THE NATURAL ENVIRONMENT'S POTENTIAL AS A DRIVING FORCE BEHIND THE SOCIO-ECONOMIC DEVELOPMENT OF RURAL AREAS

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All definitions of the natural environment's potential provided by the literature highlight the role of humans as entities making use of environmental resources. The natural environment creates conditions for life processes to occur by supplying raw materials and energy required to satisfy various human needs. It provides a basis and a precondition for socio-economic development. It is, however, difficult to define the natural environment's potential in its entirety, therefore the study focused on the resource-and-performance aspect of this potential.

Hence, the article aims at identifying the relationships between the level of the natural environment's potential and the level of socio-economic development of communes. The study involved communes located in Warmińsko-Mazurskie Voivodeship. The study was carried out in several stages and involved an analysis of the level of the natural environment's potential as well as of the meta-indicator that shows the socio-economic determinants of communes in a synthetic manner. The analysis of the relationships between the level of the natural environment's potential and the socio-economic development was performed using the Pearson product-moment correlation coefficient.

Keywords: rural areas, natural environment, socio-economic development, environmental potential

INTRODUCTION

All definitions of the natural environment's potential provided by the literature highlight the role of humans as entities making use of environmental resources. The natural environment creates conditions for life processes to occur by supplying raw materials and energy required to satisfy various human needs.

Due to methodological difficulties, the determination of the full potential of the environment is rather unrealistic, therefore Haase (1978) introduced the concept of a partial potential. The list of partial potentials of the environment, mentioned by various authors, is extensive. A certain classification of them was introduced by Przewoźniak (1991), who paid additional attention to the intangible nature of some of the resources exploited by humans. He introduced the following groups of potentials: self-regulatory and immunological, resource-based and functional, and perceptional and behavioural (Piętak, 2011).

This analysis assesses the potential of the resource-based and functional group.

For these reasons, the aim of the article is to identify the relationships between the level of the natural environment's potential and the level of socio-economic development of communes.

MATERIALS AND METHODS

The study was carried out in four stages. The first stage of the study involved an assessment of resources of the natural environment in communes. The second stage involved an analysis of socio-economic conditions in communes. In the third stage, an analysis of relationships between the potential of natural conditions and the socio-economic conditions of communes. The final stage involved drawing conclusions based on the performed research.

The study involved rural and rural-and-urban communes located in Lubelskie Voivodeship.

The Lubelskie Voivodeship occupies an area of 25,12215 km2. It is the third largest voivodeship in the country, followed by Mazowieckie and Wielkopolskie Voivodeships.

The number of population amounts to 2,242 thousand, placing it on the 7th position in the country. The density of population is relatively low – approximately 85 persons per 1 km2. The natural growth index amounts to 0.4. The population of the voivodeship constitutes 5.8% of the residents of Poland.

Rural areas in Lubelskie Voivodeship occupy 24,152 km2, constituting 96.1% of the region.

In the Lubelskie Voivodeship, agriculture is of high importance. It benefits from environmental conditions considerably better than the national average, as suggested by the indicator of valorisation of agricultural production space amounting to 74.1 points (Poland 66.6 points). It is also distinguished by a relatively low level of use of the agricultural production potential (Fotyma, Krasowicz, 2001).

Its agricultural character is proved by the fact that the majority of population inhabits rural areas (villages), 53%, while most of the country inhabitants live in cities (61%). Rural areas are 96.2% of the voivodeship's whole area, and the agriculture is one of the most important parts of its economy (Kopiński, Krasowicz, 2013).

RESULTS AND DISCUSION

Stage I. **An assessment of the natural environment resource in communes.**

This analysis assesses the potential of the resource-based and functional group.

The factors which, according to Hopfer et al. (1982), should be included in the evaluation, include: the terrain, erosion risk, the patterns of surface water occurrence, water relations in the soil, agricultural suitability of soils, the existing habitats, climate, microclimate, geological conditions, the occurrence of natural resources, aesthetic value of the landscape, accessibility of areas to production and recreational purposes, the presence of architectural and natural monuments, and the state and distribution as well as capacity of built-up areas.

The method of agricultural evaluation of the production space, developed by the team of the Institute of Soil Science and Plant Cultivation in Puławy (Witek, Górski, 1977), involves an assessment of four elements of the natural environment that have a major influence on agricultural production. The following are subject to the assessment: soil quality, climate, terrain, and water relations. Each element is assigned points, and their sum forms the indicator of agricultural evaluation of the production space. The higher the sum of points assigned to a particular area, the highest the quality of the agricultural production conditions for that area.

A slightly different method of assessment of the agricultural potential was suggested by Malinowska (2010). This author distinguished 6 elements (the terrain, soil valuation class, surface formations, agri-climatic conditions, groundwater table depth, the level of soil degradation) evaluating the natural environment, and assigns each of them from 1 to 3 points, respectively. In this method, the sum of points enables an assessment of the degree of a potential in a particular area.

Bielska and Krupińska (2016) used the following to assess the conditions of the natural environment: terrain, accessibility of the water-covered land, the presence of forests, the current use, and the type of parent rock.

Based on a literature review and the analyses conducted, the following were adopted to determine the synthetic indicator of the level of resources of the natural environment: the indicator of evaluation of the quality and agricultural suitability of soils (w1), the indicator of agri-climate evaluation (w2), the indicator of the terrain evaluation (w3), the indicator of water relations evaluation (w4), the indicator of the area of legally protected areas (w5), and the indicator of commune afforestation (w6).

To determine the synthetic indicator of the level of resources of the natural environment, the following formula was applied:

$$S = \frac{1}{n} \sum_{j=1}^{n} w_{ij}$$

where:
S - synthetic indicator
w_{ij} – the value of a variable unitarised using formulas
n - the number of features

For the stimulants:

$$W_{ij} = \frac{W_{ij} - \min\{W_{ij}\}}{\max\{W_{ij}\} - \min\{W_{ij}\}}$$

For the destimulants:

$$W_{ij} = \frac{\max\{W_{ij}\} - W_{ij}}{\max\{W_{ij}\} - \min\{W_{ij}\}}$$

Diagrams 1-6 present the distribution of variables w1-w6 in the Lubelskie Voivodeship communes under analysis. On the X-axis, the percentage of the communes under analysis is presented (%). On the Y-axis, the parameters of the analysed variables are shown (points or %).
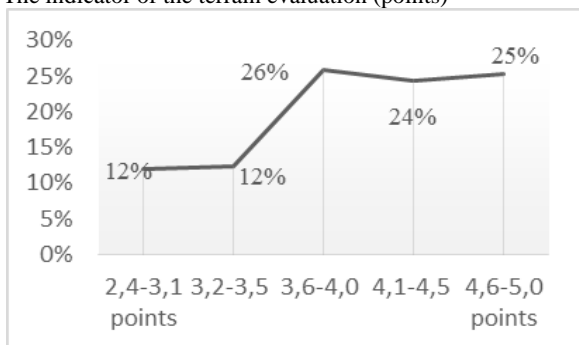
The indicator of evaluation of the quality and agricultural suitability of soils (points)
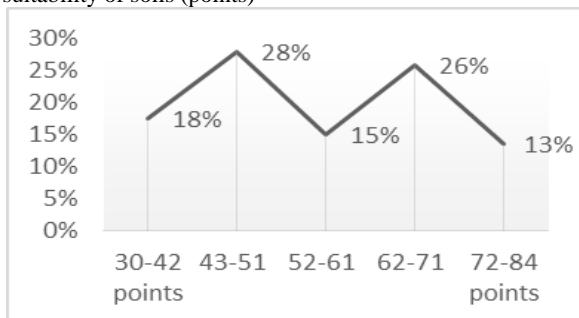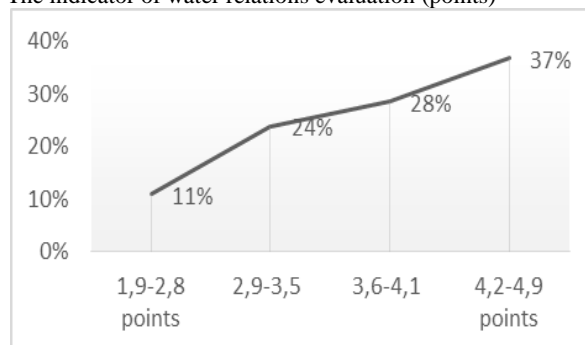
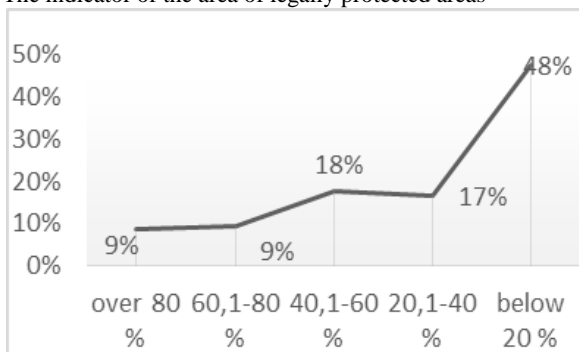The indicator of agri-climate evaluation (points)
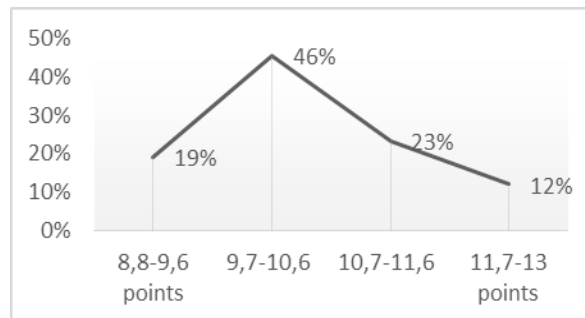
The indicator of the terrain evaluation (points)

The indicator of water relations evaluation (points)

The indicator of the area of legally protected areas
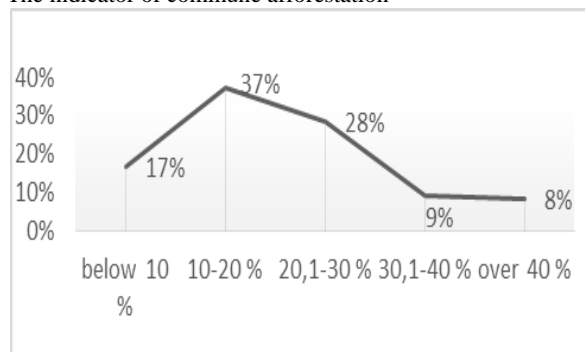
The indicator of commune afforestation

Figure 1-6. Diagrams of the distribution of variables in the Lubelskie Voivodeship communes under analysis.

A synthetic measure in the form of the indicator of the level of resources of the natural environment was calculated with account taken of the six indicators described above. From a synthetic perspective, the indicator of the potential of natural conditions was most favourable in 19% of communes. Most communes are characterised by a medium potential (36%), and the fewest (only 16%) by a low potential (Fig. 7).

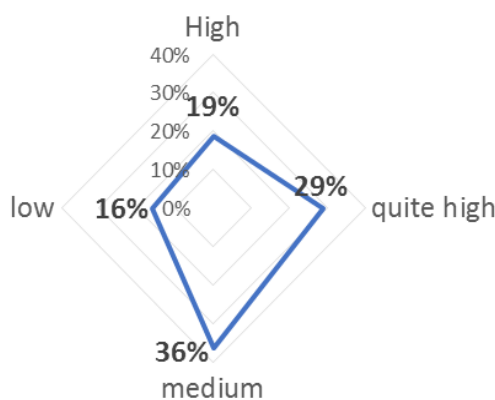Figure 7. Indicator of the level of resources of the natural environment

Stage II. Presents the meta-synthetic indicators characterising socio-economic conditions in the communes of Lubelskie Voivodeship

The phenomenon of socio-economic development can be described using a large number of variables describing both demographic, social, and economic conditions, and those characterising the condition of the natural environment

(Grabiński et al., 1983). In order to assess socio-economic phenomena, indicators are required which allow one to draw conclusions concerning the ongoing processes (Nowak, 1990). The selection of indicators for quantitative analyses is determined by the accessibility of data and subjective assessments; however, it should be substantially justified.

The research basis for this study was provided by public statistical data for 193 communes of Lubelskie Voivodeship, made accessible as part of the Bank of Local Data. 11 variables grouped into four information groups were accepted for analyses (Table 1). Additionally, for the years 2010, 2015, variable No 12 was adopted, namely the number of operators in the category A_01 of Polish Classification of Business Activities from 2007 (agricultural cultivation, animal raising and breeding, hunting). The factors adopted for the study are stimulants in nature, and are indicators of the structure and intensity of phenomena.

Table 1. The initial set of variables adopted for the analysis of socio-economic conditions of the communities.

Designation of variable	Name of variable
Demographic variables	
x_1	Number of population per 1 km^2 (population density)
x_2	Number of population at non-productive age per 100 people at productive age
x_3	Number of employed people per 1000 people
x_4	Contribution of the registered unemployed in the number of population at productive age [%]
Economic variables	
x_5	Total income of the budget of a commune per 1 resident in PLN
x_6	Total expenditures of the budget of a commune per 1 resident in PLN
Variables from the scope of social infrastructure	
x_7	Residences commissioned per 1000 residents
x_8	Entities in the REGON register
X_9	The number of operators in the category A_01 of Polish Classification of Business Activities from 2007
Variables from the scope of technical infrastructure	
X_{10}	Percentage of population using water supply utilities
x_{11}	Percentage of population using sewing utilities
x_{12}	Percentage of population using sewing utilities

As regards the variables describing socio-economic conditions of the communes, initial analyses already demonstrated that variable x_7, namely flats provided for use to the population per 1000 inhabitants, and variable x_8, namely operators in the REGON register, were characterised by the highest variation.

Based on the data of 2015, diagnostic characteristics were selected taking into account the calculated variation coefficients and the Pearson product-moment coefficients (Table 2). A diagnostic characteristic should be typical of a phenomenon under study, and should be characterised by high variation; at the same time, it is recommended that it should be strongly correlated to non-diagnostic characteristics from its information group, and poorly correlated to other characteristics considered to be diagnostic ones (Kolenda, 2009).

A. **high**; to be classified into this group, the communes had to meet the following condition: *(Ri > Ram + s),*

B. **quite high** *(Ram + s > Ri > Ram),*

C. **medium** *Ram > Ri > Ram – s),*

D. **low** *(Ram – s > Ri).*

Table 2. Matrix of Pearson's coefficients of correlation calculated between variables adopted for the

	Demographic variables			Economic variables			Variables from the scope of social infrastructure			Variables from the scope of technical infrastructure		
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	X_9	X_{10}	x_{11}	x_{12}
x_1	1.000	**-0.403**	0.159	-0.317	-0.237	-0.219	0.378	**0.729**	0.151	0.094	0.258	**0.715**
x_2		1.000	-0.127	0.030	-0.001	-0.066	-0.357	**-0.427**	-0.150	-0.023	**-0.408**	-0.353
x_3			1.000	-0.156	0.323	0.295	0.301	0.227	0.080	0.097	0.325	0.166
x_4				1.000	0.097	0.077	-0.286	-0.247	-0.171	-0.188	-0.087	-0.275
x_5					1.000	**0.909**	0.092	-0.215	-0.116	0.090	0.113	-0.180
x_6						1.000	0.121	-0.192	-0.108	0.074	0.172	-0.177
x_7							1.000	0.448	0.152	0.125	0.117	0.385
x_8								1.000	0.369	0.054	0.244	**0.562**
X_9									1.000	-0.229	-0.032	0.207
X_{10}										1.000	0.268	-0.010
x_{11}											1.000	0.147
x_{12}												1.000

With these objectives in mind, the following variables were selected as diagnostic characteristics: x_3 – the number of persons employed per 1000 inhabitants, x_6 – expenditures from the commune budget per 1 inhabitant, x_7 - namely flats provided for use to the population per 1000 inhabitants, and x_{11} – percentage of population using the sewage system.

Further analyses were performed on selected diagnostic characteristics. Analyses, data as at 2015. Source: own elaboration based on data of the Central Statistical Office.

Diagnostic characteristics were selected from among variables adopted for the analysis. For this purpose, mutual correlations were analysed between variables adopted for the study. Normalisation of diagnostic characteristics was performed by the unitarisation method, with the application of the following formula:

$$Xi' = \left(\frac{Xi - Xmin}{Xmax - Xmin}\right) \quad for \ i = 1, 2, \ldots, 17 \tag{1}$$

where: X_i' – normalised value of the i-th element of the characteristic X
X_i – value of the i-th element of the characteristic X prior to normalisation

Successively, a reduction in the multi-characteristic space was performed using the method of standardised sums (Grabiński et al., 1983), and then the synthetic meta-indicator presenting the arithmetic mean of the standardised diagnostic characteristics was calculated (Kolenda, 2009), which is presented for the analysed communes in Table 2. The analysed dimensions of the development were divided into four main groups of communes with high, quite high, medium, and low level of development (Ziemiańczyk, 2010). While establishing the groups, the arithmetic mean (*R*am) of the obtained synthetic assessments in separated groups of variables and the indicator of the level of development for all communes was used, as well as the standard deviation (*s*) from the mean, with the assumption that the communes are distinguished by the following levels of development:
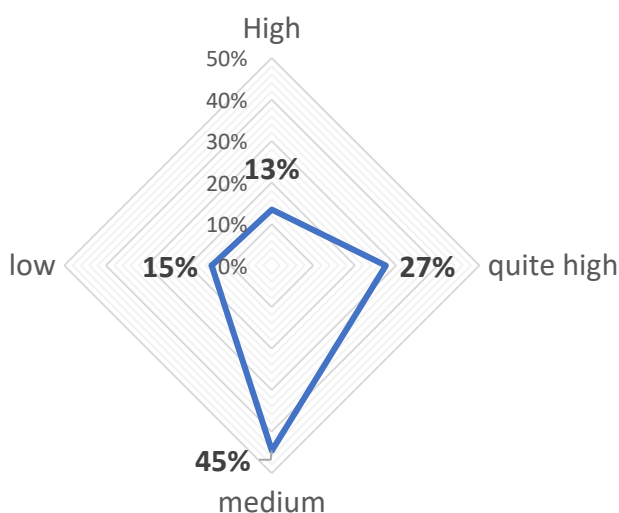

Figure 8. Summary of meta-synthetic indicator characterizing socio-economic conditions of communes

From a synthetic perspective, the meta-synthetic indicator characterising socio-economic conditions was most favourable in 13% of communes. Most communes are characterised by a medium potential (45%), and the fewest (only 15%) by a low potential (Fig. 8).

Stage III. In the third stage, an analysis of relationships between the level of the synthetic indicator of resources of the natural environment (S) and the meta-synthetic indicator characterising socio-economic conditions (X) was carried out.

The relationships was analysed by the determination of the Pearson's correlation coefficients between the obtained values of the indicators and the obtained levels of these potentials.

Table 3. Pearson's correlation coefficients

Variable	X	X(level)
S	-0,119835	-0,124649
S(level)	**-0,185866**	**-0,210520**

A weak correlation between the level of the synthetic indicator of the potential of natural conditions (S) and the meta-synthetic indicator characterising the socio-economic conditions (X) was obtained (tab. 3).

CONCLUSIONS

1. In the communes under study, the level of resources of the natural environment varied – 36% of the analysed communes were characterised by a medium potential.

2. In Lubelskie Voivodeship, communes are characterised by a various level of socio-economic development. In these communes, 45% were characterised by a medium level of socio-economic development.
3. The results obtained from the analysis did not prove the existence of a significant relationship between the presented indicators showing the level of resource of the natural environment in communes, and the level of socio-economic development.
4. The failure to obtain a significant relationship may result from the fact that the determination of the level of socio-economic development is such a complex and qualitatively diverse phenomenon, that its quantitative comparisons produce, in this particular case, no satisfactory results. In addition, it is necessary to give some thought to the validity of the assumptions adopted while constructing the synthetic indicators, and a great number of such simplifying assumptions had to be adopted.

REFERENCES

1. Bielska, A., Krupińska, I. 2016. Ocena potencjału środowiska przyrodniczego i kierunków rozwoju jako element planowania przestrzennego gminy wiejskiej. *Infrastruktura I Ekologia Terenów Wiejskich*, No. II/1/2016, pp. 473–484. http://www.infraeco.pl/pl/art/a_17859.htm [In Polish]
2. Fotyma, M., Krasowicz, S. 2001. The potential productivity of arable land in Poland. Regional coverage. *Pamiętnik Puławski*, Vol. 124, pp. 99–108.
3. Grabiński, T., Wydymus, S., Zeliaś, A. 1983. *Metody prognozowania rozwoju społeczno – gospodarczego*, PWE, Warszawa.
4. Haase, G., Zur Ableitung Und Kennzeichnung von Naturpotentialen, Pet. Geogr. Mitt. 2, 1978. [In German]
5. Hopfer A., Cymerman, R., Nowak, A. 1982. Ocena i waloryzacja gruntów wiejskich, Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa. [In Polish]
6. Kolenda, M. 2006. Taksonomia numeryczna: klasyfikacja, porządkowanie i analiza obiektów wielocechowych. Wyd. Akademii Ekonomicznej we Wrocławiu, 359 p. [In Polish]
7. Kopiński, J., Krasowicz, S. 2013. Przyrodnicze i organizacyjno-ekonomiczne uwarunkowania konkurencyjności rolnictwa Lubelszczyzny. Studia Ekonomiczne i Regionalne. VI/ 3, pp. 69-82. http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.ekon-element-000171329877 [In Polish]
8. Malinowska, E. 2010. Teoria regionu i regionalizacja. Potencjał przyrodniczy i kierunki zagospodarowania regionu, materiały wykładowe, Warszawa. [In Polish]
9. Nowak, E. 1990. Metody taksonomiczne w klasyfikacji obiektów społeczno-gospodarczych. Wyd. PWE, Warszawa. [In Polish]
10. Piętak, K. 2011. Propozycja wykorzystania metody potencjału środowiska przyrodniczego w planowaniu przebiegu ścieżek dydaktycznych w pobliżu wielkich miast. *Czasopismo techniczne*, No. 17, pp. 151–155. http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.baztech-73bef6f8-e9ff-4a6a-9a86-b52149da065b [In Polish]
11. Przewoźniak, M. 1991. Krajobrazowy system interakcyjny strefy nadmorskiej w Polsce, UG Gdańsk. [In Polish]
12. Witek, T., Górski, T. 1977. Przyrodnicza bonitacja rolniczej przestrzeni produkcyjnej w Polsce. Wyd. Geodezyjne. [In Polish]
13. Ziemiańczyk, U. 2010. Ocena poziomu rozwoju społeczno-gospodarczego gmin wiejskich i wiejsko-miejskich w woj. małopolskim. *Infrastruktura i Ekologia Terenów Wiejskich*, No. 14, pp. 31–40. http://www.infraeco.pl/pl/art/a_16225.htm [In Polish]