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ANALYSIS OF LANDSCAPE PARKS OF LOWER SILESIAN VOIVODSHIP BASED ON MULTIDIMENSIONAL STATISTICAL ANALYSIS ACCORDING TO SUSTAINABLE DEVELOPMENT INDICATORS

Among the efficient tools to carry out a diagnose of landscape parks' condition are the sustainable development indicators, which present a level of environmental and socioeconomic phenomena. The aim of this article is to conduct a hierarchical classification for communities situated in the areas of landscape parks located in Lower Silesia Voivodships, according to the sustainable development indicators. Hierarchical classification on the basis of a synthetic measure of development serves for a continuous analysis of changes dynamics in the accomplishment of sustainable development concept for landscape parks. The subjects of this research are the communities situated in the areas of landscape parks. Appointing the sustainable development indicators was conducted on the basis of the Local Bank Data.

Keywords: sustainable development; landscape park; hierarchical classification.

JEL classification: Q01, Q26, C19.

Анета Зелінська

АНАЛІЗ ЛАНДШАФТНИХ ПАРКІВ НИЖНЬОЇ СІЛЕЗІЇ: БАГАТОВИМІРНИЙ СТАТИСТИЧНИЙ АНАЛІЗ НА БАЗІ ІНДИКАТОРІВ СТІЙКОГО РОЗВИТКУ

У статті показано, як на основі індикаторів стійкого розвитку можна оцінити стан та розвиток ландшафтних парків як еко-соціально-економічного явища. Проведено ієрархічну класифікацію населених пунктів, частково розташованих на територіях ландшафтних парків Нижньої Силезії. Ієрархічна класифікація, побудована на основі індикаторів стійкого розвитку, дозволила провести аналіз динаміки змін у досягнення цілей стійкого розвитку. Індикатори стійкого розвитку було розраховано на основі «Місцевого банку даних» Центрального статистичного управління Польщі.

Ключові слова: стійкий розвиток; ландшафтний парк; ієрархічна класифікація.

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Анета Зелинска

АНАЛИЗ ЛАНДШАФТНЫХ ПАРКОВ НИЖНЕЙ СИЛЕЗИИ: МНОГОМЕРНЫЙ СТАТИСТИЧЕСКИЙ АНАЛИЗ НА БАЗЕ ИНДИКАТОРОВ УСТОЙЧИВОГО РАЗВИТИЯ

В статье показано, как на основе индикаторов устойчивого развития можно оценить состояние и развитие ландшафтных парков как эко-социально-экономического явления. Проведена иерархическая классификация населенных пунктов, частично расположенных на территориях ландшафтных парков в Нижней Силезии. Иерархическая классификация, выстроенная на основе индикаторов устойчивого развития, позволила провести анализ динамики изменений в достижении целей устойчивого развития. Индикаторы устойчивого развития рассчитаны на основе «Местного банка данных» Центрального статистического управления Польши.

Ключевые слова: устойчивое развитие; ландшафтный парк; иерархическая классификация.

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Introduction – landscape parks. Nature's resources are seriously endangered and rapidly shrinking. This situation impacts the protected areas, including landscape parks. Last century was the period of increased pressure on environment and degradation of protected areas, what resulted in biodiversity decrease. According to the abovementioned, it is needed to accurately diagnose the current state of protected areas.

The main function of protected areas is preserving natural resources, all other business and non-business activities have to be subordinated to this function. Sustainable development of protected areas means adjusting economy's structure and intensity to the nature's values. One should tie socioeconomic functions with natural environment, not bringing about losses to biodiversity. Practical implementation of sustainable management is possible in the areas of landscape parks.

For landscape parks, an act on nature conservation is understood as "protected area considering environmental, historical and cultural nature's values, and landscape's values in order to maintain popularization of these values in sustainable development conditions" (Act..., Article 16, Paragraph 1). Arable lands and forests, real estates situated within landscape parks' borders are left in economic usage" (Act..., Article 16, Paragraph 6). Landscape parks in Poland are introduced in Table 1.

Table 1. Landscape parks, as of 31st December, 2011

Voivodships	Number of objects
Lower Silesian	12
Kuyavian-Pomeranian	8
Lublin	16
Lubush	7
Lodz	6
Lesser Poland	9
Masovian	5
Opole	3
Subcarpathian	7
Podlaskie	3
Pomeranian	7
Silesian	7
Swietokrzyskie	9
Warmian-Masurian	6
Greater Poland	11
West Pomeranian	5
Total	121

Source: Own study based on (Environment 2012: 288).

Restrictions on sustainable development in the areas of landscape parks concern e.g. arable lands and forests situated with its range, where these lands are economically used, under the condition of not too intensive use of natural environment resources. Significant restrictions within this area concern industrial activity, excessive area dehydration, intensive settlement, communication and technical infrastructure development (Ptaszyccka-Jackowska and Baranowska-Janota, 1996).

Practical tools serving to diagnose landscape parks' state are sustainable development indicators, which show environmental and socioeconomic level on a certain area. These indicators should be used in assessment procedures for the accomplish-

ment level of sustainable development concept. On the basis of the abovementioned, the aim of this article is to conduct multidimensional comparative analysis and hierarchical classification for the communities situated in landscape parks, located in Lower Silesian Voivodship, according to the sustainable development indicators.

Sustainable development indicators for landscape parks vs. Local Bank Base.

Sustainable development constitutes one of the major global aims, where economic, social, ecological and spatial developments have to complement each other.

In statistics, an indicator is most often understood as a number showing a level of a certain phenomenon (variable, feature) in the form of an absolute or a relative value. An indicator is one of many tools serving to analyse the level of implementing sustainable development concept (Eco-development indicators, 1999: 23; Sustainable development indicators, 2005: 62–68).

In practice, there is a set of sustainable development indicators for landscape parks. Such a set will constitute a source of information about sustainable development concept accomplishment's level on these areas. A set of indicators constructed in this way, will give a signal if nature protection processes are proper, or if there is a need to update tasks, protective plans, or if to change these plans, and adjust them to a changing tendency of protected areas' functioning and their socioeconomic surrounding. A set of indicators will contribute to the improvement of sustainable development concept accomplishment's monitoring for protected areas (Zielinska, 2013: 219).

A set of sustainable development indicators will always be a compromise between the universality of sustainable development's nature and specificity of a particular park.

One should pay attention to the fact that, creating a set of sustainable development indicators on the local level in Poland is characterized by voluntarism and big arbitrariness. Very often, indicator monitoring system of sustainable development strategy is not correlated with the main strategy's aims, and used indicators often have got a traditional character, which is loosely connected with sustainable development (Borys and Zielinska, 2001: 225). Local level refers to landscape park area.

Appointing sustainable development indicators was carried out on the basis of the Local Data Bank (LDB). LDB is a multilevel statistical database of diversified, if it goes about scale and range, territorial units placement (Zielinska, 2008: 561).

LDB is the biggest in Poland, ordered set of information on socioeconomic, demographical and social situation, and environment's state, describing voivodships, communities, regions and subregions constituting nomenclature elements of territorial units for statistical purposes (www.stat.gov.pl, 25.11.2013):

- provides stable, user friendly access to current statistical information;
- enables running multidimensional statistical analyses in regional and local arrangements.

Since January, 2014, there is a LDB module available, including sustainable development indicators on local levels (community). LDB provides support for sustainable development through making available indicators, which monitor a state and changes within sustainable development.

A set of information, in the case of a landscape park concerns a territorial unit, which is a community here. One should pay attention to the fact that, information on

landscape parks in a community arrangement, often refers to the analysed areas, which does not often go together with in the whole community's surface. It causes that a value of appointed indicator is of approximate value, which will be used in further multidimensional statistical analyses. Despite this imperfection of information about a community, the analysed indicators constitute necessary information on the surroundings, where landscape park is functioning, influencing it economically and socially, as well as spatially and environmentally.

The research was conducted for landscape parks situated in Lower Silesian Voivodship (Table 2).

Table 2. Landscape parks of Lower Silesian Voivodship

Lp.	Landscape parks	
1	Lower Silesian Landscape Parks Group	Barycz Valley Landscape Park
2		Bystrzyca Valley Landscape Park
3		Sleza Landscape Park
4		Jezierzyca Valley Landscape Park
5	Snieznik Landscape Park	
6	Przemkow Landscape Park	
7	Chelmy Landscape Park	
8	Rudawy Landscape Park	
9	Bobr Valley Landscape Park	
10	Owl Mountains Landscape Park	
11	Sudety Walbrzyskie Landscape Park	
12	Ksiaz Landscape Park	

Source: own study based on (Environment 2012).

The scope of this research constituted the communities situated in the area of landscape parks, Lower Silesian Voivodship. Urban and rural communities, which 42% of surface is located in the researched landscape parks were selected for this study. As a result, among 12 landscape parks, 5 were classified for this research (Table 3).

Table 3. Communities belonging to the selected landscape parks of Lower Silesian Voivodship

No.	Landscape parks		Community/contribution of landscape park's surface in the total community's surface, %
1	Lower Silesian Landscape Parks Group	Barycz Valley Landscape Park	Krosnice/68.8
2	Snieznik Landscape Park		Stronie Slaskie/76.8
3	Przemkow Landscape Park		Gromadka/41.9
4	Chelmy Landscape Park		Mecinka/61.2
5	Rudawy Landscape Park		Myslakowice/62.9

Source: Own study based on (www.stat.gov.pl, 25.11.2013).

For the abovementioned communities there are some indicators, which are possible to calculate (Annex, Table 1):

1. Population density, in persons per 1 km².
2. Contribution of the unemployed registered in the population number of a productive age, %.

3. Surface of forest lands in the surface totality, %.
4. Surface contribution of private forests in the overall forests' surface, %.
5. Contribution of parks' surface, green spaces and areas of housing development's greenery in cities and villages in the overall surface, %.
6. Contribution of the surface taken up by local plans of spatial management in the overall surface, %.
7. Contribution of local and spatial management plans, in the process of preparation on the basis of Act of 7 July, 1994, and on the basis of Act of 27 March, 2003, in the overall surface, %.
8. Contribution of population benefiting from sewage plant in the overall population, %.
9. Contribution of wastes created and subject to recycling toward wastes created during a year, %.
10. Quantity of water usage for the purposes of national economy and population within a year per 1 inhabitant, dam³/person.
11. Number of handed in flats for usage in residential and non-residential buildings per 1 inhabitant, item/person.
12. Contribution of people in households benefiting from socioenvironmental assistance in the overall population, %.
13. Number of readers in public libraries per 1000 people, person.
14. Parties' participants toward quantity of parties at homes and culture centres, clubs and club-rooms, persons.
15. Number of subjects signed to the REGON registry, 10 ths of population.
16. Number of business entities, running their own business per 100 inhabitants in productive age, person.
17. Number of foundations, associations and social organizations per 10 ths inhabitants, person.
18. Contribution of own incomes per 1 inhabitant, %.
19. Contribution of incomes coming from housing and environment protection in the overall incomes, %.
20. Expenditures to incomes in the overall budget, %.
21. Contribution of incomes coming from housing and environment protection in the overall expenditures, %.
22. Expenditures per 1 inhabitant, PLN.
23. Contribution of expenditures per 1 inhabitant on education and upbringing in the overall, %.
24. Contribution of expenditures on culture and national heritage protection in the overall expenditures, %.
25. Contribution of expenditures on public roads in the overall expenditures, %.

Multidimensional comparative analysis and hierarchical classification. In the communities' classification, indicators, expressed in different physical units, are often used. It is a cause of difficulties connected with the assessment of objects, e.g., communities. It is purposeful to look for such methods, which would allow procedures' objectification of the general environment's state and the level of the sustainable development concept implementation (Mazurski, 1999: 29). This problem can be solved by means of multidimensional comparative analysis.

Multidimensional comparative research has got huge application in economies, as well as in environment protection, because it enables assessing the level of analysed objects (communities) development, and it constitutes a basis for taking proper decisions, concerning e.g. sustainable development concept implementation for selected protected areas (Zielinska and Poskrobko, in print).

Multidimensional comparative research aims at identifying certain accurateness in statistical collectivity, where units are described by relatively numerous set of indicators.

In order to conduct a multidimensional comparative analysis one also uses the hierarchical classification (the method of linear order), which aim is to put in order objects or their sets, by certain criterion. These methods can be applied only when there is a possibility to assume certain fundamental criterion, thanks to which it is possible to order them from "the best" to "the worst ones". That is why, the level of sustainable development concept accomplishment in communities situated in the landscape parks of Lower Silesian Voivodship, was taken as a research problem (Zielinska, 2010: 184–187; Zielinska, 2011: 87–96).

At the beginning of the MCA analysis, a character of the selected indicators was standardized, it means that, there was a transformation from destimulants into stimulants for the researched indicators (Sej-Kolasa and Zielinska, 2004: 92):

$$S_{ij} = b[D_{ij}]^{-1}, \quad (1)$$

where D_{ij} – the value j of this destimulant (indicator) observed in the i of this community; b – the stable arbitrarily assumed, e.g., $b = \min D_{ij}$.

For destimulants, according to subjective assessment were taken (the indicators' numbers): 5 and 6.

Next, the normalization of indicators (x_{ij}) was conducted, depriving the values of indicators' names and standardization quantity rows to lead to their comparability. The following formula was used here (Sej-Kolasa and Zielinska, 2004: 92):

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S_j}, \quad (2)$$

where z_{ij} – the normalized value j of this indicator in i of this community; x_{ij} – the indicator's value; \bar{x}_j – arithmetic average j of this indicator; S_j – the standard diversion j of this indicator.

That way, for all the indicators according to the communities, a normalized data matrix has been appointed.

Hierarchical tool for this classification is a synthetic development measure (SDM), which is a certain function aggregating partial information, gathered in particular indicators and appointed for each object (community) from the objects' sets. Formulas of variable values aggregation can be divided into model and non-model ones. Model formulas are different distances of particular objects from a model object, what is mostly the so-called lower or upper poles of development. In non-model formulas, there is a process of averaging normalized variable values (with a possibility to take into account the weights for particular variables) (Gatnar and Walesiak, 2004: 351–355; Grabinski, 1984: 38). Synthetic development measure was used in the research, according to the model formula of the upper pole of development (Sej-Kolasa and Zielinska, 2004: 97):

$$p_i = \frac{1}{m} \sum_{j=1}^m |z_{ij} - z_{0j}|, \quad (3)$$

where p_i – the synthetic development measure for i of this community; m – the number of indicators; z_{0j} – the coordinated j of this feature of the model object (the upper pole of development).

In the model formula, according to the upper pole of development, the most useful (the highest) values for particular indicators is appointed. For "the best" community, one assumes the one, which has got the minimal value p_i , and "the worst" – the maximal value p_i .

The analysis' results, according to the model formula for communities of landscape parks are illustrated in Table 4.

Table 4. Synthetic measure of development for communities in the landscape parks of Lower Silesian Voivodship, own study

Community position	Landscape park	Name of community	Synthetic measure of development
1	Snieznik LP	Stronie Slaskie	1.12
2	Rudawy LP	Myslakowice	1.37
3	Chelmy LP	Mecinka	1.42
4	Przemkow LP	Gromadka	1.66
5	Barycz Valley LP	Krosnice	1.99

On the basis of SMD for communities situated in the landscape parks of Lower Silesian Voivodship, the most desirable level was reached by Stronie Slaskie community (Snieznik Landscape Park), the second position belongs to Myslakowice community, situated in the Rudawy Landscape Park. The worst community, according to sustainable development indicators, is Krosnica community (Barycz Valley Landscape Park). One should pay attention to the fact that, for calculations all the indicators were treated equally if it goes about the influence of sustainable development.

Final conclusions:

- communities participating in the analysis have got a similar socioeconomic and environmental situation;
- one should create a homogenous set of sustainable development indicators for landscape parks, which will be used to assess the sustainable development accomplishments in communities;
- it is necessary to assign certain weights for particular indicators, according to their significance in sustainable development accomplishment within landscape parks;
- gained results, although they can arise some doubts, confirm the usefulness of synthetic measure of development in the level assessment of the sustainable development concept implementation in landscape parks;
- the level of synthetic measure of development serves for continuous analysis of changes' dynamics within the sustainable development concept accomplishment for landscape parks;
- hierarchical classification of communities situated in landscape parks show, which communities implement the sustainable development concept in the best way.

Annex
Table 1. The structure of sustainable development indicators for communities located in the areas of landscape park, Lower Silesian Voivodship, 2012

Lp.	Variables	Objects	Stronie Śląskie	Myszkowice	Mecinika	Gromadka	Krosnice
1	Population density, person per 1 km ²		53	116	34	21	46
2	Contribution of the unemployed registered in the population number of a productive age, %		14.2	10.5	12.8	7.5	9.1
3	Surface of forest lands in the surface totality, %		14.2	10.5	12.8	7.5	9.1
4	Surface contribution of private forests in the overall forests' surface, %		0.7	12.6	4.5	0.9	2.9
5	Contribution of parks' surface, green spaces and areas of housing development's greenery in cities and villages in the overall surface, %		0.1225	0.0057	0.00	0.0460	0.0062
6	Contribution of the surface taken up by local plans of spatial management in the overall surface, %		25.1	30.1	100	99.9	99.7
7	Contribution of local and spatial management plans, in the process of preparation on the basis of Act of 7 July, 1994, and on the basis of Act of 27 March, 2003, in the overall surface, %		2.05	0.00	0.34	0.07	0.00
8	Contribution of population benefiting from sewage plant in the overall population, %		89.8	66.5	71.1	47.1	51.3
9	Contribution of wastes created and subject to recycling toward wastes created during a year, %		100	0	100	0	0
10	Quantity of water usage for the purposes of national economy and population within a year per 1 inhabitant, dam ³ /person.		0.033	0.278	0.018	0.0178	0.942
11	Number of handed in flats for usage in residential and non-residential buildings per 1 inhabitant, item/person		0.0026	0.0031	0.0032	0.0013	0.0016
12	Contribution of people in households benefiting from socio-environmental assistance in the overall population, %		5.2	9.3	12.5	11.3	15.5
13	Number of readers in public libraries per 1000 people, person		275	184	141	116	81
14	Parties' participants toward quantity of parties at homes and culture centres, clubs and club-rooms, persons.		0	83	47	106	50
15	Number of subjects signed to the REGON registry, 10 ths of population		980	933	645	574	632
16	Number of business entities, running their own business per 100 inhabitants in productive age, person.		11	11	8	7	8
17	Number of foundations, associations and social organizations per 10 ths inhabitants, person		39	32	36	25	26
18	Contribution of own incomes per 1 inhabitant, %		43.5	53.4	42.2	56.4	41.3
19	Contribution of incomes coming from housing and environment protection in the overall incomes, %		6.2	4.3	0.3	0.3	3.7
20	Expenditures to incomes coming from housing and environment protection in the overall budget, %		107.3	103.7	92.7	110.8	112.4
21	Contribution of incomes coming from housing and environment protection in the overall expenditures, %		15.2	12.8	3.5	21.6	6.8
22	Expenditures per 1 inhabitant, PLN		3299.96	3163.75	3370.55	3677.89	3853.98
23	Contribution of expenditures per 1 inhabitant on education and upbringing in the overall, %		22.0	34.4	25.2	28.9	32.8
24	Contribution of expenditures on culture and national heritage protection in the overall expenditures, %		3.3	1.8	5.3	2.9	20.6
25	Contribution of expenditures on public roads in the overall expenditures, %		4.8	3.6	10	6	0.8

Source: Own study based on the Local Bank Data (www.stat.gov.pl, 25.11.2013).

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