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Effectiveness of management of EU funds under the ROPs by municipalities aimed at reducing pollutants in the area of water and sewage management in Poland

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ABSTRACT

Regional Operational Programmes (ROPs) provide an opportunity to achieve the goals of EU policy in 16 voivodships in Poland in terms of economic development, including environmental protection, adjusted to the specificity of particular regions and their local needs. The main aim of the study is to determine whether the municipalities take full advantage of available EU funds for environmental measures, taking into account fields related to water and sewage management, and thus to show a level of effectiveness of the funds management. Another aim is to find out to what extent the pro-environmental measures carried out by municipalities in the current period of EU budgeting, that is, 2014–2020, have influenced a general condition of the natural environment and quality of life of their inhabitants, with special attention given to measures implemented in the Slaskie Voivodeship. Quantitative methods, including classic descriptive statistics and taxonomic methods based on a linear ordering of objects, were used for the research. The effectiveness of EU funds management was examined in a general way as well as within an environmental dimension through the result and product indicators for the European Regional Development Fund, broken down into categories by regions. The obtained values of the indicators at the current stage of the conducted analysis are not satisfactory, and that indicates a low level of effectiveness of management and illustrates the fact that much more remains to be done to improve the state-of-art. The next period of EU budgeting is focused primarily on supporting the transition of the Polish economy to a green and low-carbon model. Energy efficiency and renewable energy sources will be more important areas in this respect. That is why it is so important to observe how many municipalities are already active and carries out environmental activities, including investments in the area of water and sewage management, and how many and which ones are not, thus showing their effectiveness or ineffectiveness in the process. From the point of view of a foreign reader, the publication gives a picture of mechanisms introduced in the field of water and sewage management and effects of the EU financial contributions in municipalities of one of the new EU member states that until then had a leadership position in implementation of the cohesion policy.

Keywords: Environment; Management; EU funds; Water and sewage management; Municipality; ROP

1. Introduction

The amount and rational use of financial resources allocated for investment measures concerning environmental protection have a great impact on the natural environment in particular regions and life of their inhabitants. In the recent years, thanks to availability of EU resources, Poland has improved own level of development in relation to an EU average one. However, a diversity between regions is still

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considerable. Investments implemented under Regional Operational Programmes (ROPs) help minimize those disproportions and are an opportunity to achieve the goals of EU policy in terms of economic development and environmental protection, adjusted to specificities of particular regions, and their local needs. In the 2014–2020 budgeting period, Poland has 31.3 billion euros from EU funds at a voivodeship level, including nearly 2.0 billion euros from the European Regional Development Fund (ERDF) allotted for environmental protection measures as part of ROPs [1,2]. First aim of the current study is to determine whether beneficiaries take full advantage of the available EU resources for environmental measures in order to show efficiency of their operation. Another aim is to find out to what extent pro-environmental measures carried out by communes in recent years have influenced the condition of the natural environment and quality of life of inhabitants, with special attention given to measures implemented in the Slaskie Voivodeship in areas related to water and sewage management.

2. Factors affecting the allocation of EU resources to 16 ROPs

In the 2014–2020 EU budgeting period the most important instruments of regional policy are 16 ROPs that supervise all tasks carried out in the framework of the EU funds by self-governments. In accordance with the EU law, operational programmes for voivodeships are prepared by both: the state and the regions, and eventually they are presented to the European Commission for negotiations. They include detailed priorities and measures based on thematic objectives to be achieved with the use of resources allocated from the EU support. With regard to environmental protection, the thematic objective includes preservation and protection of natural environment and support for effective management of resources [1]. The description of each priority includes specifications of financial contribution from the European Union Funds as well as own contribution from a member state. The Union's Financial Resources are distributed among member states predominantly on the basis of their GDP per capita. Regions with GDP per capita at the level of 75%–90% of the average EU value are regarded as so-called transition regions. Those with the 90%+ level are considered to be more developed regions [3]. In Poland, GDP per capita is only 68% of the EU average. The level is similar in Hungary, whereas in Greece it is 73% [4]. Financial resources from EU funds distributed among ROPs for the 2014–2020 period were divided by means of an algorithm based on the Berlin method. These calculations take into account statistical data from the Eurostat concerning each region's population, GDP per capita, and unemployment rate at the NUTS-2 level [1]. The analysis of Polish regions showed that the five following voivodeships are below 50% of the EU average: Lubelskie, Podkarpackie, Warminsko-mazurskie, Swietokrzyskie, and Podlaskie. From the economic point of view, the Slaskie Voivodeship is one of the strongest regions in Poland, with 70% of the average EU GDP per capita. It ranks fourth, following Mazowieckie, Dolnoslaskie, and Wielkopolskie voivodeships. The Mazowieckie Voivodeship is the only one to exceed 75%, with 107% GDP per capita expressed as the percentage of EU-27 average, thus being one of the more developed European regions (Fig. 1).

In addition, Eastern Polish voivodeships with the lowest GDP have a high unemployment rate, and they implement economic reforms much slower. The disproportions between voivodeships are presented in Table 1. The data shows that in the recent years the unemployment rate has been the highest in the Warminsko-mazurskie Voivodeship.

3. Analysis of indicators illustrating the need for environmental measures to be implemented in voivodeships

Despite environmental protection investments carried out in recent years, aimed mainly at reduction of negative environmental influence on living conditions of the regions' inhabitants, in some voivodeships measures taken are evidently insufficient. The level of water supply connections has still been the lowest in the towns of Lodzkie, Swietokrzyskie, and Lubelskie voivodeships. In rural areas in 2018, the ratio was below 90% in five voivodeships: Podlaskie, Lubelskie, Swietokrzyskie, Mazowieckie, and Lodzkie. The availability of sewage treatment plants has grown rapidly especially in towns of the Mazowieckie Voivodeship (by 39.8%). However, the sewage connection rate in rural areas is still very low. In 2018, it was below 30% in two eastern voivodeships (Lubelskie and Podlaskie), as well as in Lodzkie Voivodeship, in central Poland. The highest rate of 62.4% population with an access to sewage treatment plants is in rural areas of the Pomorskie Voivodeship. In the analyzed period, that is, 2009–2018, 40,358.3 km of the new water supply network and 60,469.9 km of sewage network have occurred in Poland (Table 2).

The data shows that the rates of water supply and sewerage connections in different regions have grown considerably in recent years. All that has significantly influenced the quality of life of residents of those regions.

Based on the available data, one can deduce that a level of surface and underground waters is still not satisfactory in Poland but that it has slightly improved since 2009. Out of 384 groundwater samples taken at measurement points in 2018, the largest number was in the third quality class (over 31%), while the lowest in the first quality class (2.6%). In total, in 65.1% of points, a chemical status of groundwater was described as good, and in remaining 34.9% as weak [9]. To compare in 2009, the chemical status of groundwater was described as good in over 36% of the tested measuring points in the third quality class, while in the first one—none (Table 3).

As far as a surface water status is concerned, the analysis of data in 2018 showed that only a negligible number, that is, 151 of tested uniform bodies of surface water (including river waters and dam reservoirs) reached good condition, whereas 999 of them was below the good condition level (Table 4).

Analyzing in greater detail the changes that have occurred in the Slaskie Voivodeship in recent years, one needs to admit that as far as an area is concerned the voivodship ranks 14th in Poland and covers 3.9% of the area of the whole country [8]. The population of the Slaskie Voivodeship has been gradually decreasing. In 2009, there

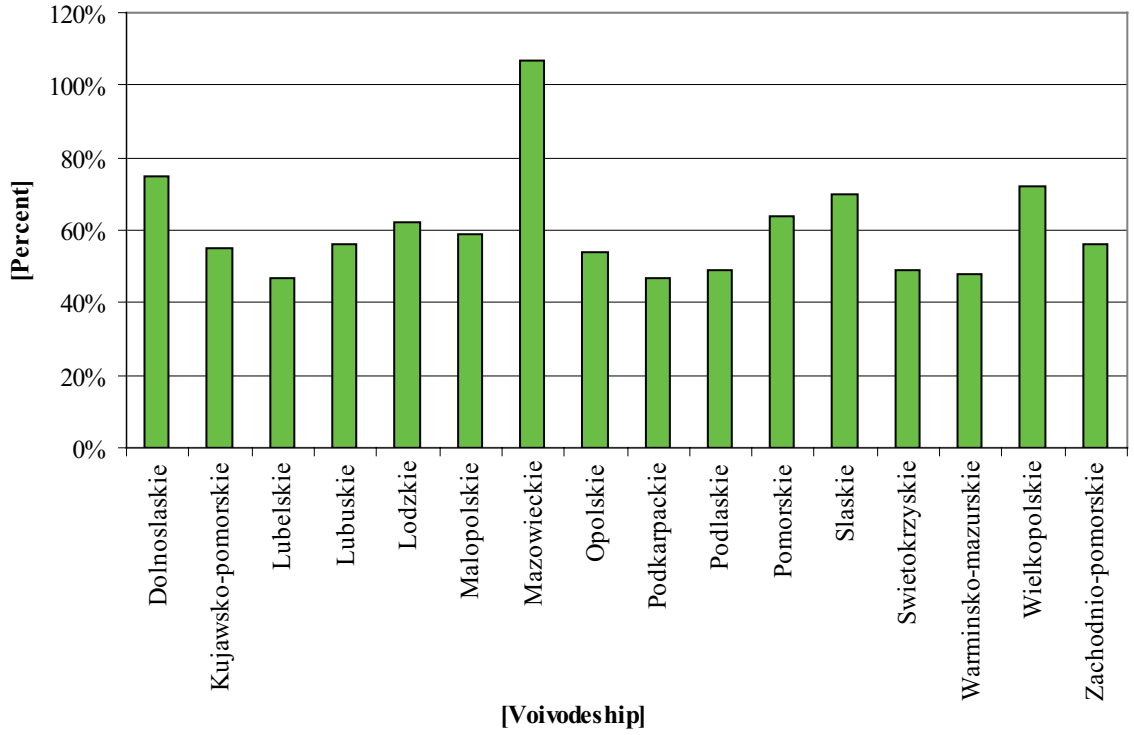

Fig. 1. Regional gross domestic product per inhabitant as a percentage of the EU-27 average [4].

Table 1
Characteristics of voivodeships by population and unemployment rate [5–8]

Voivodships	Population (thousands/year)				Registered unemployment rate (%/year)			
	2009	2011	2013	2018	2009	2011	2013	2018
Poland	38,167.3	38,538.4	38,495.7	38,411.1	12.1	12.5	13.4	5.8
Dolnoslaskie	2,876.6	2,916.6	2,910.0	2,901.2	12.8	12.4	13.1	5.2
Kujawsko-pomorskie	2,069.1	2,098.4	2,092.6	2,077.8	16.2	17.0	18.2	8.8
Lubelskie	2,157.2	2,171.9	2,156.2	2,117.6	12.9	13.2	14.4	8.0
Lubuskie	1,010.0	1,023.2	1,021.5	1,014.5	16.2	15.4	15.7	5.8
Lodzkie	2,541.8	2,533.7	2,513.1	2,466.3	11.9	12.9	14.1	6.1
Malopolskie	3,298.3	3,346.8	3,360.6	3,400.6	9.7	10.5	11.5	4.7
Mazowieckie	5,222.2	5,285.6	5,316.8	5,403.4	9.0	9.8	11.1	4.9
Opolskie	1,031.1	1,014.0	1,004.4	986.5	12.9	13.3	14.2	6.3
Podkarpackie	2,101.7	2,128.7	2,129.3	2,129.0	15.9	15.5	16.3	8.7
Podlaskie	1,189.7	1.201.0	1,195.0	1,181.5	12.8	14.1	15.1	7.7
Pomorskie	2,230.1	2,283.5	2,295.8	2,333.5	11.9	12.5	13.2	4.9
Slaskie	4,640.7	4,626.4	4,599.4	4,533.6	9.4	10.2	11.3	4.3
Swietokrzyskie	1,270.1	1,278.1	1,268.2	1,241.5	15.1	15.2	16.6	8.3
Warminsko-mazurskie	1.427.1	1,452.6	1,446.9	1,429,0	20.7	20.2	21.6	10.4
Wielkopolskie	3,408.3	3,455.5	3,467.0	3,494.0	9.2	9.1	9.6	3.2
Zachodnio-pomorskie	1,693.2	1,722.7	1,718.9	1,701.0	17.1	17.6	18.0	7.4

were 4.64 million residents, and in 2018, the number fell by 2.4%. Yet, the Slaskie Voivodeship still ranks second among Polish regions in terms of population (Table 2). This region also has the highest population density, that is, 369 people/km², whereas an average for Poland is 123 people/km² [11].

The region's characteristics are mostly reflected by the condition of its natural environment. There are several problems connected with water conditions in the area of the Slaskie Voivodeship. In the years 2009–2018, water intake for different economic needs and the voivodeship's inhabitants

Table 2
Result indicators for voivodeships in terms of water and sewage management [5,8]

	Dwellings fitted with water supply system in % of total dwellings						Population connected to wastewater treatment plants in % of total population					
Voivodeships	City	Village	City	Village	City	Village	City	Village	City	Village	City	Village
Year	2009		2013		2018		2009		2013		2018	
Poland	98.6	89.0	99.0	91.8	99.1	92.3	88.1	26.9	93.3	35.5	94.6	42.9
Dolnoslaskie	99.1	94.2	99.4	95.8	99.5	96.1	95.2	30.0	94.7	39.2	96.1	48.3
Kujawsko-pomorskie	99.1	92.6	99.4	95.2	99.5	95.5	94.2	33.4	94.4	35.4	95.8	40.0
Lubelskie	97.4	79.6	98.1	84.5	98.1	85.0	93.5	17.4	94.5	22.0	93.9	25.6
Lubuskie	99.1	93.9	99.6	95.6	99.5	95.8	92.2	24.0	93.3	33.8	94.7	43.6
Lodzkie	96.3	84.0	97.1	88.7	97.2	89.3	94.0	15.7	94.7	21.8	95.2	26.5
Malopolskie	98.4	91.2	99.1	93.3	99.2	93.7	89.3	21.7	90.9	29.9	94.2	40.9
Mazowieckie	98.0	83.4	98.7	87.7	98.8	88.4	68.6	19.8	93.8	25.9	95.9	31.8
Opolskie	99.3	95.8	99.5	96.4	99.5	96.5	94.8	29.3	95.3	43.9	94.6	54.8
Podkarpackie	97.9	87.9	98.4	90.6	98.6	91.1	92.6	39.1	95.4	52.0	96.7	59.3
Podlaskie	97.7	79.8	98.6	83.0	98.7	83.7	92.7	16.9	95.9	21.3	96.8	23.8
Pomorskie	99.7	96.3	99.8	97.7	99.9	97.9	97.8	46.9	96.8	57.6	94.4	62.4
Slaskie	99.2	94.7	99.3	96.1	99.4	96.3	82.5	27.7	88.1	38.6	91.2	47.9
Swietokrzyskie	96.6	79.9	97.6	86.4	97.6	87.0	95.7	17.3	92.5	27.0	95.3	39.1
Warminsko-mazurskie	99.8	90.6	99.8	91.7	99.9	92.2	98.1	34.9	98.2	40.8	96.4	49.9
Wielkopolskie	99.3	95.0	99.5	96.6	99.6	96.9	88.8	28.7	91.5	38.5	94.2	48.0
Zachodnio-pomorskie	99.7	96.5	99.8	97.4	99.8	97.5	92.2	43.6	94.8	53.8	94.4	58.6

Table 3
Results of monitoring of underground waters quality in domestic network in 2009 and 2018 [9,10]

Year	Number of measurement points	Waters by quality class				
		Good			Weak	
		I	II	III	IV	V
2009	299	0	41	172	58	28
2018	384	10	118	122	94	40

decreased from 477.3 hm^3 in 2009 to 418.6 hm^3 in 2018, that is, by 14.0% [8,10]. The length of the water supply network has increased from 19,867.9 km in 2009 to 21,674.9 km in 2018, that is, by 9.1% [12,13]. In terms of amount of wastewater that requires purification, the region of Slask ranks first in Poland. According to the Central Statistical Office, the amount of wastewater that requires purification produced in the region in 2018 accounted for 17.2% of the total amount of wastewater in Poland [8]. In 2009, the amount of wastewater discharged through the sewage network in the Slaskie Voivodeship was 150.0 hm^3, and in 2018, 155.4 hm^3, which shows its slight increase. In 2018, sewage was treated in 201 wastewater treatment plants, including 109 biological plants, 91 ones with increased biogenic removal, and also 1 mechanical plant [8]. The length of the sewage network has increased from 10,300.3 km in 2009 to 16,677.5 km in 2018, that is, by 61.9% [12,13].

It is clear that not all goals have been yet achieved. The processes are long-term, and considerable financial resources are needed to carry them out. The state of knowledge about links between environment and health conditions confirms a direct dependence of the health and quality of life on the quality of environment. The harmful environmental factors cause several human health disorders. Reducing and preventing environmental threats are an indispensable element of the national environmental policy [14]. Therefore, it is important to use efficiently the currently available EU funds as they contribute a lot to the improvement of the natural environment conditions.

4. Allocation of EU resources to 16 ROPs

The management in a municipality is a complex process based on self-governments obligations and local structures as well as relevant national legislations [15]. General organization of managerial duties in the public authority system have significant importance because of a wide range and types of services provided [16]. In an implementation process especially, an important role is played by a careful planning and advanced forecasting. In our case, the most important prerequisite for planning is obtaining external financial resources to introduce all necessary changes and investments. It is crucial to make the whole process effective. Effectiveness is seen as one of the evaluation criteria used for measuring the action quality. Lack of effectiveness or resourcefulness can easily negate the sense of foreseen undertakings. The activity may be called successful when it is purposeful and leads to achieving set objectives and targets [17]. Proved willingness to obtain the chosen goals and doing one's best to reach the destination point means

Table 4
Status of rivers and dam reservoirs uniform surface water bodies in 2009 and 2018 [9,10]

River basins	Number of evaluated uniform bodies of river waters in 2009			Number of evaluated uniform water bodies in 2018		
	Total	Good status	Bad status	Total	Good status	Below good status
Wisla	2,618	145	2,290	694	115	579
Odra	1,673	67	1,383	415	29	386
Dniestr	3	0	2	1	0	1
Dunaj	11	3	7	4	1	3
Jarft	6	0	5	3	0	3
Laba	8	0	0	2	0	2
Niemen	39	4	28	15	2	13
Pregola	119	4	107	14	4	10
Swieza	4	0	4	2	0	2
Ucker	0	0	0	0	0	0
Total	4,481	223	3,826	1,150	151	999

that the taken action and introduced activities had been efficient. As various mechanisms are introduced to measure the effectiveness, a degree of estimating the level of reaching the goal can vary. The action is considered to be more effective than others as long as it brings acting persons closer to the determined results and outcomes [18]. Generally speaking, in the currently described situation, effective management defines that kind of activity that within available EU funds leads to the achievement of certain ecological goals and to creating appropriate conditions for improvement of water and sewage water management systems in particular areas and communes.

The mechanism of distribution of resources among ROPs was the same for 15 less developed regions, whereas the Mazowieckie Voivodeship, as a more developed region, received only 55% of the total available allocations for the area [1]. Table 5 presents in detail distributions of amounts allocated to each voivodeship as part of ROPs, taking into account resources dedicated specifically for environmental protection.

The total indicative allocation of EU resources to ROPs is the highest in the Slaskie Voivodeship (3.5 billion euros) and the lowest in the Lubuskie Voivodeship (over 0.9 billion euros). Generally, it is a 0.25% increase in the total pool allocated for ROPs in relation to the 2007–2013 period [19]. 6.25% of EU resources for the ROPs resources were guaranteed for environmental measures, which is a 5.12% decrease in relation to the previous EU budgeting period [19]. The highest percentages of financial resources, that is, 10%–13% of the total pool depending on a kind of the Regional Operational Programme, were allotted for environmental measures in Lubuskie and Swietokrzyskie voivodeships, and the lowest, that is, 3%–4%, in Mazowieckie, Wielkopolskie, Podlaskie, Lodzkie, and Zachodnio-pomorskie voivodeships. However, in terms of amount, the highest resources (over 200 million euros) was allotted for activities connected to the environmental protection in Slaskie and Wielkopolskie voivodeships, which is the result of high total values allocated there as part of the programmes. Moreover, the highest percentages of resources (more than 60%) were allotted for activities connected with water supply and sewage management in Lubelskie and Malopolskie voivodeships, which covers the regions' demands for such investments. The highest amounts, that is, 92 million euros, were allocated for this purpose in the Podkarpackie Voivodeship, as one can see from the statistical data presented in Table 2.

5. Methodology of studies

The own research conducted previously on factors influencing an improvement of the natural environment condition in municipalities showed that the accessibility of the EU funds is the most important factor for the implementation of ecological investments [20].

The purpose of the current research was to determine to what extent the availability of EU funds makes municipalities to apply for financial contributions for ecological purposes and activities. Specifically speaking, to what extent the municipalities are effective in obtaining the EU funds and how the received resources have affected the condition of the natural environment in the area of water and sewage management in the analyzed period, as seen through the mechanism of achieved product and result indicators.

As part of the adopted research methodology, one determines the level of effectiveness of communes in particular voivodeships in obtaining EU funds, indicated by a successfully completed procedure finalized with the signing of contracts enabling commencement of necessary ecological investments. The value of the effectiveness was calculated on the basis of the amount of resources formally approved for environmental investments in ROPs, seen in relation to the value of indicative allocations received as part of ERDF financing.

In order to explore the theme and measure to what extent the implementation of investments undertaken with the share of the EU funds resulted in development of water and sewage water management in particular voivodships, one of the taxonomic methods was used. The methods are taken advantage of in many fields of modern research [21]. The currently used method allows a linear ordering of objects

Table 5
ROPs-indicative allocation of EU resources from the ERDF for the 2014–2020 period, in euros [2]

16 Regional Operational Programmes	Total allocation for the ROPs	Number of the priority axis regarding the environment according to 16 ROPs	Allocation under the axis of the environment from the ERDF	Including: for activities related to water and wastewater management
	31,276,897,550		1,956,185,978	802,307,401
Dolnoslaskie	2,252,546,589	IV	176,504,698	56,104,689
Kujawsko-pomorskie	1,903,540,287	IV	108,698,279	35,000,000
Lubelskie	2,230,958,174	VI	110,139,605	75,972,429
Lubuskie	906,929,693	IV	91,538,944	30,668,420
Lodzkie	2,256,049,115	V	88,498,058	49,352,946
Malopolskie	2,878,215,972	V	122,741,264	81,288,795
Opolskie	944,967,792	V	78,700,000	15,300,000
Podkarpackie	2,114,243,760	IV	186,159,639	91,745,981
Podlaskie	1,213,595,877	VI	47,000,000	22,000,000
Pomorskie	1,864,811,698	XI	120,909,938	47,154,876
Slaskie	3,476,937,134	V	208,163,836	86,459,292
Swietokrzyskie	1,364,543,593	IV	176,560,369	86,996,030
Warminsko-mazurskie	1,728,272,095	V	105,215,193	22,963,943
Wielkopolskie	2,450,206,417	IV	204,000,000	76,300,000
Zachodnio-pomorskie	1,601,239,216	III	63,000,000	25,000,000
Mazowieckie	2,089,840,138	V	68,356,155	0

based on introducing of standards and patterns that were presented by Hellwig [22]. It involves an analysis of complex phenomena described by at least two features. In the analyzed case, a set of diagnostic variables was based on the result indicators in terms of water and sewage management specified in Table 2: dwellings fitted with water supply system in city in % of total dwellings (x_1); dwellings fitted with water supply system in village in % of total dwellings (x_2); population connected to wastewater treatment plants in city in % of total population (x_3); population connected to wastewater treatment plants in village in % of total population (x_4).

The construction of the Hellwig's development measure is [22]:

- standardization of variables: $z_{ij} = \frac{x_{ij} - \overline{x_j}}{s_j}$, x_{ij}, observation of the j-th variable for the object i; $\overline{x_j}$, arithmetic mean of observation j-th variable; s_j, standard deviation of observation j-th variable;
- coordinates of the standard: $z_{oj} = \max_i\{z_{ij}\}$ for variables of booster character;
- the distance of objects from the standard: $d_{io} = \sqrt{\sum_{j=1}^{m}\left(z_{ij} - z_{oj}\right)^2}$;
- variable values: $q_i = 1 - \frac{d_{io}}{d_o}$, wherein: $q \in [0;1]$; $d_o = \overline{d_o} + 2s_d$; $\overline{d_o} = \frac{1}{n}\sum_{i=1}^{n} d_{io}$; $s_d = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(d_{io} - \overline{d_o}\right)^2}$.

Importantly, all analyzed variables were boosters. After the standardization of variables, an abstract object was determined, that is, a so-called standard with the best values for each variable—a hypothetical voivodeship with the best result indicators in 2018. Testing the similarity of objects, that is, similarities between specific voivodeships and the best abstract object, consists of a process of determination of the Euclidean distance of each object from the standard. The distance was measured both for 2013 (the year finalizing the EU budgetary period 2007–2013) and for 2018. During the next stage of the research, development measures with properties were determined for each object (voivodeships): the higher the measure, the higher the level of the phenomenon. This allowed to establish the ranking for the level of effectiveness of investments implemented as part of water and sewage management.

As part of the conducted research, based on a detailed analysis of materials regarding completed investments in the field of water and sewage management under the ROP by the end of the first quarter of 2019, product indicators were measured, which were then tabulated.

6. Use of EU resources for pro-ecological measures in 16 ROPs

ROPs play an important role in financing projects which significantly contribute to the improvement of natural environment condition and the quality of life of inhabitants of the regions. The programmes are used to support individual projects and projects carried out through official call for proposals. A project to be implemented in the region only qualifies for support from EU funds if a number of criteria are successfully met. The project must be compliant with specific requirements and areas of support of structural funds, horizontal communal policies adopted operational program,

and specific criteria for the action priority. In addition, the region is able to receive resources from an EU fund when the project results are sustainable, that is, when the durability of the outcomes and outputs of the project is not less than 5 y after the project implementation [23].

According to data presented at the end of the 1st quarter of 2019, 1,907 contracts for financing environmental protection measures had been signed in 16 ROPs for the 2014–2020 period as part of call for proposals, with ERDF support equal to 1,287.4 million euros. This is approx. 66% of the total indicative allocation for the 2014–2020 period. Most of the contracts in 15 less developed voivodeships were signed in the Slaskie Voivodeship, and the lowest number, that is, 22 contracts (1.2%), for the amount of 11.0 million euros, in the Podlaskie Voivodeship. This data is presented in Fig. 2.

In the Slaskie Voivodeship, 254 contracts were signed (13.3%), involving 147.0 million euros support from the ERDF. The value of contracted resources as part of signed contracts divided into subregions is presented in Fig. 3.

Detailed analysis of the data showed that the investments carried out as part of environmental protection mostly referred to water supply and sewage disposal. The value of projects in this area was 1,022.5 million euros (47.7%) for the performance of 582 tasks (30.5%), including 570.6 million euros (44.3%) from the ERDF. The Mazowieckie Voivodeship was the only one where no project was carried out in this area in the discussed period, which resulted from the assumptions of the Regional Operational Programme for the region that no resources are to be included for the measure [28]. However, according to data for 2017, the level of water supply and sewerage connection in this region was not among the highest in Poland (Table 2). Until 31.03.2019, the most of contracts concerning water supply and sewage disposal had been signed in the Lubelskie Voivodeship, and the fewest number in the Podlaskie Voivodeship. The Slaskie Voivodeship ranked second, with 68 carried out projects. Out of these projects, 12 contracts referred to the construction or expansion of sewage treatment plants, whereas the aim of 14 investment projects was to construct a waterworks and sewerage system. The most of the projects (35) referred exclusively to the construction of sewerage systems, and only 7 projects focused on the water supply [27]. The highest amount of support out of the 15 regions was approved as part of the signed contracts concerning water supply and sewage disposal in the Podkarpackie Voivodeship, and the lowest, in Podlaskie and Opolskie voivodeships. In the Slaskie Voivodeship, the amount of 60.8 million euros from the ERDF was allocated for the described kind of activities. The data are presented in Fig. 4.

7. Efficiency of the use EU resources for environmental measures in ROPs—results of studies

Analyzing the amount of resources approved for environmental investments in ROPs in relation to the value of indicative allocation as part of ERDF financing, one needs to point out that most of the resources have not yet been distributed as part of the signed contracts. The level of 63% must be considered as too low, especially in the light of the fact that the budgeting period is slowly coming to the end. In addition, in the years 2007–2013, the level of distribution of resources for environmental activities in the middle of the budgeting

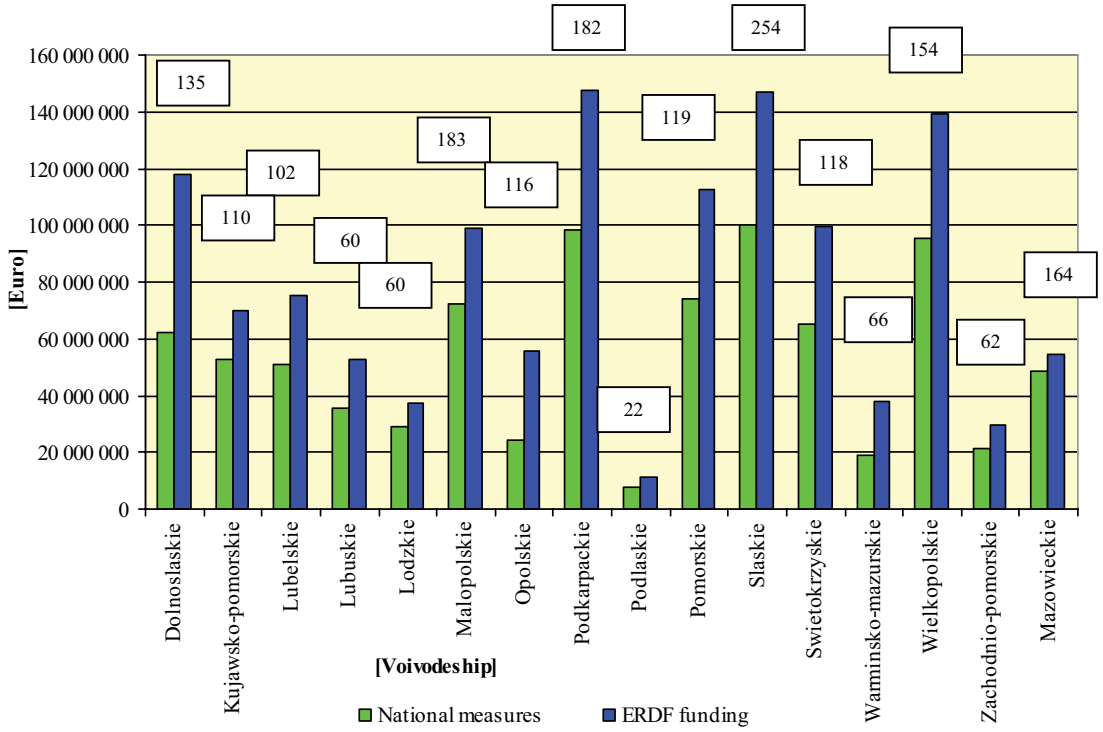

Fig. 2. Number of signed contracts and financial resources allocated for their performance in ROPs as part of environmental protection measures as of 31.03.2019, in euros [24,25].

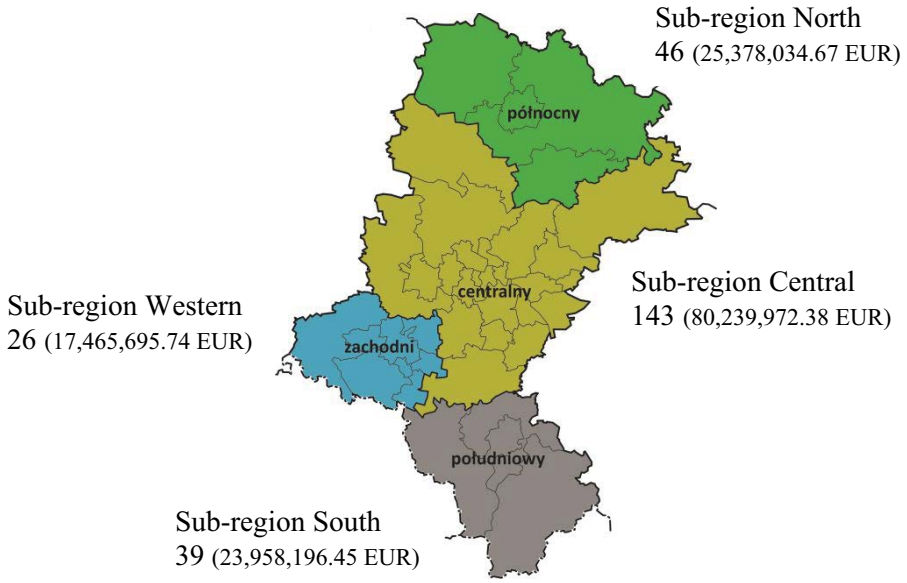

Fig. 3. Number of contracts signed as part of V Priority Axis of the ROP for Slaskie Voivodeship and the amount of ERDF financing divided into subregions of the voivodeship as of 31.03.2019 [25–27].

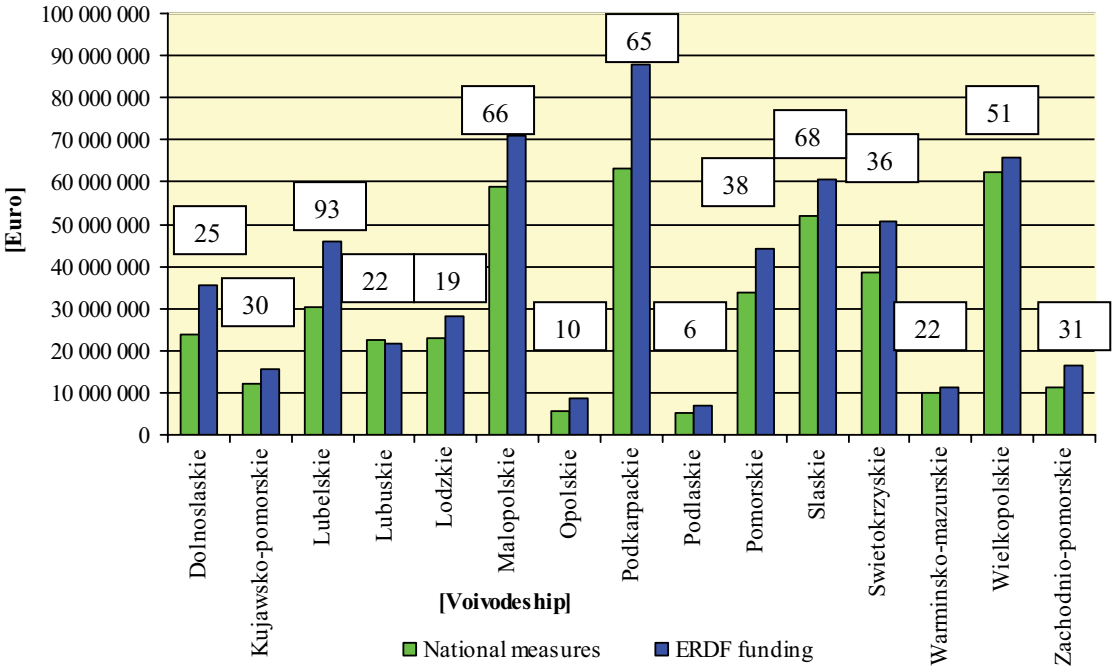

Fig. 4. Number of signed contracts and financial resources allocated for their performance in ROPs as part of water supply and sewage disposal measures as of 31.03.2019, in euros [24,25].

period had been higher, over 70% [19]. This may suggest inefficiency in obtaining EU resources by some voivodeships as part of the ROPs in comparison to the previous period. In Pomorskie, Malopolskie and Podkarpackie voivodeships the use of resources from the ERDF by the end of the 1st quarter of 2019 was more than 75% (in the Pomorskie Voivodeship it was even more than 90%). In six regions the level of efficiency of obtaining the available EU funds did not reach 63%, and in the Podlaskie Voivodeship it was the lowest, only 23.4%. In the Slaskie Voivodeship, the level was just over 70% of the indicative allocation. The data are presented in Fig. 5.

As of the end of March 2019, the value of approved support from the ERDF for activities concerning water supply and sewage disposal was the highest in the Podkarpackie Voivodeship and was equal to 96.0% of the indicative allocation for this measure. It is important to admit that the

Fig. 5. Use of ERDF resources as part of ROPs for activities connected with environmental protection, in % [1,24,29].

level of water supply and sewerage connection of residents in this region is high as compared to other voivodeships. In Kujawsko-pomorskie, Podlaskie, and Warminsko-mazurskie voivodeships, where extensive work in this area is needed, the level of use of ERDF resources was on average approximately 50%, with the lowest level of 31.0% in the Podlaskie Voivodeship. In the Slaskie Voivodeship, the value of approved financing from the ERDF was 70.3% of the indicative allocation for this measure.

Data on the use of the available ERDF resources for activities connected with water and sewage management as part of the signed contracts as of the end of the 1st quarter of 2019 are presented in Fig. 6.

The situation was different for completed projects as of the end of March 2019. The value of used support from the ERDF for activities concerning water supply and sewage disposal was the highest in the Dolnoslaskie Voivodeship and was equal only to 57.6% of the indicative allocation for this measure. In seven voivodeships the level of use of ERDF resources was below 10%, with the lowest level of 3.1% in the Warminsko-mazurskie Voivodeship. In the Slaskie Voivodeship, the value of used financing from the ERDF was 19.2% of the indicative allocation for this measure.

Data on the use of the available ERDF resources for activities connected with water and sewage management as part of completed investments as of the end of the 1st quarter of 2019 are presented in Fig. 7.

Analyzing the impact of EU funds invested in development in the framework of water and sewage management of particular voivodeships, based on the measured result indicators, it should be stated that it is generally positive. The distance of voivodeships from the reference object in the analyzed period decreased in most of the cases, that is, in 9 out of 15 analyzed objects. An omission in the analysis of the Mazowieckie Voivodeship resulted from the lack of allocation of EU funds for the region for activities related to water and sewage management under the ROP, in the analyzed period. On the other hand, an increase in distance from the reference object, between 2013 and 2018, concerned mainly the Pomorskie Voivodeship. Nevertheless, the value of the development measure located this voivodeship in third ranking position in 2018, immediately after Dolnoslaskie and Warminsko-mazurskie voivodeships. Moreover, ambiguous information can be obtained from analyses of relations between the area in which projects supported by EU assistance were implemented and the change in the level of development. There was no correlation between the value of EU co-financing for water and sewage management activities calculated per capita in a given voivodeship and the measure of its development. The exception is the Dolnoslaskie Voivodeship. Data regarding the level of development of voivodeships in 2013 and 2018 as part of water and sewage management and the values of EU co-financing per capita, regarding completed investments, is presented in Table 6.

It is worth noting, however, that as part of completed investments affecting the quality of life of residents of communes and reducing the level of pollution in the area of water and sewage management, at the end of March 2019,

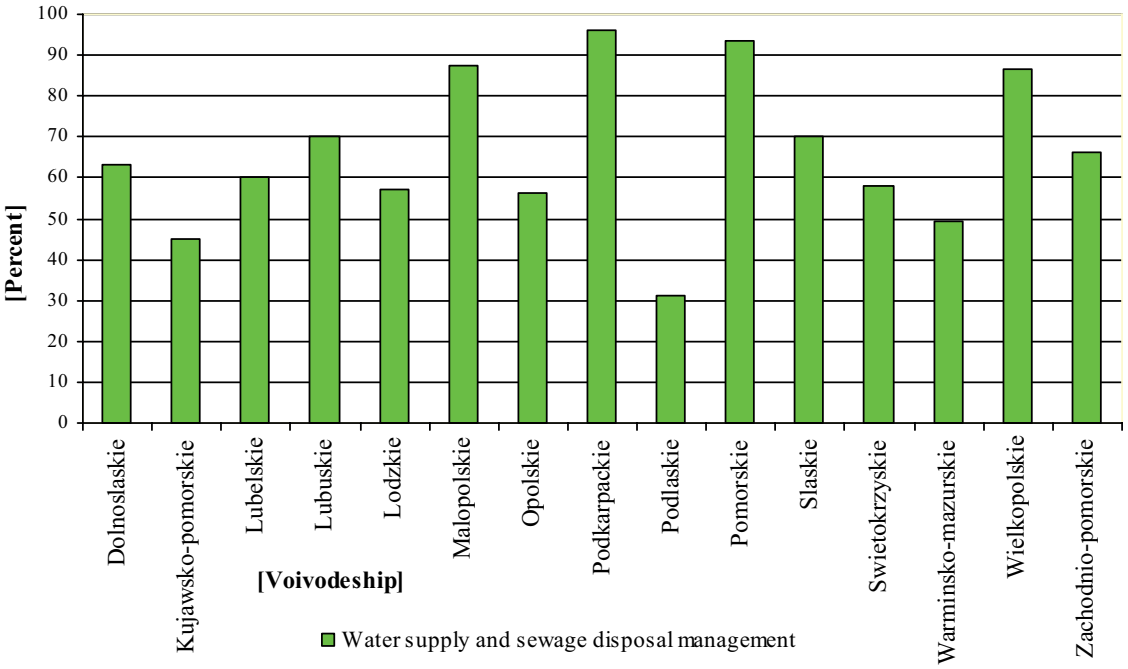

Fig. 6. Use of ERDF resources for activities connected with water and sewage management as part of the signed contracts as of 31.03.2019, in % [1,24,25].

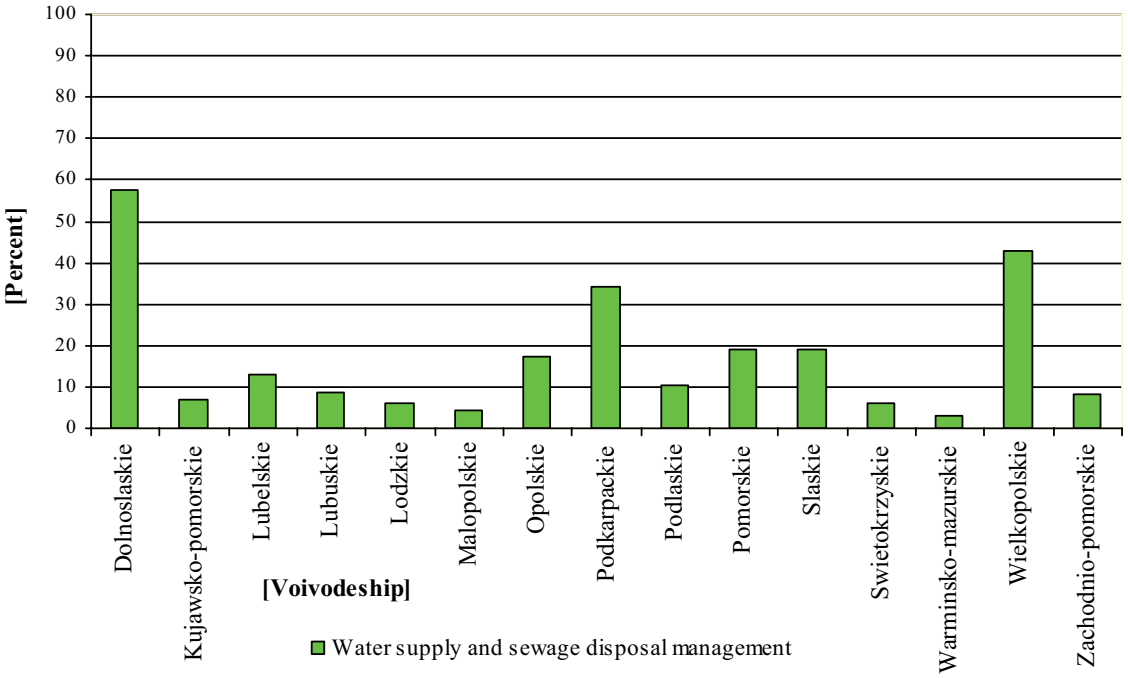

Fig. 7. Use of ERDF resources for activities connected with water and sewage management as part of completed investments as of 31.03.2019, in % [1,24,25].

as part of Regional Operational Programs, a total of 70 sewage treatment plants were built and modernized, most of them in the Podkarpackie Voivodeship. On the other hand, the Lubelskie Voivodeship supported the largest number of water treatment stations and built the most km of the water supply network, focusing on the improved use of water supply by residents of the municipalities of this area. In addition, in three voivodeships: Wielkopolskie, Dolnoslaskie, and Podkarpackie, investment projects were focused on the construction of a sewage network. The product indicators achieved as part of completed investments in voivodeships are presented in Table 7.

Table 6
Development level of voivodeships as part of water and sewage management in 2013 and 2018

Object	2013			2018			Value of EU funding per capita, in Euros
	d_i	q_i	Rank	d_i	q_i	Rank	
Dolnoslaskie	1.7874	0.6787	5	1.3967	0.7414	1	11.14
Kujawsko-pomorskie	2.1268	0.6177	6	2.0868	0.6136	6	1.17
Lubelskie	4.5225	0.1872	13	5.0332	0.0680	15	4.71
Lubuskie	2.4416	0.5612	8	2.2382	0.5855	9	2.60
Lodzkie	4.7608	0.1443	15	4.8436	0.1031	14	1.19
Malopolskie	3.5487	0.3622	10	2.8243	0.4770	10	1.00
Opolskie	1.2958	0.7671	3	1.7690	0.6724	5	2.68
Podkarpackie	2.3752	0.5731	7	2.1243	0.6066	7	14.74
Podlaskie	4.4166	0.2062	12	4.5925	0.1496	13	1.95
Pomorskie	0.4003	0.9281	1	1.7004	0.6851	3	3.85
Slaskie	3.9996	0.2811	11	4.1975	0.2227	12	3.66
Swietokrzyskie	4.6400	0.1660	14	4.1853	0.2250	11	4.34
Warminsko-mazurskie	1.7049	0.6936	4	1.6097	0.7019	2	0.49
Wielkopolskie	2.7410	0.5074	9	2.2264	0.5877	8	9.41
Zachodnio-pomorskie	1.0379	0.8135	2	1.7348	0.6788	4	1.21

Table 7
Product indicators as part of completed investment projects in the area of water and sewage management as of 31.03.2019 [24]

	Length of the constructed and modernized sewage network (km)	Length of the constructed and rebuilt water supply network (km)	Number of financially supported wastewater treatment plants (pcs.)	Number of financially supported water treatment stations (pcs.)
Dolnoslaskie	136.820	7.433	9	0
Kujawsko-pomorskie	15.672	0	1	1
Lubelskie	36.349	45.568	2	12
Lubuskie	14.032	2.325	2	0
Lodzkie	0.605	0	2	0
Malopolskie	18.140	0	2	0
Opolskie	21.024	3.280	1	1
Podkarpackie	188.352	0	22	0
Podlaskie	1.941	3.110	3	1
Pomorskie	54.541	0	6	0
Slaskie	36.452	10.526	3	2
Swietokrzyskie	17.740	2.850	2	0
Warminsko-mazurskie	0	2.560	1	2
Wielkopolskie	218.182	5.463	14	2
Zachodnio-pomorskie	6.213	6.940	0	5

8. Conclusions

With a view to improving natural environment conditions in Poland and the quality of life of residents in different regions, it is important to use properly the available financial resources, including those from the ERDF. On the basis of data analysis presented in the paper, we can see that investment activities concerning natural environment protection are inefficient in the current period of EU budgeting. The rate of implementation of these measures equal to 63% of the indicative allocation from the ERDF is unsatisfactory, similarly 66% as part of water and sewage management, especially that the budgeting period is slowly coming to the end. The highest level of the use of EU resources for water supply and sewage disposal has been in the Podkarpackie Voivodeship, and the lowest in the Podlaskie Voivodeship. The majority of projects as part of the water supply and sewage disposal measure began only in 2016 and 2017. What is important, only 35.1% of these investments had been completed by the end of the 1st quarter of 2019; in the Slaskie Voivodeship, this was at the level of 41.2%.

As a result of accomplished investments in the field of water and sewage management:

- 70 wastewater treatment plants were built and modernized,
- a total of 766 km of sewage network was built and modernized,
- 90 km of water supply network was built and rebuilt,

which resulted in a significant improvement in the level of water purity in voivodships where such investment projects were implemented.

It is necessary to perform all measures diligently in order to take full advantage of the available EU resources allocated for each of the 16 ROPs that are a clear element of financial leverage for communes. Furthermore, one needs to remember that the next EU budgeting period may not be so beneficial for Poland as the 2014–2020 one and that the natural environment demands constant care, especially as far as the growing needs of inhabitants of the regions are concerned.

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