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EVALUATION OF THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT IN RURAL COMMUNES IN EASTERN POLAND

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Abstract. The paper attempts to evaluate the durability and sustainability of both socio-economic development and environmental order in rural communes in Eastern Poland. The authors analysed indicators selected on the basis of literature studies, which demonstrated the level of socio-economic development and environmental order for two years: 2007 and 2013. The developed analysis is based on two methods. Firstly, based on the collected indicators, a synthetic indicator was determined using the Hellwig's method, which was employed to classify the area under study by distinguishing three classes representing the levels of socio-economic development and environmental order. Secondly, a relationship was determined between the levels of socio-economic development and environmental order. An interrelation between socio-economic phenomena and environmental order is present in each of the communes under study. However, the method and effects of the implementation of sustainable development vary. The study showed that units characterised by average development in terms of socio-economic aspects and environmental order predominate in rural communes in Eastern Poland. Most communes under study showed the balance between the class of socio-economic development and the class of environmental order. This indicates the durability and sustainability of development, which is a welcome trend from the perspective of the concept of sustainable development.

Key words: socio-economic development, environmental order, sustainable development, Eastern Poland.
JEL code: Q01, O12, O18, R12,

Introduction

The basis of the concept of development sustainability is the interaction between anthropogenic and natural elements in the economic, environmental, social and institutional aspects of functioning, which link with one another, and thus contribute, through complex processes, to the durability of development (Valentin A., Spangerberg J. H., 2000; Gobattoni F. et al., 2015). Therefore, at present, the protection of landscape and tradition, appropriately linked with the current social, political and economic situation, cultural and technological achievements, and environmental changes, should be one of the main issues to be taken into account in the policy and territorial management. In order to cope with the need for the durability of development, multi-faceted integration is therefore required (Zurlini G. et al., 2013). Particular attention should be paid to the natural environment, since the nature is an essential prerequisite for sustainable economic development of a particular area as it attracts people to that place, and is, at the same time, a source of economic development in sectors such as organic farming, forestry, fisheries, tourism as well as efficient and smart production based on natural resources (Livina A., Rozentale S., 2015). This contributes to the strengthening of social capital, while improving economic development at the same time (Borawski P., Dunn J. W., 2014).

In Poland, numerous development-supporting programmes based on the principles of sustainable development are under implementation. The Operational Programme entitled "Development of Eastern Poland" is among those worth indicating. The main objective of the Programme is "*to accelerate the pace of socio-economic development of communes in Eastern Poland, at the same time respecting the sustainable development policy".* The Programme is implemented within the time frameworks of 2007–2013 and 2014–2020, and is aimed at equalising the development

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opportunities for five poorest regions of the EU (Lubelskie, Podkarpackie, Podlaskie, Swietokrzyskie and Warminsko-Mazurskie provinces) (Pawlewicz A. et al., 2015).

For the research into the level of sustainable development, it is extremely important to determine the degree of balance achieved between development factors and the condition of the environment. Information on the proportions of the main components may determine the lines of measures for both the achievement of durability and the stimulation of development in the future. Therefore, the basis for considerations and analyses in the paper is a thesis stating that sustainable development occurs when an increase in the socio-economic level is accompanied by a proportional increase in the environmental order. Therefore, the objective of sustainable development is the durable maintenance of proportions between socio-economic development and environmental protection. This is evidenced by the fact that for two decades in Poland, economic growth and improvement in the quality of life have been noted, along with an increase in legally protected areas and general improvement in the environment of rural areas, which has no adverse effect on local economies (Cieslak I. et al., 2015). It should be borne in mind that the directions of these phenomena are opposing, and since they concern the same entity or territorial unit, they should balance out, which, by assumption, results in the durability of development and not stagnation. The discussed literature indicates that a positive relationship exists between socio-economic processes and environmental order. This relationship occurs with varying intensity in relation to heterogeneous spheres of the development and, contrary to the common belief, is a directly proportional relationship.

Materials and methods

In order to support the proposed thesis, the authors evaluated the durability and sustainability of development by comparing the quotients of values showing the level of socio-economic development with adequate values indicating the level of environmental order in horizontal layout in the years 2007 and 2013. A set of economic, social, and environmental indicators of sustainable development was adopted as the values describing those two phenomena. During the analysis, indicators were selected based on a review of literature, which, for the specified area of research, due to its political and economic determinants, represented the level of discussed phenomena most accurately. The area under study included provinces of Eastern Poland, which are still perceived as problem areas and are actually struggling with development problems, primarily in the socio-economic sphere. The basic subject of the study was a rural commune. The study focused on 496 such communes.

Since, as already mentioned, both socio-economic development and environmental order are multi-faceted concepts, they are characterised using synthetic variables which allow a set of many coefficients to be replaced with one variable (Bossel H., 1999; Caschili S. et al., 2014). In the course of the study, two measures were distinguished using the Z. Hellwig's method (1968). One of them characterised the level of socio-economic development, while the other characterised environmental order of rural communes in Eastern Poland. The synthetic measures were determined using the following procedure:

1) analysis of literature on the subject for the selection of characteristics – indicators of socio-economic development and environmental order (Spangenberg J. H. eta al., 1999, Bossel H., 1999, Borys T., 2005, Korol J., 2007, Pawlewicz K., 2015);
2) elimination of excessively correlated characteristics through an analysis of diagonal elements of the inverse correlation matrix, which resulted in the exclusion of variables

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being too strongly correlated, i.e. those for which the values on the main diagonal exceeded the number 10, from further considerations. Eventually, the following characteristics (indicators) were selected for further research:

- socio-economic development: x_1 – birth rate per 1,000 population; x_2 – population density; x_3 – gross enrolment ratio for primary schools; x_4 – gross enrolment ratio for lower-secondary schools; x_5 – outpatient clinics per 10,000 population; x_6 – participation of women in the Commune Council; x_7 – average usable floor area of a flat per 1 person; x_8 – commune's income from personal income tax per capita; x_9 – total commune's own income per capita; x_{10} – received specific grants to the budget's income, total; x_{11} – expenditure on culture and national heritage protection per capita; x_{12} – expenditure on social welfare per capita; x_{13} – investment asset expenditure per capita; x_{14} – entities entered into the REGON register per 10,000 inhabitants; x_{15} – income from agricultural tax per capita; x_{16} – length (in km) of the active water-pipe network per km^2 of the area; x_{17} – length of the active sewerage system (in km) per km^2 of the area; x_{18} – percentage of the registered unemployed in the population in productive age; x_{19} – population in post-productive age per 100 persons in productive age; x_{20} – migration balance per 1,000 persons;
- environmental order: y_1 – area of legally protected areas as a percentage of the commune area; y_2 – number of natural monuments per 100 km^2; y_3 – area of parks, green squares and community green spaces per 100,000 inhabitants; y_4 – forestation rate in a commune; y_5 – share of regeneration and afforestation in the commune area; y_6 – expenditure on waste management per capita; y_7 – expenditure on wastewater management and water conservation per capita; y_8 – percentage of population using water-pipe network; y_9 – percentage of population using sewerage system; y_{10} – asset expenditure on municipal services management and environmental protection per capita; y_{11} – expenditure on greenery maintenance per capita; y_{12} – mixed waste collected in a year per capita; y_{13} – water consumption per capita; y_{14} – percentage of population served by sewage treatment plants in total population; y_{15} – total wastewater treated per 1,000 inhabitants; y_{16} – percentage of treated wastewater in industrial and municipal wastewater requiring treatment.

The indicators were selected based on data originating from the GUS (Central Statistical Office) Bank of Local Data.

A list of analysed characteristics in a form of an observation matrix:

$$X = \begin{bmatrix} x_{11} & x_{12} \dots x_{1m} \\ x_{21} & x_{22} \dots x_{2m} \\ \dots\dots\dots\dots \\ x_{n1} & x_{n2} \dots x_{nm} \end{bmatrix}, \quad (1)$$

where: x_{ij} (i = 1,2, …, n; j = 1,2, …, m) – denotes the value of the j-th characteristic (in this case, an indicator of socio-economic development and environmental order) for the i-th object (rural commune).

Normalisation[1] of the values of characteristics (indicators) through the standardisation thereof according to the formula:

[1] Most frequently, diagnostic variables bear different names, which results in the lack of possibility for the direct comparison thereof. Therefore, in order to give characteristics a name of comparability, it is necessary to perform normalisation, i.e. elimination of the influence of measurement units.

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$$z_{ij} = \frac{(x_{ij} - \bar{x}_j)}{S_j}, \qquad (j = 1, 2, \ldots, m), \tag{2}$$

where:

$$\bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}, \qquad s_j = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_{ij} - \bar{x}_j)^2} \tag{3}$$

A result of the performed transformations is a matrix of standardised values of characteristics – Z.

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \cdots & \cdots & & \cdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix}, \tag{4}$$

Based on the obtained matrix, determination of the so-called "*development pattern*", i.e. an abstract object P0 (rural commune) with the coordinates: $P_0 = [z_{01}, z_{02}, \ldots, z_{0j}]$, where: z_{0j} = max{z_{ij}}, when Z_j is a stimulant, and z_{0j} = min{z_{ij}}, when Z_j is a destimulant. According to considerations, it should be noted that the "*development pattern*" is a hypothetic rural commune with the most favourable values of variables.

$$q_i = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_{0j})^2}, \tag{4}$$

The next step was the determination of Euclidean distances for each object P_i under evaluation (rural commune) from the determined "*development pattern*".

Based on the determined values qi, a value of Hellwig's synthetic measure of development was calculated, which was used to evaluate the rural communes under study. The indicator value may be presented according to the following formula:

$$S_i = 1 - \frac{q_i}{q_0}, \qquad (i = 1, 2, \ldots, n), \tag{5}$$

$$q_0 = \bar{q}_0 + 2s_0, \qquad \bar{q}_0 = \frac{1}{n}\sum_{i=1}^{n} q_i, \qquad s_0 = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(q_i - \bar{q}_0)^2}.$$

where:

Hellwig's synthetic measure of development S_i typically takes values from the range of (0.1). The closer the values thereof are to 1, the higher is the level of maintenance of particular componential orders (social, environmental-and-spatial, and economic) of the object under study.

Performance of the linear ordering of objects under study (rural communes) and the determination of typological classes for socio-economic development and environmental order using an arithmetic mean and standard deviation in according with the following procedure:

$S_i > \overline{S_i} + s_{S_i}$ – Class I – a higher level of socio-economic development, environmental order;

$\overline{S_i} - s_{S_i} < S_i \leq \overline{S_i} + s_{S_i}$ – Class II – an average level of socio-economic development, environmental order;

$S_i \leq S_i - s_{S_i}$, – Class III – a lower level of socio-economic development, environmental order;

where:

S_i – value of the synthetic measure calculated using the Hellwig's method for: socio-economic development; environmental order,

$\overline{S_i}$ – arithmetic mean of synthetic measure S_i,

s_{S_i} – standard deviation of synthetic measure Si.

Then, based on specific classes, sustainability coefficients (indicator of sustainable development) were determined in accordance with the following procedure:

$$ISD = \frac{KRSG}{K\acute{L}\acute{S}}, \tag{6}$$

where:

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ISD – indicator of sustainable development (intensity indicator – a relative value expressing the formation of the value of a phenomenon against the background of another one being logically linked with it);

$KRSG$ – class of socio-economic development;

$KŁŚ$ – class of environmental order.

when:

ISD = 1 – sustainable development – the balance occurs between the class of socio-economic development and the class of environmental order;

ISD < 1 – protective (passive) development – focused on environmental protection, the class of socio-economic development is lower than the class of environmental order;

ISD > 1 – expansive (aggressive) development – focused on economic expansion, the class of socio-economic development surpasses the class of environmental order.

Research results and discussion

Analysis of the data showed that units characterised by average development (Class II) in terms of socio-economic aspects and environmental order predominate in rural communes in Eastern Poland (Table 1). In 2007, there were 380 of analysed communes in the first case and 394 in the second, out of the total 496. In turn, in 2013 an increase by just under one unit took place for socio-economic factors, and an increase by nearly 7 % (31 communes) for indicators for environmental order. This is affected by the fact that, on the one hand, there are many areas with favourable natural assets, a relatively small area of degraded soils, and a typical rural landscape (Pawlewicz A., Pawlewicz K., 2012). On the other hand, this is a result of the adaptation to the standards in force in the EU Member States, which is necessary for the implementation of pro-environmental projects (Mazur-Wierzbicka E., 2015).

In 2007, there were 66 units with a higher level (Class I) of socio-economic development, and 42 units with a higher level of environmental order. As regards this typological class, it may be noted that units characterised by a high level of socio-economic development failed to maintain durability as in 2013, a decrease by nearly 1% was noted. In turn, environmental order was durable as there had been no change to the number of communes characterised by a high level of sustainable development.

In turn, in Class III, i.e. the class of units characterised by a low level of development, bilateral changes occurred during the analysis. On the one hand, the number of communes characterised by a low level of socio-economic development increased from 50 in 2007 to 52 in 2013. On the other hand, the number of territorial units characterised by a low level of environmental order decreased very significantly: in 2007, there were 60 of them, while in 2013, only 29. Therefore, one can notice a positive trend indicating an improvement to the quality of life but mainly in terms of environmental protection. Unfortunately, having analysed economic and social aspects, an increase may be observed in the number of communes in which economic downturn occurs, which results in their transfer to a lower class of development (details provided in Table 1).

Another studied phenomenon was the formation of the balance of socio-economic factors and environmental order, which are logically linked. According to results of the analysis conducted in 2007, 341 of 496 communes showed the balance between the class of socio-economic development and the class of environmental order, which indicates strong durability and stability of both factors. However, in 2013 there were 10 more of those communes. In turn, as regards economic expansion (ISD > 1), in 2007 there were 94 communes, while in 2013, a decrease to 72 territorial units (nearly 5% of the entire population under study)

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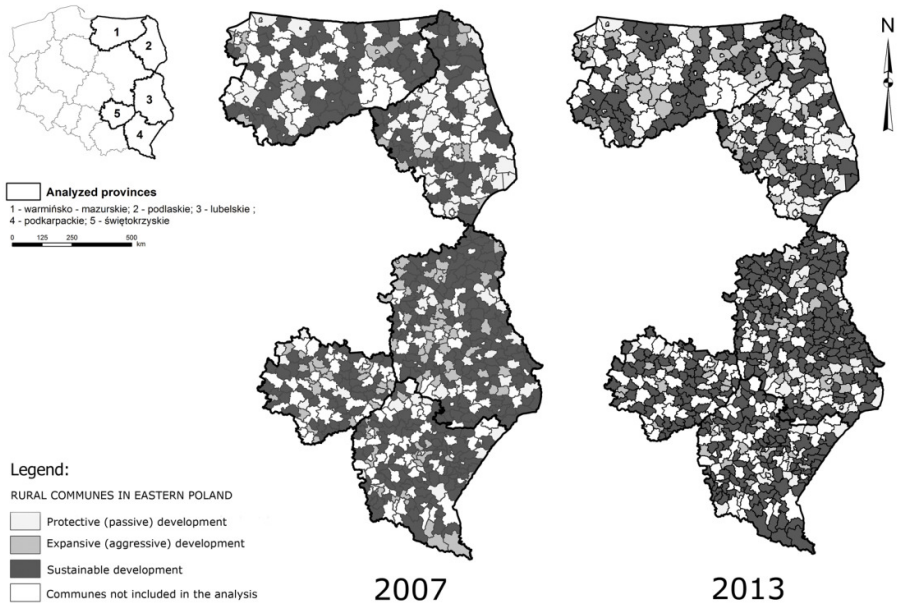
was noted. A reverse situation occurred for communes focused on development based on environmental protection (ISD < 1): in 2007 there were 61 communes, while in 2013 there were 73 of them, which is an increase by nearly 3 % (Table 1).

Table 1

Comparison of the number of communes according to the typological classes and sustainability indicator in the years 2007 and 2013

	2007		2013		2007/2013 (496=100%)	
The number of communes by classes						
	socio-economic development	**environmental order**	**socio-economic development**	**environmental order**	**socio-economic development**	**environmental order**
Class I	66	42	63	42	-0.64	0.00
Class II	380	394	381	425	0.21	6.61
Class III	50	60	52	29	0.43	-6.61
Total	**496**	**496**	**496**	**496**	**-**	**-**
The number of communes by ISD						
	ISD 2007		**ISD 2013**			
ISD = 1	341		351		2.13	
ISD > 1	94		72		-4.69	
ISD < 1	61		73		2.56	
Total	**496**		**496**		**-**	

Source: authors' construction based on GUS (Central Statistical Office) Bank of Local Data



Source: authors' construction based on GUS (Central Statistical Office) Bank of Local Data

Fig. 1. **Spatial differentiation of the value of sustainability indicator in rural communes in Eastern Poland in the years 2007 and 2013**

A positive trend can be observed: firstly, an increase in the number of units with socio-economic development balanced with environmental order as well as an increase in the number of communes which are focused on environmental protection. However, in order to nevertheless achieve sustainability in the long term, communities should be more focused on economic activity, creating cooperation networks, and developing new economic activities allowing

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the society to be entrepreneurial (Paula L., 2015). Secondly – a decrease in the number of units which are only focused on an economic expansion. It should be borne in mind that only integrated measures may contribute to the combination of socio-economic development with environmental protection (Lanfranchi M. et al., 2015).

Changes between the year 2007 and 2013 as regards spatial differentiation of the value of sustainability indicator are presented in Figure 1.

Conclusions, proposals, recommendations

The determination of the level of balance between economic-and-social factors and the condition of the environment is very important in analysing the degree of sustainable development. This is of significance because of the question: *"Is it possible to combine economic growth with the objective of sustainable development?" Theoretically, a model of "sustainable development*" (self-sustaining and durable, in which all three dimensions are maintained at a permanent equilibrium) is an ideal model, the implementation of which should be pursued through following a long-term policy of development. Knowledge of the relationships between the main components of the process under study may help implement lines of measures aimed at achieving the durability, and stimulate development in the future.

The proposed thesis was considered to be true, and its validity was demonstrated in the course of the study on the balance between the status of socio-economic development and environmental order as illustrated by the example of 496 communes in Eastern Poland. It was demonstrated that sustainable development, owing to its particular determinants, is an extremely sensitive process due to the fluctuation of indicators being representative for both phenomena. The following conclusions were drawn in the course of the study:

1) In rural communes in Eastern Poland, the predominant units are those characterised by average development in terms of socio-economic aspects and environmental order.

2) Most communes under study showed the balance between the class of socio-economic development and the class of environmental order. This indicates the durability and sustainability of development, which is a welcome trend from the perspective of the concept of sustainable development.

3) A relationship between socio-economic phenomena and environmental order is present in each of the communes under study. However, the method and effects of the implementation of sustainable development vary.

4) The studies being carried out provide a possibility for monitoring the status of and changes in the process of implementation of the concept of sustainable development.

5) Horizontal analysis of synthetic values constructed on the basis of representative indicators for the phenomena under study provides a clear answer to the question about the level of sustainable development, with account taken of particular determinants of the area under study. Such research allows targeting self-government's measures as well as following the policy of both the state and the UE towards the strengthening of specific components of sustainable development. This may lead to the optimisation of living conditions while maintaining the intergenerational justice, which is the primary objective of the concept of sustainable development. This is of exceptional importance, particularly to the poorer regions where the pursuit of rapid economic development may frequently threaten the maintenance of a proper level and the protection of natural environment, leading to irreversible changes and permanently

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threatening the idea of sustainable development.

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