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APPLYING MULTIDIMENTIONAL COMPARATIVE ANALYSIS FOR THE ASSESSMENT OF THE CONCEPT REALIZATION OF SUSTAINABLE DEVELOPMENT FOR THE PROTECTED AREAS

ABSTRACT. On the basis of hierarchical classification, districts situated in the areas of protected lands and their nearest neighborhood of Lower Silesian Voivodeship were organized in the following way: beginning with the best and ending with the worst. They were organized on the basis of a synthetic measure of development and sustainable development's indicators.

The result of the investigation allowed setting up some conclusions and demands: hierarchical classification of the districts situated in the area of natural valuable areas shows, that these are not always the best districts in implementing the sustainable development concepts in comparison with the districts which are not included into the researched areas; sustainable development's indicators for the districts should diagnose socio-economic-environmental condition; one should create a homogeneous set if indicators for natural valuable areas in a district order, which will be used for an assessment of the sustainable development concepts accomplishment; a synthetic development measure will serve for a continuous analysis of dynamics' changes in the accomplishment of sustainable development.

Introduction. Natural areas valuable versus sustainable development

Sustainable development constitutes one of the main global aims where economic, social, ecological and spatial development must merge and complete each other.

The effectiveness of the resources of environmental protection mainly depends on the realization of the concept of sustainable development. Environmental protection is not limited by any administrative boundaries, that is why it is effective at the time when it encompasses the whole area of environment, not only single elements (e.g. certain plant, animal and mushroom species). Creating and functioning of protected areas must be correlated with the development of the neighboring areas, in such a way that it would not be a threat for natural

environment. The following forms of protected areas should be recognized according to the environmental protection act: nature reserves, national parks, landscape parks, the areas of protected landscape and areas Natura 2000 (Journal of Laws of the Republic of Poland 2009). These areas are particulary predestined to the effective and successful implementation of the concept of sustainable development.

The aim of this article is to do a hierarchical classification for the districts which are situated on the protected areas and in their neighborhood of Lower Silesian Voivodeship according to the sustainable development's indicators.

The article gives a description of two kinds of districts, which are situated in the area of landscape parks and in the area of protected landscape. Certain kinds of sustainable development indicators had been distinguish, which served to make some calculations for a researched districts. Finally, a hierarchical classification had been conducted, what allowed to order the districts in Lower Silesian Voivodeship, beginning with "the best" ending with the "worst" on the basis of sustainable development indicators.

1. Characteristics of researched districts and indicators

Basic territorial unit in Poland, where the conception of sustainable development is being implemented and monitored is a district.

The subject of research were two kinds of districts from Lower Silesian Voivodeship:

1) districts mainly or in a bigger part situated in the areas of landscape parks and the areas of protected landscape (over 50% of district's surface),

2) districts situated near the districts 1), what means they are in a neighborhood or not far away, which surface is not included or included but only partly to the protected areas.

The pairs of districts were created which belong to one out of three kinds of districts (urban, rural and urban-rural). They were constructed in order to have a chance of comparison of social, economic, environmental and administrative conditions.

After accomplishing the above mentioned assumption, a suitable selection was done and one pointed out in Lower Silesian Voivodeship fifteen districts belonging to natural areas valuable: ten of them were localized in the area of landscape parks, and five of them in the areas of protected landscape. Districts belonging to two national parks had not been taken into account (Karkonosze National Park, Table Mountains National Park). Only three districts were selected and the number of the objects needed to carry out the comparative analysis is too little. The research did not concern nature reserves, because mostly these are little areas, which do not fulfill earlier mentioned principles, and Natura 2000 is not included in the base of Regional Data Bank (BDR). That is why the overall analysis was carried out only for thirty districts (look *Table 1*, *2*).

Table 1. Districts situated in the area of landscape park and their closest surroundings of Lower Silesian Voivodeship

District situated in the area of landscape park	Contribution of the landscape park's surface to the total surface (%)	Kind of district	District near to landscape park
Przemków – Przemkowski PK	83,4	urban-rural	Polkowice
Milicz – PK Dolina Baryczy	79,3	urban-rural	Twardogóra
Stronie Śląskie – Śnieżnicki PK	76,8	urban-rural	Bystrzyca Kłodzka
Jedlina Zdrój – PK Gór Sowich	69,1	urban	Szczawno-Zdrój
Krośnice – PK Dolina Baryczy	68,8	rural	Cieszków
Żmigród – PK Dolina Baryczy	65,8	urban-rural	Prusice
Mysłakowice – Rudawski PK	62,9	rural	Jeżów Sudecki
Męcinka – PK Chełmy	61,2	rural	Mściwojów
Wleń – PK Doliny Bobru	58,5	urban-rural	Lubomierz
Paszowice – PK Chełmy	57,5	rural	Wądroże Wielkie

Source: own study on the basis of Regional Data Bank, 2009; www.stat.gov.pl (date of access 10.10.2010).

Table 2. Districts situated in the area of protected landscape and their closest surroundings of Lower Silesian Voivodeship

District situated in the area of protected landscape	Contribution of the area of protected landscape to the total surface[%]	Kind of district	District near to the area of protected landscape
Międzybórz	100,0	urban-rural	Twardogóra
Jemielno	99,2	rural	Rudna
Wąsosz	85,7	urban-rural	Żmigród
Duszniki-Zdrój	83,0	urban	Polanica-Zdrój
Góra	61,8	urban-rural	Rawicz (Greater Poland Voivodeship)

Source: own study on the basis of Regional Data Bank, 2009; www.stat.gov.pl (date of access 10.10.2010).

Comparative analysis was carried out thanks to the indicators which were possible to point out for each district. By the indicator we understand a number introducing a level of a certain phenomenon, shown in the form of absolute value or relative value. Absolute value indicators stand for the percentage relation of the amounts examined according to the accepted basis. Indicators play a specific role in the system of economic information (Wskaźniki..., 1999, p. 23). It is a synthetic measure which serves to the description of a certain phenomenon, state and situation, which all are the elements of more complex system.

On the basis of the above mentioned assumptions 13 indicators of sustainable development, which describe districts according to the integrated order (social, economic and environmental) were selected (Appendix: *Tables 1*, *2*) in order to conduct research:

1. The contribution of the unemployed registered in the total number of population according to the registered for permanent residency (%).
2. Population density (person/km^2).
3. Contribution of industrial cleaned sewages towards the sewages channeled in the whole (%).

4. The floor surface of the flats given to use towards the number of flats (m^2/item).
5. Water supply system per 100 km^2.
6. Sewerage system per 100 km^2.
7. Water consumption from the waterworks in households per one inhabitant (m^3).
8. A total number of people using accommodation towards the all year round accommodation places in the objects of mass accommodation (person/item).
9. Book collection of libraries per 1000 of population (volume).
10. Borrowings of book collections per one reader (volume).
11. Contribution of the public sector units towards a total number of registered units according to the units of Polish Classification of Activities (PKD) (%).
12. Contribution of private sector units towards a total number of registered units according to of Polish Classification of Activities (%).
13. Material incomes of districts per one inhabitant (zl/person).

The above set of indicators on a local level does not include many fields, however it is a characteristic of the most crucial data describing districts according to the realization of the development concept.

2. Hierarchical classification in multidimensional and comparative analysis for districts

Indicators are often used in the districts' classification. They are represented in different physical units. It is a cause of difficulties connected with the similarity assessment of the objects for example: districts. Looking for such methods, which would allow for the objectification of a procedure of the general environment condition's assessment and also for the level of the implementation of eco-development concept, seems to be purposeful. (Mazurski, 1999, p. 29). The method of multidimensional comparative analysis solves this problem (WAP).

Multidimensional comparative research is widely applied as well in economy as in environmental protection because it enables to assess the level of development of the analyzed objects (districts) and they serve as a basis of making right decisions concerning for example: the assessment of the sustainable development concept's implementation for chosen protected areas.

The aim of WAP is to introduce multidimensional comparative research thanks to which correctness in statistical communities is found, where the units are described by relatively numerous team of indicators (features).

Normalization of the indicators (x_{ij}) was conducted, it means to take away the value from indicators' features and to standardize the rows of volume, in order to lead them towards comparability. The following formula was used here (Sej-Kolasa, Zielińska, 2004, p. 92):

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S_j} \qquad (1)$$

where:
$\bar{x}_j$ – arithmetic mean j – of this indicator,

S_j – the area of variability j – of this indicator.

That way, standardized data matrix was set for all indicators according to districts.

The tool of hierarchical classification is a synthetic measure of development which joins fragmentary information included into particular variables, pointed out for each object from the set of objects. Aggregation formulas of variable values can be generally divided into standard and non-standard ones. Standard formulas are various kinds of distances of particular

objects from a standard object, which is usually called lower or upper pole of development. In non-standard formulas there is an averaging out the standardized values of variables (with the possibility to take into account weights for particular variables) (Gatnar, Walesiak, 2004, pp. 351-355; Grabiński, 1984, p. 38). In the research there was used a synthetic measure of development according to non-standard formula (Sej-Kolasa, Zielińska, 2004, p. 97):

$$p_i = \frac{1}{m} \sum_{j=1}^{m} z_{ij} \qquad (2)$$

where:

p_i – a synthetic measure of development for i – of this district – a number of indicators;

z_{ij} – standardized value j – of this indicator in i – of this district.

In a non-standard formula, the best district to be is considered the one which has got maximum value of pi, and the worst one – minimum value of p_i.

The analysis according to non-standard formula was conducted separately for the districts belonging to landscape parks and to their nearest neighborhood and for the districts belonging to the areas of protected landscape and in their nearest area (tables 3, 4) for different legal regime reasons according to the act on environmental protection for landscape parks and the areas of protected landscape (Act of 16 April 2004 on environmental protection).

Table 3. A synthetic measure of development for the districts situated in the area of landscape parks and in their nearest neighborhood of Lower Silesian Voivodeship

Position of a district	The name of a district	Localization	Synthetic measure of development
1.	Męcinka	in the area of landscape parks	0,143
2.	Wądroże Wielkie	near landscape parks	0,086
3.	Mysłakowice	in the area of landscape parks	0,077
4.	Jeżów Sudecki	near landscape parks	0,063
5.	Prusice	near landscape parks	0,043
6.	Paszowice	in the area of landscape parks	0,024
7.	Polkowice	near landscape parks	0,011
8.	Krośnice	in the area of landscape parks	0,006
9.	Mściwojów	near landscape parks	0,004
10.	Jedlina-Zdrój	in the area of landscape parks	0,001
11.	Szczawno-Zdrój	near landscape parks	-0,008
12.	Cieszków	near landscape parks	-0,014
13.	Przemków	in the area of landscape parks	-0,020
14.	Stronie Śląskie	in the area of landscape parks	-0,060
15.	Lubomierz	near landscape parks	-0,062
16.	Milicz	in the area of landscape parks	-0,089
17.	Wleń	in the area of landscape parks	-0,101
18.	Bystrzyca Kłodzka	near landscape parks	-0,104

Source: own study.

On the basis of results of SMR for the districts situated in the area of landscape parks and in their nearest neighborhood of Lower Silesian Voivodeship, most desirable level was reached by Męcinka district (situated near Chełmy Landscape Park), the second place (with a

significant difference of SMR) goes to Wądroże Wielkie district which is not situated in the area of park, the third place belongs to Mysłakowice district, situated in the area of Rudawski Landscape Park. Surprising is the position taken by Milicz and Wleń (districts situated in the area of parks), which in the ranking took the next to last position, it means they are the worst districts according to the realization of eco-development concept. At the same time in a comparison of this group between each other, Męcinka district differs a lot from its counterpart Mściwojów district. The rest pairs of district do not show significant differences in ranking, according to the level of SMR.

Table 4. Synthetic measure of development for the districts situated in the area of protected landscape and in their nearest neighborhood of Lower Silesian Voivodeship

Position of a district	The name of a district	Localization	Synthetic measure of development
1.	Rudna	near OCHK	0,561
2.	Polanica-Zdrój	near OCHK	0,391
3.	Duszniki-Zdrój	in the area of OCHK	0,201
4.	Rawicz	near OCHK	0,100
5.	Twardogóra	near OCHK	-0,034
6.	Wąsosz	in the area of OCHK	-0,129
7.	Żmigród	near OCHK	-0,131
8.	Jemielno	in the area of OCHK	-0,181
9.	Międzybórz	in the area of OCHK	-0,247
10.	Góra	in the area of OCHK	-0,531

Source: own study.

The best districts situated near the areas of protected landscape according to the realization of eco-development concept are the following ones: Rudna and Polanica-Zdrój. The third place goes to Duszniki-Zdrój district, situated in the area of protected landscape. Last places in the ranking went to three districts which are situated in the area of protected landscape. Significant differences had been found between the results of SMR for the districts creating "paris", in other words neighboring districts. It particularly concerns two pairs of districts: Rudna and Jemielno, Rawicz-Góra.

Final conclusions

Gained results allow to formulate few conclusions:
- Hierarchical classification of the districts situated in the area of natural valuable areas shows, that these are not always the best districts in implementing the sustainable development concepts in comparison with the districts which are not included into the researched areas;
- the districts used in the analysis have got a similar socio-economic-environmental situation;
- suggested sustainable development's indicators mostly diagnose a socio-environmental condition, and they describe an economic situation in the districts a bit.

It is suggested to create a homogenous set of indicators for natural valuable areas in the districts' area, which will be used to assess the accomplishment of sustainable development concepts in the districts.

The use of hierarchical classification, based on a synthetic measure of development, serves for a continuous analysis of a the dynamics' changes, in the accomplishment of sustainable development concepts for natural valuable areas.

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Appendix

Table 1. The structure of indicators for the districts situated in the area of landscape parks and in their nearest neighborhood of Lower Silesian Voivodeship in 2009

Lp	Variables	Męcinka	Mściwojów	Paszowice	Wądroże Wielkie	Jeżów Sudecki	Myslakowice	Lubomierz	Wleń	Polkowice	Przemków	Bystrzyca Kłodzka	Stronie Śląskie	Jedlina-Zdrój	Szczawno-Zdrój	Cieszków	Krośnice	Milicz	Prusice
1.	The contribution of the unemployed registered in the total number of population according to the registered for permanent residency (%)	10,3	10,8	9,4	7,2	7,5	10,6	12,9	12,9	6	10,9	13,9	15,2	9	8	11	8,7	9,2	7
2.	Population density (person/km^2)	33	56	38	45	71	114	46	52	157	81	57	54	290	380	46	45	56	58
3.	Contribution of industrial cleaned sewages towards the sewages channeled in the whole (%)	0,0	0,0	0,0	0,0	0,0	70,4	0,0	0,0	0,0	0,0	41,2	0,0	0,0	0,0	0,0	0,0	10,7	0,0
4.	The floor surface of the flats given to use towards the number of flats (m^2/item)	141,8	152,5	139,2	153,1	138,7	143,0	123,0	101,0	87,9	129,3	142,7	107,9	178,0	83,4	108,8	113,7	103,8	136,2
5.	Water supply system per 100 km^2	32,4	86,6	43,3	44,5	81,7	66,2	19,5	28,7	79,6	66,5	27,7	11,1	162,8	120,1	62,1	58,8	44,2	57,3
6.	Sewerage system per 100 km^2	29,7	47,1	34,1	26,9	0,0	14,3	9,0	9,2	82,0	34,6	0,4	22,5	45,3	103,1	0,0	42,5	10,9	3,0
7.	Water consumption from the waterworks in households per one inhabitant (m^3)	12,9	25,9	18,7	16,4	18,6	16,9	11,1	16,4	33,1	27,8	27,2	19,6	24,2	33,6	25,4	28,5	33,2	23,5
8.	A total number of people using accommodation towards the all year round accommodation places in the objects of mass accommodation (person/item)	0,0	0,0	0,0	0,0	0,0	33,1	14,8	16,1	41,6	62,5	20,8	21,9	0,0	32,8	0,0	5,4	22,8	44,0
9.	Book collection of libraries per 1000 of population (volume)	8132	6995	6183	6381	3603	3229	6380	7214	3414	5452	5477	4430	3314	7667	4721	4214	4354	3394
10.	Borrowings of book collections per one reader (volume)	25	15	23	19	24	24	23	21	19	16	20	22	21	12	32	24	22	29

11.	Contribution of the public sector units towards a total number of registered units according to the units of Polish Classification of Activities (PKD) (%)	2,9	3,2	3,7	2,7	1,6	2,0	10,9	9,0	2,8	4,3	9,6	3,4	9,4	4,7	2,7	4,3	4,4	3,3
12.	Contribution of private sector units towards a total number of registered units according to of Polish Classification of Activities (%)	97,1	96,8	96,3	97,3	98,4	98,0	89,1	91,0	97,2	95,7	90,4	96,6	90,6	95,3	97,3	95,7	95,6	96,7
13.	Material incomes of districts per one inhabitant (zl/person)	706,37	272,99	246,28	545,80	468,26	150,82	200,60	191,48	337,04	282,85	105,54	394,47	829,34	393,85	260,90	660,71	52,54	328,54

Source: own study on the basis of Regional Data Bank, 2009; www.stat.gov.pl (date of access 10.10.2010).

Table 2. The structure of indicators for the districts situated in the area of protected landscapes and in their nearest neighborhood of Lower Silesian Voivodeship (except from Rawicz, Greater Poland Voivodeship) in 2009

Lp.	Objects / Variables	Góra	Jemielno	Wąsosz	Rudna	Duszniki-Zdrój	Polanica-Zdrój	Międzybórz	Twardogóra	Żmigród	Rawicz
1.	The contribution of the unemployed registered in the total number of population according to the registered for permanent residency (%)	12,4	14,8	10,7	6,3	16,1	10,4	8,3	8,7	10,9	8,9
2.	Population density (person/km^2)	78	25	38	34	219	398	58	77	51	222
3.	Contribution of industrial cleaned sewages towards the sewages channeled in the whole (%)	0,0	0,0	0,0	100,0	0,0	95,9	0,0	0,0	0,0	0,0
4.	The floor surface of the flats given to use towards the number of flats (m^2/item)	134,4	0,0	139,8	141,0	95,6	88,1	133,8	141,8	137,1	110,4
5.	Water supply system per 100 km^2	61,5	42,5	59,6	46,9	99,2	252	33,7	93,5	33,1	97
6.	Sewerage system per 100 km^2	13,2	0	2	77,7	126,6	224,7	7,5	15,1	11,4	62,3
7.	Water consumption from the waterworks in households per one inhabitant (m^3)	31,9	24,8	29,7	27,3	35,9	33,5	29,5	26,4	29,5	35,1
8.	A total number of people using accommodation towards the all year round accommodation places in the objects of mass accommodation (person/item)	17,4	13,8	0,0	0,0	33,3	28,0	0,0	0,0	37,7	46,8
9.	Book collection of libraries per 1000 of population (volume)	2907	9290	3934	5958	7496	4826	4801	3787	4356	5038
10.	Borrowings of book collections per one reader (volume)	19	20	16	23	22	16	19	19	20	19
11.	Contribution of the public sector units towards a total number of registered units according to the units of Polish Classification of Activities (PKD) (%)	8,02	7,69	3,48	5,97	4,57	3,34	5,71	6,99	6,22	3,35
12.	Contribution of private sector units towards a total number of registered units according to of Polish Classification of Activities (%)	91,98	92,31	96,52	94,03	95,43	96,66	94,29	93,01	93,78	96,65
13.	Material incomes of districts per one inhabitant (zl/person)	214,30	234,92	197,51	391,09	684,38	126,07	145,79	783,57	296,77	145,78

Source: own study on the basis of Regional Data Bank, 2009; www.stat.gov.pl (date of access 10.10.2010).