only as a tourist asset (affecting, among other things, leisure activities), an element of national wealth, but also a factor necessary to maintain good physical health and mental well-being (Malinowski, Wasiuta, 2021). All this is of great importance for the implementation of the idea of sustainable development.

The socioeconomic development of the country is not uniform throughout its territory. Individual parts and regions differ, for example, in location, geographical and natural conditions, state of economic development, and the way of organisation and functioning of the area's community. The practical implementation of the concept of sustainable development, the essence of which is, among others, a lasting improvement in the quality of life of residents, is of particular importance in local, territorial systems.

Upon analysing the ranking of voivodships presented in this study, it can be noted that the best group due to the environmental quality of life included: Podkarpackie, Lubuskie, Małopolskie and Warmińsko-Mazurskie. These voivodships were characterised by high natural values and relatively low environmental impact indicators compared to other voivodships and the national average. The last places belonged to the Pomorskie, Opolskie, Łódzkie and Śląskie voivodships. Most of them are industrial, which means that the indicators of environmental impact, especially air pollution and collected waste, are relatively high and exceed the national average.

When analysing the indicators calculated for individual voivodships, it should be remembered that they give only an "averaged" picture of a given voivodship without providing information about its internal diversity. These differences, as in the entire country, run, among others, on the urban-rural line or central areas – peripheral areas.

The results of research on the quality of life in its objective dimension are a valuable source of information on the most important problems that should be considered when defining the goals and objectives of development policy in all its dimensions: social, economic and environmental. This type of research seems to be particularly justified in relation to local, territorial systems.

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