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DIFFERENTIATION OF EXPENDITURES ON ENVIRONMENTAL PROTECTION INVESTMENTS IN RURAL AREAS OF LOWER SILESIA

Abstract: The main aim of the study was to identify the trends concerning expenditures on environmental protection in rural areas of Lower Silesia in the years 2000–2008. The general level, rate of growth, participation in GDP as well as the structure of finances annually invested in the protection of rural environment were analysed. A ranking of voivodships with regard to the fulfilment of environmental protection and water management investments in rural areas calculated per one inhabitant was prepared. Structures of expenditures in various voivodships were compared. An attempt was made to identify the direction and scope of changes in the structure of expenditures in the analysed period. The results were used to define the position of Lower Silesia among all regions of Poland.

Key words: environmental protection, expenditures on environmental protection, Lower Silesia.

1. Introduction

The conditions of natural environment in the region are dependent on the level of economic development. Economic development leads directly to an increased level of pollution to increased social well-being of citizens, at the price of growing pollution of environment. However, along with growing economic development, the demand for clean environment grows too. As a result more and more financial sources are directed to the protection of the environment.

The aim of the study is the identification of the present investments into environmental protection in the rural areas of Lower Silesia.

The conducted analysis made it possible to identify the position of Lower Silesia in environmental protection investments in rural areas of Poland and allowed to compare Silesia with the other regions of the country.

2. Research data and methods of analysis

The level of environmental protection was estimated on the basis of data obtained from the Ministry of Agriculture and Rural Development. It concerned the realisation of water supply systems and sanitation of rural areas. Other data used in the analysis was obtained from the Regional Data Bank.

The study shows the structure and kinds of protection investments in the rural areas of Lower Silesia. This was an attempt to define the directions and the scope of changes in the structure of investments on environmental protection between 2000 and 2008.

An analysis of similarities and differences in structures of investments into environmental protection of rural areas in 16 Polish voivodships (between 2004 and 2008) was conducted. The main criteria of comparisons of sources of financing the environmental protection were: *national budget*, *self-government means*,[1] *own resources of inhabitants*, *subsidies and loans for environmental purposes from the National Fund for Environmental Protection and Water Management*[2] as well as *the structural funds of European Union*.[3]

The data was adjusted (to make it comparable) for the year 2004 as a base, and calculated as expenditures *per capita* in rural area in the following years. The values obtained were summarized and averaged. As a result, real and average *per capita* investments for environmental protection in Polish rural areas within the last five years were calculated.

Next, each voivodship was characterised using the following sequence of indicators *k* for the structure of financing sources:

$$\beta_{ij} = \frac{x_{ij}}{\Sigma_{j=1}^{k} x_{ij}},$$

where: β_{ij} – indicator of the structure of *j*-th source of financing for *i*-th voivodship,
x_{ij} – the amount of environmental protection investments from *j*-th source of financing for *i*-th voivodship,
$\Sigma_{j=1}^{k} x_{ij}$ total environmental protection investments for *i*-th voivodship.

The next step was to identify the degree of differentiation of structures of investments. This was calculated using composite statistics with the following formula:

$$\nu_{p,q} = \frac{\Sigma_{j=1}^{k} \left| \beta_{jp} - \beta_{jq} \right|}{2},$$

where: β_{jp}, β_{jq} are the participation of the *j*-th source of financing in *p*-th and *q*-th voivodship.

The measure of differentiation $\nu_{p,q}$ is within the variability bracket: [0, 1]. The values close to one indicate that there are essential differences between the components of structures. If they were identical, the value would be zero.

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[1] Combined sources of communal, *powiat*, and voivodship units of self-government.

[2] The National Fund for Environmental Protection and Water Management of the voivodship, *powiat* and communal.

[3] Financial means within the Sectoral Operational Programme (SOP) and within the Integrated Regional Operational Programme (IROP).

Next we tried to estimate the directions of time change in the structure of investments. The stability of the process of structural changes was defined using monotonic measure:

$$\eta_n = \frac{v_{n,o}}{\sum_{t=1}^{n} v_{t,t-1}}.$$

The η_n measure is in the bracket [0, 1]. The zero value indicates that the structure in n and base period is the same. The value $\eta_n = 1$ indicates that all components of the structure evolve in the studied period of time and that the direction of changes is constant [Kukuła (Ed.) 1996, pp. 64–69].

3. Results and discussion

Special attention was paid in the study to evaluating protection investments in rural areas of Lower Silesia. An analysis of the changes in investments showed that, between 2000 and 2008, the average annual investments increased by 1.5%, in real terms approximately two million PLN a year.[4] Detailed indices were calculated taking the year 2004, the year of accession of Poland into the EU as a base (Table 1). In 2006, the expenditures on protection of rural areas in Lower Silesia were approximately 12% higher than in 2004. In the remaining years which were analysed, the level of protection investments in Lower Silesia was lower than in the year of accession. The lowest level of investments was observed in 2002 (the expenditures were 32% lower than in 2004). In 2007 and 2008 the decrease in expenditures (as compared to 2004) was on a constant level of 12% and 13%, respectively.

Table 1. Expenditures on environmental protection in rural areas in Poland and Lower Silesia 2000-2008 (in %)

Expenditures on environmental protection in rural areas	Dynamics indices, constant base, 2004 = 100							
	2008 vs 2004	2007 vs 2004	2006 vs 2004	2005 vs 2004	2003 vs 2004	2002 vs 2004	2001 vs 2004	2000 vs 2004
Poland	82.8	78.0	88.4	84.7	132.0	89.8	63.2	76.6
Lower Silesia	87.0	88.2	112.3	70.5	82.9	68.0	71.0	77.1

Source: own study.

The analysis of trends at national level happens to be similar to those observed at regional level. The expenditures on environmental protection in rural communes in Poland in all years of observation were lower than in 2004 (except for 2003).

[4] Environmental protection investments in rural areas in Poland increased by 1% a year in the same period.

What is interesting is the distribution of protection investment between voivodships. The analysis of data made it possible to define the position of Lower Silesia in the context of other regions.

The voivodships were ranked according to the degree of realisation of environmental protection and water management investments in rural areas (Table 2). As the measure served the investment *per capita* in a given voivodship between 2000 and 2008. Lower Silesia (dolnośląskie) has gained a leading position when compared with other voivodships. To be precise in 2006 and 2007 Lower Silesia came first, in 2003, 2001 and 2000 – second. In 2005, it came fifth, and voivodships that were ranked lower before (such as mazowieckie, wielkopolskie, opolskie and śląskie) took the leading positions. In 2005, participation of the regions in the analysed indicator was comparable (7–8%), but the changes in the level of expenditures were considerable. Realisation of protection investments in these voivodships increased in the year before the accession of Poland into the EU (in wielkopolskie by over 18%), while in Lower Silesia it decreased by almost 30%.[5]

Table 2. Position of voivodships according to investment expenditures *per capita* (in thousands PLN) spent between 2000 and 2008

Voivodship	Years								
	2008	2007	2006	2005	2004	2003	2002	2001	2000
Dolnośląskie	**4**	**1**	**1**	**5**	**3**	**2**	**3**	**2**	**2**
Kujawsko-pomorskie	8	9	9	11	2	1	1	5	9
Lubelskie	**15**	**15**	**15**	**16**	**15**	**16**	**16**	**16**	**16**
Lubuskie	14	5	4	6	1	5	10	8	5
Łódzkie	9	11	12	15	14	15	12	14	11
Małopolskie	6	10	14	12	16	13	14	15	13
Mazowieckie	2	2	5	1	4	11	5	4	6
Opolskie	1	3	7	3	6	12	13	9	3
Podkarpackie	7	12	16	13	12	3	6	11	8
Podlaskie	16	16	13	14	13	14	9	10	14
Pomorskie	5	7	3	10	7	8	2	3	4
Śląskie	12	4	6	4	9	9	11	13	15
Świętokrzyskie	11	14	10	7	5	10	15	12	12
Warmińsko-mazurskie	10	6	8	9	11	4	7	7	10
Wielkopolskie	3	8	11	2	10	7	8	6	7
Zachodniopomorskie	13	13	2	8	8	6	4	1	1

Source: own study.

[5] Rate of changes, 2005 vs 2004.

The ratio of expenditures on environmental protection to GDP can be used as an important indicator in the analysis of the differentiation of environmental protection investments (Table 3). It ranged between 0.9 and 0.7% for the years 2000–2008 for the whole country.

Table 3. Expenditures on environmental protection in GDP in all Lower Silesia and in rural areas of Lower Silesia 2000–2008 (%)

Years	Expenditures on environmental protection in %GNP			
	Lower Silesia total	Poland	rural areas of Lower Silesia	rural areas in Poland
2007	0.56	0.67	0.17	0.16
2006	0.67	0.69	0.24	0.20
2005	0.62	0.66	0.18	0.20
2004	0.72	0.58	0.25	0.25
2003	1.01	0.61	0.22	0.35
2002	0.95	0.62	0.19	0.25
2001	1.21	0.79	0.20	0.18
2000	1.10	0.88	0.23	0.21

Source: own study.

Until 2004, the same ratio in Lower Silesia was much higher than in other voivodships. However, since 2005 it was subject to a substantial decrease. Taking into account only rural parts of Lower Silesia, the ratio is much worse.

The values of the corresponding measures determined for rural areas of Lower Silesia and Poland were much lower – they varied between a fourth and a fifth part of a percent and, since the year 2000, were on an almost constant level.

Taking into account the low level of investment in environmental protection in Lower Silesia in the past, and the big potential in this field, one can expect substantial growth in the future.

The next interesting observation is concerned with the ratio of investments in environmental protection in rural areas to investments in all areas of Lower Silesia. The area of rural areas in Lower Silesia is almost 50% of the total area of the voivodship.[6] Between 2000 and 2008, the participation of expenditures on environmental protection of rural areas in Lower Silesia in the total of environmental protection investments in Lower Silesia varied from almost 17% (in 2001) to approximately 36% in 2006.

Another aspect of the study was concerned with the differentiation of the structure of sources of finances used in environmental protection of rural areas in Lower Silesia.

[6] Over 93% in the case of the total territory of Poland.

Table 4. Expenditures on environmental protection in rural areas of Lower Silesia as a percentage of total expenditures on environmental protection in Lower Silesia between 2000 and 2008

Years	2008	2007	2006	2005	2004	2003	2002	2001	2000
Participation	24.26	30.84	36.19	29.90	34.75	22.20	19.91	16.84	20.41

Source: own study.

Table 5 presents the distribution of expenditures on environmental protection in the light of sources of financing between 2004 and 2008. Comprehensive analysis of the results indicates that there were large differences between the role of particular sources of financing. The monotonic measure used for the purposes of the analysis was 0.24, which indicates that the changes in the structure of expenditures are not a constant trend.

Table 5. Expenditures on environmental protection of rural areas of Lower Silesia according to the sources of financing between 2004 and 2008 (in %)

Sources of financing		Years				
		2008	2007	2006	2005	2004
Budget		0.43	0.91	0.84	1.56	2.65
Self-government		39.82	38.56	54.77	28.24	28.78
Inhabitants		2.06	2.10	1.38	5.58	1.86
Environmental protection	Subsidies	13.45	9.63	6.22	20.32	17.46
	Loans	29.18	20.06	11.69	23.29	27.64
European Union		8.62	24.00	21.74	16.59	19.69
Other		6.44	4.74	3.37	4.42	1.92

Source: own study.

Self-governments played the most important role among the units responsible for environmental protection in Lower Silesia. Their expenditures ranged from 30% to almost 55% of all expenditures. The data also shows the important role of the National Fund for Environmental Protection and Water Management as well as the European Union Structural Funds as sources of financing. Also from 2009, the value of projects co-financed by the European Union was systematically decreasing (the rate of decrease was 13% in 2007 and 65% in 2008).

Participation of the Central Budget was the lowest within all sources of financing. The level of expenditures from this source was constantly decreasing since 2004, and reached from 0.43% to a maximum of 2.65% of the total amounts for environmental protection in rural areas of Lower Silesia.

In order to deepen the analyses of investment in rural areas we use some special measures based on average, real and annual *per capita* expenditures on environmental

protection in rural areas between 2004 and 2008 (Table 6). Using this measure we observe the same trends both in Silesia and the whole country. Trends observed in Lower Silesia were similar to general trends in the country.

Table 6. Average annual expenditures on environmental protection between 2004 and 2008 in voivodships, realized in 2004 (in PLN *per capita*)

Voivodship	Sources of financing							
	budget	self-government	inhabitants	environmental protection		European Union	other	Total
				subsidies	loans			
Dolnośląskie	2	76	5	25	42	36	8	194
Kujawsko--pomorskie	2	98	3	1	39	17	5	165
Lubelskie	3	31	5	1	18	18	4	78
Lubuskie	6	102	0	5	19	39	7	178
Łódzkie	1	49	3	3	33	15	2	107
Małopolskie	2	41	3	3	24	30	9	111
Mazowieckie	5	77	9	5	58	19	5	179
Opolskie	3	78	1	3	41	40	5	171
Podkarpackie	1	40	3	1	24	36	1	106
Podlaskie	2	40	4	2	13	26	1	89
Pomorskie	2	69	2	11	40	15	12	151
Śląskie	1	47	3	4	42	36	5	139
Świętokrzyskie	3	44	3	2	20	48	2	122
Warmińsko--mazurskie	3	61	2	3	16	37	9	130
Wielkopolskie	2	51	3	4	42	20	28	149
Zachodnio-pomorskie	1	48	2	7	32	38	5	134
Total	40	951	51	78	505	470	108	2204

Source: own study.

Self-governments were the biggest investor. The National Fund for Environmental Protection and Water Management, offering loans for that purpose, was second. The European Union, within its operational programmes, spent almost half as much as self-governments on environmental protection of rural areas in Poland. The budget had the lowest input.

The same indicator was used to analyse the regional distribution of expenditures. In the analysed period from 2004 to 2008, the highest level of environmental investments was observed in Lower Silesia (dolnośląskie) – 194 PLN *per capita*, the lowest in lubelskie – 78 PLN *per capita*.

The data from Table 6 was used as the indication of structures defined in relation to the sources of financing of environmental protection in the voivodships. The degree of differentiation of the structures was calculated based on the calculated indicators. The results are presented in Table 7.

Table 7. Matrix of the differentiation of the structures of expenditures on environmental protection between the sources of financing in the voivodships from 2004 to 2008

Voivodship	Dolnośląskie	Kujawsko-pomorskie	Lubelskie	Lubuskie	Łódzkie	Małopolskie	Mazowieckie	Opolskie	Podkarpackie	Podlaskie	Pomorskie	Śląskie	Świętokrzyskie	Warmińsko-mazurskie	Wielkopolskie	Zachodniopomorskie
Dolnośląskie	**0.00**															
Kujawsko-pomorskie	**0.222**	0.00														
Lubelskie	**0.116**	0.21	0.00													
Lubuskie	**0.233**	0.17	0.19	0.00												
Łódzkie	**0.168**	0.15	0.17	0.23	0.00											
Małopolskie	**0.137**	0.25	0.09	0.22	0.20	0.00										
Mazowieckie	**0.191**	0.16	0.15	0.27	0.06	0.21	0.00									
Opolskie	**0.141**	0.15	0.08	0.15	0.11	0.12	0.15	0.00								
Podkarpackie	**0.169**	0.25	0.11	0.26	0.20	0.10	0.23	0.13	0.00							
Podlaskie	**0.205**	0.25	0.14	0.16	0.19	0.13	0.21	0.11	0.12	0.00						
Pomorskie	**0.150**	0.14	0.19	0.25	0.10	0.19	0.12	0.14	0.25	0.23	0.00					
Śląskie	**0.163**	0.26	0.12	0.25	0.14	0.10	0.17	0.13	0.12	0.19	0.20	0.00				
Święto-krzyskie	**0.222**	0.32	0.17	0.25	0.27	0.13	0.29	0.18	0.08	0.11	0.31	0.17	0.00			
Warmińsko-mazurskie	**0.214**	0.25	0.16	0.12	0.22	0.12	0.25	0.12	0.17	0.07	0.20	0.19	0.16	0.00		
Wielkopolskie	**0.212**	0.25	0.21	0.34	0.17	0.18	0.19	0.22	0.25	0.31	0.17	0.16	0.30	0.29	0.00	
Zachodnio-pomorskie	**0.120**	0.24	0.11	0.23	0.19	0.08	0.21	0.11	0.08	0.15	0.18	0.07	0.14	0.15	0.20	0.00
Total	**2.66**	**3.26**	**2.20**	**3.33**	**2.57**	**2.25**	**2.84**	**2.03**	**2.51**	**2.56**	**2.83**	**2.43**	**3.12**	**2.68**	**3.45**	**2.25**

Source: own study.

The values of the differentiation measures showed that the distribution of the sources of financing environmental protection was similar in particular voivodships. The biggest difference was observed between wielkopolskie and lubuskie voivodships, where the analysed measure was 0.34. The smallest difference between the components of the structures was observed in the łódzkie and mazowieckie voivodships – $v_{łódzkie/mazowieckie} = 0.06$.

The last row of Table 7 presents the measures of differentiation totalled for each voivodship. The structure of the sources of financing protection investments in rural areas was particular in the wielkopolskie voivodship ($v_{wielkopolska}$ = 3.45), where the participation of *self-government* and the *European Union* was significantly lower than average and where the participation of *loans for environmental purposes* from the National Fund for Environmental Protection and Water Management as well as of *other investors* was above average. The next particular voivodships were lubuskie ($v_{lubuskie}$ = 3.33) and kujawsko-pomorskie ($v_{kujawsko\text{-}pomorskie}$ = 3,26). The structure of expenditures sources of financing observed in the lubelskie voivodship was the least different than in other voivodships ($v_{lubelskie}$ = 2.2).

The summed up coefficient of differentiation in Lower Silesia (dolnośląskie voivodship) was 2.66 and the average for all voivodships was 2.62. The percentage distribution of entities investing in environmental protection most similar to that of Lower Silesia was observed in lubelskie ($v_{dolnośląskie/lubelskie}$ = 0.116) and zachodniopomorskie ($v_{dolnośląskie/zachodniopomorskie}$ = 0.120) voivodships, followed by małopolskie, opolskie and pomorskie. The least similar structure was observed in lubuskie ($v_{dolnośląskie/lubuskie}$ = 0.233), kujawsko-pomorskie ($v_{dolnośląskie/kujawsko\text{-}pomorskie}$ = 0.222) and świętokrzyskie ($v_{dolnośląskie/świętokrzyskie}$ = 0.222) voivodships.

4. Conclusions

The process of transformation of the Polish economy, which started in 1989, was extremely beneficial for the quality of the natural environment in the country. The accession of Poland to the European Union was also beneficial for the protection and reconstruction of Polish nature.

The obligation of Poland to accommodate European laws and standards brought about changes in the legal regulations concerning protection of the environment.

The restructuring of industry and the liquidation of a number of companies that were especial harmful to the environment resulted in a lower level of contamination of the environment. The opening of the borders resulted in the transfer of information and increased care of citizens about their health, brought an increased ecological awareness in Polish society. The social demand for a clean environment grows together with economic prosperity. As a result more and more financial resources are allocated to its protection and reconstruction of the environment.

The analysis of the volume of expenditures invested in environmental protection of rural areas makes it possible to conclude that, when compared with other voivodships, Lower Silesia is in a leading position.

The structure of sources of financing environmental protection in rural areas in Lower Silesia is similar to that observed in other voivodships. As in other parts of Poland, self-governments play the most important role as investors.

Lower Silesia was the top-ranking voivodship regarding the level of environmental investments *per capita* in rural areas in the period 2004–2008.

The average annual expenditures on environmental protection of rural areas in Lower Silesia between 2000 and 2008 increased faster than in the rural areas in the whole country.

Rural areas take almost half of the area of the voivodship but environmental investments in those areas amount to only one fourth of the total expenditures on environmental protection in Lower Silesia (the average value in the analysed period was approximately 25%).

The indicators of the ratio of expenditures on environmental protection to GDP calculated for rural areas of Lower Silesia were much lower than those calculated for the whole voivodship (total of rural and town areas).

The results of the study show that the expenditures calculated per one inhabitant of rural areas in Lower Silesia, as well as the ratio of environmental protection and water management investments to GDP need to be increased. This thesis is compliant with the so-called Decreasing Productivity Rule which says that: "In order to reach higher and higher levels of the quality of environment, the expenditures on its protection or reconstruction must be the higher than simply proportional" [Fiedor (Ed.) 2009, p. 199].

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ZRÓŻNICOWANIE NAKŁADÓW INWESTYCYJNYCH NA OCHRONĘ ŚRODOWISKA NA OBSZARACH WIEJSKICH DOLNEGO ŚLĄSKA

Streszczenie: Głównym celem artykułu jest identyfikacja aktualnego stanu oraz zbadanie kształtowania się nakładów inwestowanych w ochronę środowiska na obszarach wiejskich Dolnego Śląska w latach 2000–2008. W pracy zbadano ogólny poziom, określono tempo wzrostu, udział w PKB oraz strukturę środków inwestowanych rokrocznie w ochronę środowiska na wsi. Uszeregowano województwa pod kątem realizacji inwestycji i gospodarki wodnej na wsi przypadających na jednego mieszkańca. Dokonano stopnia podobieństwa struktur nakładów między poszczególnymi województwami Polski. Podjęto próbę określenia, jak duże zmiany i w jakim kierunku dokonały się w strukturze badanych nakładów w analizowanych latach. Przeprowadzone analizy posłużyły do określenia pozycji Dolnego Śląska w kontekście pozostałych regionów.

Słowa kluczowe: ochrona środowiska, nakłady na ochronę środowiska, Dolny Śląsk.