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ANALYSING AND EVALUATING MUNICIPAL AND ENVIRONMENTAL EXPENDITURE IN POLAND'S VOIVODSHIPS USING SPATIAL AUTOCORRELATION

Abstract: *Ecological and spatial development combines the formation of spatial order with the development of environmental assets. The purpose of the article is to present how to use a measure of spatial autocorrelation to determine the degree of polarization of the relationship between environmental spending, municipal management, and environmental activities at the level of provinces in Poland. The study, based on literature analysis, descriptive statistics, synthetic measure, and Moran's I statistic for Statistics Poland data from 2010-2012 and 2020-2022, showed no statistically significant relationship between the studied expenditures and environmental activities, with a slightly increasing trend. Spatial analysis in selected provinces (including opolskim, małopolskim, wielkopolskim) indicated a negative spatial autocorrelation, suggesting the formation of clusters of provinces with similar indicator values. The results provide information for local and national authorities about interprovincial variation and the effectiveness of existing policies.*

Keywords: *pro-environmental spending, environment, province, synthetic measure, spatial autocorrelation*

1. Introduction

Economic progress and the deteriorating state of the environment are prompting economic players, governments, and the public to seek innovative solutions and more intensive protection of nature. Pro-environmental activities, by affecting the threatened environment, contribute to more efficient and responsible management of increasingly scarce resources, including energy. This is necessary because in a significantly damaged environment, self-regulatory mechanisms fail and many natural resources do not renew themselves. Such measures are necessary because in a highly degraded environment, self-regulatory mechanisms cease to function, and many natural resources do not recover at all. Therefore, it becomes crucial to prevent further pollution of the environment (Pasic & Lavic, 2024).

More and more countries are betting on sustainable development for this reason, even though climate change, the collapse of many ecosystems, and other problems are profoundly affecting and hindering this concept. It is easy to understand the reasons for this decision. Sustainable development can be defined as an attempt to combine two goals economic development while protecting and preserving the ecological system. Fiedor (2002) emphasizes that economic development (sustainable development) should be compatible with the

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ecological system. Sustainable development from this perspective is necessary for any economic growth to be possible in the future. This is because if mankind runs out of natural resources, particularly energy sources, or even environmental assets, this will completely block any future economic development. This is why caring for the quality of the environment, where the basic components of this quality are energy sources, natural resources, and environmental values, has ceased to be a noble choice and has become an economic necessity.

Maintaining access to energy sources involves what is known as carbon neutrality, i.e., achieving zero carbon emissions, i.e., offsetting all carbon emissions. According to Hao et al. (2024), the concept of carbon neutrality requires regions (cities) to implement greener and more efficient energy use and reduce greenhouse gas emissions by reducing fossil fuel consumption. This can not only slow down the rate of climate change but also contribute to improving the air quality in the regions (cities) and the living environment of the inhabitants.

Environmental quality plays an important role in economic development not only at a national level but also at a regional level: it supports and stimulates it. As Napiórkowska-Baryła et al. (2017) point out, the environment is one of the basic conditions for a region's competitiveness, including its ecological advantage. As the environment is currently used very intensively, its protection for future generations should be an objective not only of national policy but also of regional policy.

When considering the environmental determinants of regional development, attention should be paid to the concept of independent regional development. According to this concept, each region has different environmental resources and development problems, and therefore each region, especially peripheral regions with underdeveloped infrastructure, should seek its own ways of development rather than waiting for support or ideas from large metropolitan areas or the government. The concept of autonomous regional development responds to the development problems of peripheral regions. It also takes account of environmental issues in the regional development process. The development problems of regions (including peripheral regions) include underdeveloped infrastructure (including green infrastructure), human capital skills, and the interconnectedness of local economic networks.

The specification of the concept of independent regional development, as Herodowicz (2018) points out, is the theory of endogenous potential utilization, which assumes the effective use of development factors inherent in the space of the (peripheral) region. The natural environment, treated as one of the factors of the endogenous potential of a region, can be the basis for setting an alternative development path.

Since each region should recognize its ecological advantages and limitations and seek the best development paths, whatever solutions are chosen, they should have one thing in common: the best possible ratio of ecological effects (ecological activities) to inputs (i.e., expenditure on environmental protection and municipal management). On the other hand, regions close to metropolises benefit from the proximity of large economic centers and find it much easier to achieve economic development (but often at the expense of the environment), while peripheral regions find it easier to keep the environment in good condition (usually at the expense of economic development). Thus, there may be some polarization and local similarities between regions. This research concept became the aim of this study.

The main aim of the article is to present how to use a measure of spatial autocorrelation to determine the degree of polarization of the relationship between spending on environmental protection, municipal management and environmental activities in

Poland (at the level of provinces). Keeping in mind the purpose of the research, in order to better understand the regional aspects of expenditures on municipal economy and environmental protection and environmental activities, as well as regional differences in the studied aspect, the authors posed the research questions: how do expenditures on environmental protection and municipal economy affect the spatial variation of the environment? What elements influence environmental activity? What are the factors that most influence the relationship between spending on municipal management and environmental activities?

On this basis, the research hypothesis was formulated, which is: higher expenditures of the provincial administration on municipal management and environmental protection improve the ecological aspect of the region and the relationship between public administration, society and the environment.

To verify the presented research hypothesis, to achieve the research objective, the authors used literature analysis, descriptive statistics, synthetic measure (according to the CRITIC-TOPSIS method) and analysis of spatial autocorrelation measure (Moran's I).Empirical data were obtained at the level of provinces in Poland.Diagnostic variables were selected due to their substantive usefulness, statistical analysis and research experience of the authors, as well as the availability of secondary data (at the level of provinces), obtained from the Central Statistical Office for the years 2010-2012 and 2020-2022.

2. Literature review

The uneven nature of economic development and its tendency to concentrate in specific geographic centers underlie the phenomenon of spatial polarization. The intensity of this phenomenon in a given region is proportional to the accumulation of population, production, services and environmental potential. Moreover, a region's ability to take advantage of polarizing impulses is linked to its level of urbanization and the configuration of its economy and space.

The green economy is an activity aimed at environmentally friendly structural changes in the economy. It is a practical implementation of the concept of sustainable and balanced development.The green economy, as Hedorowicz (2018) points out, shapes economic growth while enabling the region to achieve climate and environmental goals.Green development, as P. Liu, F. Zhong, N. Han (2024) point out, aims to promote the coexistence of people and nature and provide maximum socioeconomic benefits at the least cost to resources and the environment in terms of spatial structure. Sustainable development combines meeting today's needs with concern for the possibilities of future generations, striving for high ecological, economic, and social standards within the limits of nature's possibilities through environmental protection, equitable economic growth, and social development. Its implementation generally involves three main areas: environmental protection and rational management of natural resources, economic growth and equitable distribution of its benefits, and social development.

In practical action, as Poskrobko and Poskrobko (2012) point out, sustainable development means a holistic, systemic view of economic, social and natural phenomena.It allows the selection of development priorities using a set of economic, ecological and social criteria (Kasztelan, 2022) and treating the environment as an organic, systemic whole and striving to preserve the capacity of ecosystems for sustainable development.

Ecological and spatial development is associated with respect for the values of the natural environment and the appropriate creation of spatial order.Development of this sphere is achieved through: reducing pollution, respecting and restoring the natural resources of the natural environment, installing equipment to prevent pollution

emissions, using environmentally friendly technologies. The aspect of the growth of local development through eco-investments at the present time is very important, building a sustainable structural advantage over others. Burzyńska (2011) points out that the creation of better living conditions by ecological ventures creates a friendly and favorable climate for the development of a territory. Environmental investments have the nature of public goods, which are characterized by a lack of competitiveness in consumption and high costs of exclusion from consumption.

In 2019, the European Commission has published the European Green Deal to address social, climate and environmental challenges, loss of biodiversity.Its main goal is to achieve climate neutrality in Europe by 2050, i.e. zero net greenhouse gas emissions, and improve the well-being and health of citizens and future generations.It proposes actions in the aspects of climate, energy, transport, environment, agriculture and industrial policy. Wang and Naveed (2024) point out that environmental pollution is a negative externality of production activities that requires government intervention through measures such as spending, taxes or subsidies.It is important to measure the amount and availability of green space (environmental resources) in terms of the process of sustainable development. Yushan Jin, Yuanshuo Xu, Weidong Liu (2023) emphasize that few studies combine the assessment of the ecological environment with the efficiency of socio-economic activities when evaluating the spatial development of regions (cities), which undermines spatial sustainability. Most often, the two areas under study are analyzed and evaluated separately.

Environmental security includes, first and foremost, the balance between man and the earth.The basis of this form of activity, as Górska-Rożej (2013) points out, should always be man and his welfare.It depends on many spheres, including but not limited to the ecological sphere, which affects the functioning, development and quality of human life.Ecological security means such a state of social relations and ways of organizing interregional relations that not only reduce or eliminate ecological threats. Promoting positive actions, such as assessing and managing environmental risks through prevention and adequate financing, is key. Environmental security is based on the principle of sustainable development and the primacy of environmental protection requirements. Also important are the links between the environment, infrastructure, and ecology, referred to as green infrastructure.

Guillén Tamayo et al. (2024) define green infrastructure as a planned and organized network of natural and semi-natural areas containing ecological components.It is characterized by multifunctionality that provides specific benefits, i.e., protection of land and species using policy and strategic approaches, contributing to improved levels of health and a better quality of life for residents, supporting environmental security activities.

According to the theory of public finance and externalities, environmental pollution has obvious negative externalities, lead to misallocation of resources and low social efficiency.Fiscal spending, which is an important environmental management measure for local governments, will directly or indirectly affect the environmental quality of their area. Fiscal spending can indirectly affect environmental pollution through energy consumption in the provision of public goods and services. As Fan et al. (2022) point out, local governments should take more responsibility for environmental management and improve the efficiency of environmental spending. Environmental protection spending should be appropriately positioned according to the situation of local pollution emissions, and an effective management mechanism should be implemented according to local conditions.

It is also important to point out ecological risk, which refers to changes in the composition and structure of ecosystems

caused by natural environmental changes or human activities, which in turn threaten the safety and health of ecosystems.Under the pressure of human activities such as urbanization and industrialization, riverine ecosystems exhibit distinct vulnerabilities.This is especially true in developing countries due to the rapid pace of economic development, high population density and relative scarcity of land resources.The emphasis on economic rather than ecological benefits, as well as ad hoc land-use planning (or lack thereof) has led to serious damage to many ecosystems. As Lu (2023) points, ecological risk assessment has shifted to the spatial distribution of ecological risks and the associated impact on ecosystem services. For this process to work properly, the following actions must be taken: prevention (prevention and protection), preparation - prediction and early warning systems, crisis response, recovery.

The administration's actions in terms of preserving the high values of the environment require a consistent and coherent environmental protection policy (both at the national, provincial, county and municipal levels). Undertakings undertaken result primarily from the Act of April 27, 2001. Environmental Protection Law (Journal of Laws of 2016, item 672.) and the Act of June 5, 1998 on provincial self-government (Journal of Laws of 2024, item 566).Environmental protection matters at the regional level are handled by the provincial governor and the provincial marshal, and include, among others, climate and air quality protection, water and sewage management and waste management and prevention, natural resources.

In light of the research results presented and the research questions posed in the introduction, the authors formulated the main research hypothesis of the article.It reads as follows:higher spending of the provincial administration on municipal management and environmental protection improves the ecological aspect of the region and the relationship between public administration, society and the environment, which in turn has a positive impact on the quality of the environment.Such an extended hypothesis takes into account not only the relationship between public administration and society, but also the direct impact of expenditure on the specific quality of environmental elements.

3. Research methods

In the process of creating a synthetic measure based on the TOPSIS method, the following procedural steps can be distinguished:

1) Selection of diagnostic variables and the subject of the study (Table 1). The selection was based on the inverse correlation matrix (diagonal value =10), coefficient of variation (cut-off value =0.10) and the availability of data in Statistic Poland (Wysocki & Lira, 2003).
2) The values of the diagnostic variables were normalized based on the zero unitization method. The normalized characteristic takes values in the range [0,1] (Sompolska-Rzechuła, 2020; Kukuła, 2000).
3) Establish a system of weights for variables using statistical procedures - according to the CRITIC method, according to the formula:

$$w_j = \frac{C_j}{\sum_{k=1}^{K} C_k}, j = 1,2,\ldots,K, \quad (1)$$

$$C_j = S_{j(Z)} \sum_{k=1}\left(1 - r_{jk}\right), j = 1,2,\ldots K, \quad (2)$$

$$\mathrm{Z}^{*}{}_{\mathrm{ij}} = Z_{ij} * w_j \quad (3)$$

C_j denotes the information capacity measure of the i-th variable, $S_{j(Z)}$ is the standard deviation calculated from the normalized values of the i-th variable, r_{jk} correlation coefficient between trait jta and kta (Yin, Wang, Wang, Wang, Chang, 2023).

4) The determination of the value of the synthetic measure on the basis of the TOPSIS method for the individual objects and areas under study was

determined based on the formula (Kozera, Dworakowska-Raj, Standar, 2021):

$$q_i = \frac{d_i^-}{d_i^- + d_i^+}, i = 1, 2, \ldots, n; \quad (4)$$

$q_i \in [0; 1]$; d_i^- - means the distance of the object from the anti-pattern (from 0), d_i^+ denotes the distance of the object from the pattern (from 1).

5) Inference, linear ordering, evaluation of spatial relationships according to the value of the synthetic trait. Maps of spatial variation of the studied objects, graphs - histogram, Persona linear correlation were made in Statistica program. Analyses of spatial autocorrelation and Moran's correlation in PQStat program. Determination of the 4th class using the mean ($\overline{\boldsymbol{x}}$) standard deviation ($\boldsymbol{S_d}$).

Table 1. Diagnostic variables in the field of expenditures on municipal management and environmental protection and pro-environmental element of local government (at the level of voivodeships)

No	variables	Units	S/D
	environmental expenditures		
X1	Expenses for utilities	pln/inhabitant	s
X2	Expenses for urban and rural cleaning	pln/inhabitant	s
X3	Expenses on maintenance of greenery in cities and municipalities	pln/inhabitant	s
X4	Expenditures on lighting of streets, squares and roads	pln/inhabitant	s
X5	Expenditures on protection of atmospheric air and climate	pln/inhabitant	s
X6	Expenditures on sewage management and water protection	pln/inhabitant	s
X7	Expenditures on municipal waste management	pln/inhabitant	s
	pro-environmental activities (natural environment, ecology)		
X8	Forests	%	s
X9	Total dust emissions	t/r / 1 km2 areas	d
X10	Total waste generated per year	tys t / inhabitant	d
X11	Total legally protected areas	%	s
X12	ecological lands	ha / 100 ha	s
X13	water consumption	m3 / inhabitant	d
X14	Industrial and municipal wastewater treated as % of wastewater requiring treatment	%	s
X15	Mixed waste collected during the year total	kg / inhabitant	d
X16	wild dumps existing - as of December 31	szt /100 km2 areas	d
X17	wild landfills - liquidated - during the year	szt / 100 km2 areas	s
X18	Share of renewable energy in total electricity generation	%	s

S-stimulant, D-destimulant;
Source: own elaboration based on Bank of Local Data, Statistics Poland

Spatial autocorrelation determines the presence of systematic spatial variation or other spatial pattern. Positive autocorrelation means that objects in a region are more similar to neighboring objects, while with negative autocorrelation they are more diverse.Moran's global I statistic can be used to examine spatial correlations (Longley et al., 2006). It is used to determine the degree of correlation, that is, the strength of the relationship between a variable and the location of the spatial units under study.It was determined based on the formula (5) (Upton & Fingleton, 1985):

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} wij(x_i - \overline{x})(x_j - \overline{x})}{\sum_{i=1}^{n}\sum_{j=1}^{n} wij \frac{\sum_{j=1}^{n}(x_i - \overline{x})^2}{n}}, \quad (5)$$

Moran's global I statistic takes a value in the range (-1, 1), with a value of "0" indicating the absence of spatial autocorrelation (Janc, 2006).

Moran's local measure I determines the similarity of a spatial unit to its neighbors and tests the statistical significance of this relationship.It allows to indicate clusters of high or low values of the variable under study and indicates outliers.A positive value of a unit's local Moran statistic means that it is surrounded by units with similar values of the trait in question, a negative value means that it is surrounded by units with different values of the trait in question.The local form of Moran's I coefficient for observation i is determined according to the formula (6) (Anselin & Bera, 1998; Cliff & Ord, 1973):

$$I_i = \frac{(x_i - \overline{x}) \sum_{j=1}^{n} wij\,(x_j - \overline{x})}{\frac{\sum_{j=1}^{n} (x_i - \overline{x})^2}{n}} \quad (6)$$

where:

n – the number of spatial objects,

x_i, x_j – are the values of the variable for the compared objects,

$\overline{x}$ – is the average value of the variable for all objects,

w_{ij} – elements of the spatial weight matrix (weight matrix standardized by rows to one),

$$w_{ij} = \begin{cases} 1, \text{when unity ita is a neighbor of its unit} \\ 0, \text{when unity ita is not a neighbor of its unit} \\ 0, \text{when i} = \text{diagonal elements of the matrix} \end{cases} \quad (7)$$

4. Results

The synthetic measure of spending on municipal management and environmental protection of provinces in Poland ranged from 0.27 (świętokrzyskie) to 0.64 (śląskie) 2010-2012 and from 0.15 (warmińsko-mazurskie) to 0.65 (dolnośląskie) in 2020-2022. In the aspect they had pro-environmental measures from 0.41 (śląskie) to 0.66 (warmińsko-mazurskie) in 2010-2012 and from 0.40 (łódzkie) to 0.68 (warmińsko-mazurskie) in 2020-2022. The variation of values in terms of synthetic measures is presented in Figure 1.

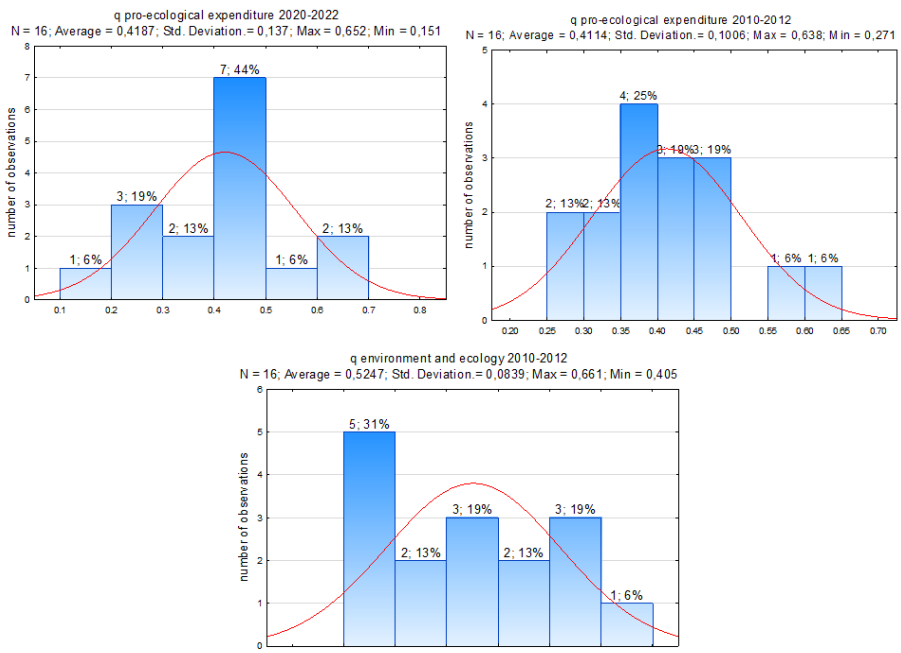

Figure 1. Distribution of synthetic measure of pro-environmental expenditures and environmental activities in 2010-2012 and 2020-2022

Source: own study based on Statistics Poland

The relationship between pro-environmental spending and the status of environmental activities varies at the provincial level, as indicated by Pearson's linear correlation coefficient. This is due to the fact that these activities are related to biogas generation, fertilizer consumption, waste recycling, water and energy conservation. These are areas for action by residents, businesses, public administration. We should also keep in mind that air quality in the province is affected by supra-regional pollution from neighboring regions (the same may be true for water quality). The relationship between spending on utilities and environmental protection and the status of environmental activities were weak and not statistically significant at the provincial level (-0.309 for 2010-2012; -0.393 for 2020-2022). It can be concluded that there has been an increase in this relationship, despite its still lack of significance, and the occurrence of some regularity between these aspects, as indicated in Table 2.

Table 2. Level of Pearson's linear correlation of the synthetic measure of expenditures on utilities and environmental protection, environment and ecology and the diagnostic variables of their structure

Variables	q pro-environmental expenditures 2020-2022	q pro-environmental expenditures 2010-2012	q environment and ecology 2020-2022	q environment and ecology 2010-2012
q pro-environmental expenditures (municipal management and environmental protection)	1	1	-0.393	-0.309
Public utilities	0.654	0.567	-0.047	-0.032
Cleaning of cities and villages	0.73	0.738	-0.137	-0.243
Maintenance of greenery in cities and municipalities	0.611	0.514	-0.104	0.012
Lighting of streets, squares and roads	0.312	0.352	-0.273	-0.544
Protection of atmospheric air and climate	0.364	0.400	-0.38	-0.3
Sewage management and water protection	0.689	0.340	0.015	-0.099
Municipal waste management	0.531	0.211	-0.475	0.261
q ecology	-0.393	-0.309	1	1
Forests	0.256	0.313	0.503	0.357
Total dust pollution emissions per 1 km2 of area	0.366	0.557	-0.586	-0.506
Total waste generated during the year per 1 inhabitant	0.59	0.786	-0.520	-0.479
% Total legally protected areas	-0.172	-0.527	0.304	0.26
Ecological grounds per 100 ha	-0.124	0.079	0.575	0.599
Water consumption per 1 inhabitant	0.027	-0.245	-0.309	-0.435
Share of treated wastewater in wastewater requiring treatment	-0.414	0.113	0.765	0.467
Total mixed waste collected per year per capita	0.275	0.542	-0.164	-0.158

Existing wild dumps - as of December 31 per 100 km2	0.525	0.502	-0.490	-0.747
Wild dumps - liquidated - during the year per 100 km2	0.608	0.383	-0.332	-0.338
Share of renewable energy in total electricity generation	-0.549	-0.379	0.805	0.73
Population using wastewater treatment plants as % of total population	0.276	0.441	0.131	0.257

0.05 level of significance
Source: own study based on Statistics Poland

The values of spatial autocorrelation for the measure of ecological spending of 2010-2012 were negative, for the measure of ecological activities - positive. Both measures were statistically insignificant (except for 2020-2022, the measure of ecological status), but they are not at a high level. This may mean that, except for 2010-2012, provinces are more similar to their neighbors than their random distribution would suggest, while with negative autocorrelation they are more diverse. The increase in the value of the global spatial autocorrelation index for the study areas from -0.006 to 0.078 and from 0.209 to 0.308 during the period under review means that there has been a slight improvement in spatial dependence (Table 3). This indicates a positive trend occurring in this sphere. There is a tendency toward concentration in the area of the variable under study in the region. It also shows the interaction between the values of the variable under study in different locations and the varying level of the phenomenon in remote units relative to neighboring ones.

Table 3. Moran's I global autocorrelation statistics

Specification	q pro-environmental expenditures 2020-2022	q pro-environmental expenditures 2010-2012	q environment and ecology 2020-2022	q environment and ecology 2010-2012
Moran's I	0.078	-0.006	0.308	0.209
Expected I	-0.067	-0.067	-0.067	-0.067
Value p	0.331	0.684	0.012	0.064

0.05 level of significance
Source: own study based on Statistics Poland

From the data in Table 4, it can be seen that during the period under study, Moran's local statistic is non-significant, positive as well as negative, depending on the analyzed sphere. Positive, which clearly dominates, indicates provinces surrounded by regions with similar levels of the synthetic measure (see Figure 2).

Table 4. I Moran's local autocorrelation statistics

3	q pro-environmental expenditures 2020-2022	p	q pro-environmental expenditures 2010-2012	p	q environment and ecology 2020-2022	p	q environment and ecology 2010-2012	p
opolskie	-0.668	0.161	-0.539	0.263	0.658	0.094	0.929	0.023
świętokrzyskie	-0.015	0.872	-0.406	0.285	0.449	0.110	0.282	0.282
kujawsko-pomorskie	0.434	0.173	0.531	0.100	0.012	0.832	0.164	0.536
mazowieckie	-0.002	0.839	0.400	0.142	-0.103	0.912	-0.297	0.478

pomorskie	-0.451	0.370	0.149	0.609	0.875	0.030	0.571	0.144
śląskie	0.100	0.697	-0.704	0.131	1.127	0.006	0.862	0.033
warmińsko-mazurskie	0.787	0.046	0.429	0.240	0.635	0.105	0.935	0.022
zachodniopomorskie	0.064	0.800	-0.072	0.992	0.258	0.534	-0.088	0.968
dolnośląskie	-0.725	0.201	-0.298	0.648	-0.017	0.925	0.311	0.472
wielkopolskie	-0.104	0.895	-0.110	0.878	-0.002	0.819	-0.102	0.901
łódzkie	-0.029	0.908	-0.131	0.838	0.974	0.001	0.320	0.233
podlaskie	0.790	0.096	0.002	0.892	0.146	0.682	0.160	0.666
małopolskie	0.642	0.169	0.058	0.805	-0.047	0.969	-0.125	0.911
lubuskie	0.214	0.586	0.416	0.339	-0.146	0.878	-0.493	0.417
podkarpackie	0.060	0.805	0.145	0.675	-0.172	0.840	-0.294	0.665
lubelskie	0.073	0.744	0.035	0.810	-0.027	0.928	-0.005	0.888

Significance level 0.05; p – value

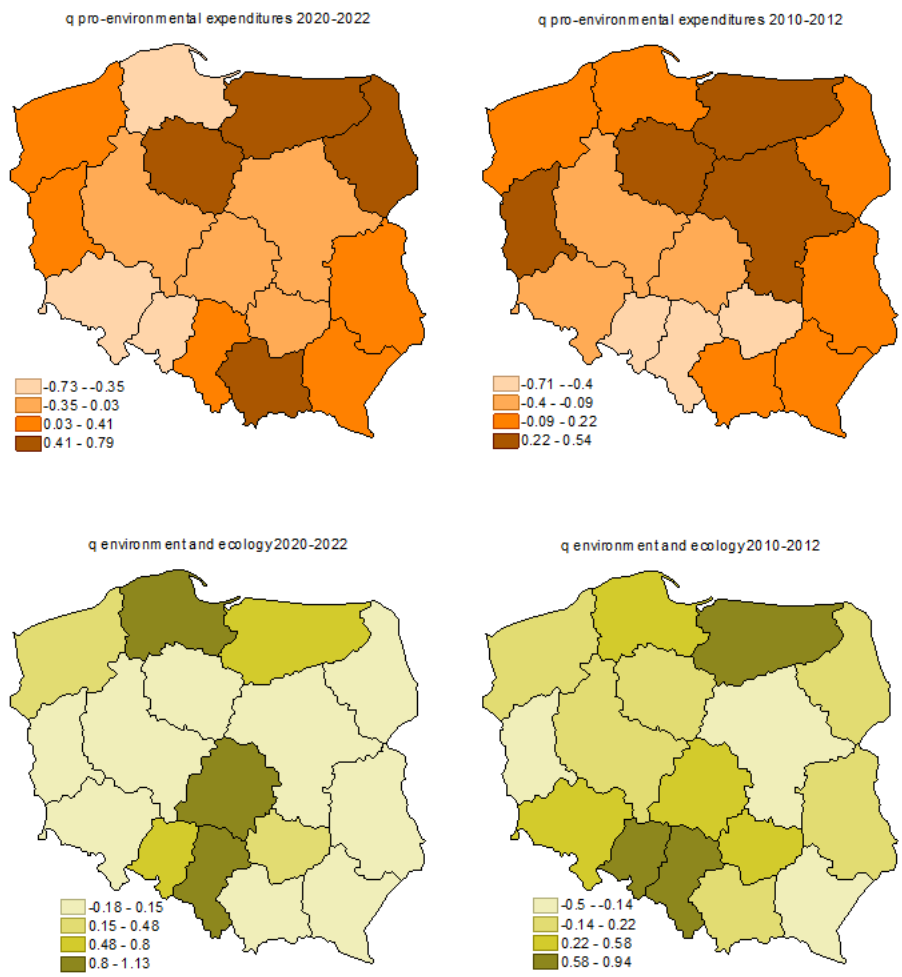

Figure 2. Spatial variation of the synthetic measure according to I Moran's local autocorrelation

Source: own study based on Statistics Poland

There was a decreasing trend (decrease in differentiation), as well as an increasing trend (increase in similarities) in both analyzed aspects. In most situations, provinces were adjacent to others with varying levels of pro-environmental spending. In the case of the state of ecology, on the other hand, there was an increasingly pronounced concentration of provinces with similar values of the synthetic measure. This may be due to the state of the environment, natural natural conditions, the advancement of urbanization processes and industrial development of the regions and its structure.

5. Discussion

Environmental degradation has adverse effects on human well-being and sustainable development. Depletion of natural resources (soil, water and air), as indicated by Canghong et al. (2024) leads to environmental degradation, causing adverse effects on the environment. The growing number of people is causing damage to the ecosystem and creating the prospect of an unsustainable future. Encouraging investment in projects that improve the environment and reduce carbon emissions emphasizes support for green finance. They support both sustainable development and ecological integrity by promoting the financing of green initiatives by both public and private entities.

Higher levels of environmental performance are correlated with public spending in the environmental sector, underscore the complementarity between the sharing economy and investment in the ecological environment. Bingcheng (2024) points out that the administration's main task is to reasonably plan the scale of environmental spending and determine the proportion of spending in different regions and industries.Environmental spending can improve the national performance of the environment, social, and governance relationship from three perspectives: environmental performance, social performance, and social governance.

Resources of raw materials are limited, and at all stages of their use, they should be managed to maximize recycling and reuse. Maintaining economic growth that respects the needs of the environment requires a wide range of information regarding, for example, the amount of natural resources available, the effects of economic activity in the depletion of natural resources and deterioration of the quality of the environment, the expenditures involved in environmental protection (including the prevention or repair of harmful effects appearing as a result of a degraded environment). Górska-Rożej (2013) reports that an increasing awareness related to environmental protection can be observed in Poland.It translates into the volume of investment expenditures related to environmental protection. The volume of expenditures on fixed assets for environmental protection has an upward trend from year to year.

Environmental needs far exceed available resources.This means that choices have to be made about the allocation and amount of resources. Burzynska (2011) emphasizes that the nature of environmental spending has a positive impact on local development.The realization of these expenditures will directly and indirectly affect local development and improve the living conditions of local residents. Treating environmental protection as an activity aimed at restoring natural balance is the rationale for distinguishing certain investments in the category of ecological investments. The possibilities for local development depend on a number of factors, the most obvious of which is the amount of own financial resources at the disposal of the local government unit.

Environmental protection requires consistent policies, access to information, and environmental education. Degradation should initiate environmental forecasting and planning, including in the financial sphere of administration.

Investments in the sphere of environmental protection are often subsidized from public sources. As Graczyk A. (2016) points out, there is a need to include external costs in solving the problem of distribution of public funds allocated for environmental protection. The problem presented is widespread and does not apply only to one province.

The competitiveness of provinces in the sphere of environmental investment shows significant spatial variation in Poland. Among the reasons for this state of affairs are the different level of economic development of the provinces, the level of industrialization and urbanization of individual provinces, the extent and urgency of the need to finance specific environmental goals, the different level of infrastructure development, the degree of human interference in the environment resulting in its degradation, the varying degree of environmental awareness of society.An important factor, as indicated by Budzeń and Marchewka-Bartkowiak (2022) affecting the level of green spending is foreign sources of funding, which in turn correspond to the climate targets adopted by the European Union, among others.

6. Conclusion

The results of studies conducted at the provincial level in Poland have shown that there is justification for the relationship between municipal management spending and environmental activities at the provincial level, but no significant statistical regularities were found.However, there is a slight increase in these correlations between spending on municipal management and environmental protection and environmental activities.

Analyses of the spatial dependence of the studied phenomena in the provinces (Opolskie, Świętokrzyskie, Mazowieckie, Pomorskie, Dolnośląskie, Małopolskie, Łódzkie - for the measure of pro-environmental expenditures, and Wielkopolskie, Małopolskie, Lubuskie, Podkarpackie, Lubelskie - for the measure of ecology) in Poland indicated a negative value of spatial autocorrelation, i.e. the formation of clusters of territorial units with similar index values for both studied areas.

The most important element of sustainable development is the role of ecological, environmental activities and precological spending, as well as their limitations in the development process.Development and the state of the environment depend on the actions of local governments, the behavior of local residents and the reorganization of industrial entities that are environmentally friendly. Slowing the consumption of natural resources will bring significant benefits in many areas, including social, economic, economic, environmental and political. Therefore, financial resources and active measures are needed at the local government level to improve the management of expenditures on municipal management, environmental protection and ecological activities.

The results obtained are a source of information for local and national authorities on interprovincial variation.This knowledge can be useful for authorities to evaluate the effectiveness of the instruments used so far and the tools of regional or environmental policies implemented.They can be the basis for further research on a wider range of variables, a larger period or other methods using structural models to diagnose the hidden relationships of sub-metrics. A microeconomic approach, i.e. examining these relationships at the municipal level, also seems interesting.

The value of the article is the combined treatment of pro-environmental spending and the state of ecology in Poland (provinces) in 2010-2012 and 2020-2022. This is an important inspiration for conducting and publishing further research aimed at how to increase the effectiveness of implementing sustainable development in the conditions of a specific territorial unit.

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