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The Impact of Environmental Policies on the Sustainable Development of the Southeast Region

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ABSTRACT

The purpose of this research is to assess the implementation of environmental policies in the South-East Region, taking into account the differences between counties that influence development. From a methodological point of view, using the Spearman correlation coefficient, the implementation of environmental policies was assessed through 6 environmental indicators selected and prioritized at the level of the 6 counties, with the use of the Tempo online database. The research results fall within the current guidelines of the 8th EAP, which analyzed the performance of environmental policies in the region, in the analyzed period 2006-2020, as well as the proposed measures for environmental management in the following period.

1. Introduction

The environmental policy promoted by the European Union takes into account several components: economic-financial analysis, waste management analysis, greenhouse gas emissions analysis, energy efficiency analysis, and biodiversity analysis (Senapati et al., 2020), (Azevedo et al., 2021),(Agovino et al., 2019), (Beaumelle et al., 2023).

The environmental policies in force today across the globe have been achieved through an extensive process of evolution, adoption and adaptation.(Omer, 2008), (Agovino et al., 2019). In the EU, environmental policy integration has been widely accepted as a principle in European policy-making(Camilleri, 2020), (Popescu et al., n.d.). Environmental problems are complex, they involve systemic interdependencies, which often accumulate over long time intervals and large spatial areas (Angel et al., 2021a),(Burns et al., 2018). Each component contributes to the implementation of coherent and efficient policies, so as to lead to the achievement of sustainable development objectives by each Member State of the European Union. We approach this topic of environmental performance at the regional level, as a continuous research that aims to function to give a specific meaning to "development", as well as to give certainty to some actors and institutions (Gommes et al., n.d.), (Schojan et al., 2024).

The main objective of the research is to identify the degree of implementation of environmental policy in Romania, at the national and regional level, for a sustainable economic environment(Mikus et al.,

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n.d.), (Guzal-Dec, 2018). To achieve this objective, a comparative assessment between territorial units is necessary regarding: the application of environmental taxes in Romania; an assessment of waste management; an analysis of energy efficiency; an analysis of greenhouse gas emissions and an analysis of biodiversity. Along with this, the research aims at several objectives, presented below, in the form of O1-O5. The research is current and aligns with EU strategies, the European Green Deal and the Circular Economy Action Plan, as well as with national sustainability strategies in Romania. Starting from sustainable production and consumption in the EU and Romania, the objectives can be structured as follows:

O1. Reducing the consumption of natural resources and reducing pollution along the production and consumption chain.
O2. Promoting the circular economy by increasing recycling and reusing resources to reduce waste.
O3. Developing renewable energy to encourage renewable sources in industry and agriculture.
O4. Increasing energy efficiency, or reducing energy consumption in industry, transport and housing.
At the level of the South East Region, the specific objectives of the research consist of:
Os1. Developing recycling infrastructure by assessing recycling capacity and selective waste collection.
Os2. Stimulating green SMEs, evaluating support for entrepreneurs investing in sustainable production.
Os3. Optimizing water consumption, respectively implementing usage technologies;
Os4. Reducing emissions from transport, developing sustainable transport, including electric and rail.
Os5. Promoting local and seasonal products, reducing non-essential imports and encouraging local consumption.

2. Literature review

Romania has adopted several environmental policies in line with European Union directives, such as the National Environmental Strategy 2013-2020, to conserve natural resources and protect biodiversity. One example is the evaluation of the National Waste Management Program, which aimed to improve recycling infrastructure (Azevedo et al., 2021). The impact on local development includes job creation in the recycling sector and improving the quality of life by reducing pollution (Guzal-Dec, 2018), (Mikus et al., n.d.). Bulgaria has implemented the National Environmental Action Plan (2021-2027), which focuses on reducing carbon emissions and promoting renewable energy. Studies show that environmental policies have led to increased investment in green energy sources, such as solar and wind power. This has not only stimulated the local economy, but has also contributed to attracting European funds(Popescu et al., n.d.), (Omer, 2008), (Burns et al., 2018).

Serbia has adopted the National Sustainable Development Strategy, which includes measures to protect the environment and manage natural resources. Environmental policy evaluations show that air quality protection measures have led to significant improvements in public health, reducing cases of respiratory diseases in urban areas, (Angel et al., 2021b), (Gommes et al., n.d.). . In all these countries, environmental policies have created economic opportunities in emerging sectors, such as the circular economy and eco-tourism. Reducing pollution and improving environmental infrastructure have led to increased quality of life in local communities, which in turn has increased the attractiveness of these areas for investors and tourists.

3. Material and methods

In order to analyze the performance of environmental policies implemented in the South East Region, the Spearman coefficient method was used (Popescu et al., n.d.), (Schojan et al., 2024). This is a statistical method used to compare and classify several territorial units, based on a set of indicators.

The set of indicators proposed to analyze the performance of environmental policies in Romania involves 6 indicators, namely: Volume of water distributed (thousands of cubic meters/year), Population connected to wastewater treatment plants (number of people), Wastewater discharged (thousands of cubic meters/year), Amount of household waste collected per capita (kg/capita/year), Degree of coverage of the population with sanitation services (%), Amount of household waste collected per capita, Investments in environmental protection (thousands of lei), Harvested wood mass (thousands of cubic meters) (Table 1).

Table 1. Average value of environmental indicators in the counties of the South East Region, during the period 2005-2020

	The volume of water distributed (thousands of cubic meters/year)	Population connected to wastewater treatment plants (no. of people)	Degree of coverage of the population with sanitation services (%)	Quantity of household waste collected (per capita)	Wastewater discharged (thousand m3/year)	Harvested wood mass (thousands of cubic meters)
Romania	1287554	8358666	65.5	249.1	2759317	16670
SE Region	294302	1038764	65.7	310	1134691	1247
Braila	158492	116960.4	72.3	166.5	14085	69
Buzau	21615	170161	55.8	228.25	12147	362
Constanta	45054	436209.7	87.9	521.75	999975	62
Galati	40427	176880.7	82.2	294.75	89449	62
Tulcea	20070	28750.47	83.7	248.75	9369	196
Vrancea	8644	109801	71.1	211	9667	496

Source: (Home - Eurostat, n.d.)

According to this method, the place occupied by each territorial unit (in our case the respective county) is established compared to the rest of the territorial units (the other counties), taking into account the 6 Interdependent statistical variables that were presented previously (Table 2). Thus, each statistical variable is assigned a rank according to value (in ascending or descending order): - if the indicator has a positive relationship with performance (e.g. Population coverage; with sanitation services, rank 1 is assigned to the maximum value.

Table 2. Ranking of counties in the South East Region, based on environmental indicators, from 2005-2020

	Population connected to wastewater treatment plants (people)	Wastewater discharged (thousand m3/year)	Quantity of household waste (kg/person/year)	Degree of coverage of the population with sanitation services (%)	Harvested wood mass (thousands of cubic meters)	The volume of water distributed (thousand m^3/year)	Average rank
România	1	1	4	7	8	1	-
SE Region	2	2	2	6	7	2	-
Brăila	6	5	8	4	3	3	4.83
Buzau	5	6	6	8	5	6	6.0
Constanța	3	3	1	1	1	4	2.16
Galați	4	4	3	3	2	5	3.5
Tulcea	8	8	5	2	4	7	5.66
Vrancea	7	7	7	5	6	8	6.66

Source: (TEMPO Online, n.d.)

Calculating the average rank for each county the place of the territorial units (counties) is established based on the arithmetic average of all ranks of the 6 statistical variables.

Spearman's correlation coefficient analysis

The difference between the ranks of each pair of observations (d) and the square of the differences (d^2) is calculated. The Spearman correlation coefficient is calculated as follows:

$$r_s = 1 - \frac{6\sum d^2}{n\,(n^2-1)}$$

r_s = Spearman coefficient
n = number of observations
$\sum d^2$ = sum of squares of differences between ranks

Spearman correlation coefficients can take values between -1 and +1, having the following interpretation:

1 – indicates a perfect positive correlation and a directly proportional relationship, when one indicator increases, the other indicator increases proportionally.

- 1 - indicates a perfect negative correlation and a directly proportional relationship, when one indicator increases, the other indicator decreases proportionally.

0 – indicates that there is no significant linear correlation between the two indicators analyzed.

Table 2.3. Spearman correlation coefficients

	Population connected to wastewater treatment plants (people)	Wastewater discharged (thousand m^3/year)	Quantity of household waste (kg/person/year)	Degree of population coverage with sanitation services (%)	Harvested wood mass (thousands of cubic meters)	The volume of distributed water (thousand m^3 a year)
Population connected to wastewater treatment plants (people)	1	0.98	0.67	-0.31	-0.29	0.83
Wastewater discharged (thousand m^3/year)	0.98	1	0.62	-0.21	-0.24	0.90
Quantity of household waste (kg/person/year)	0.67	0.62	1	0.31	0.22	0.42
Degree of population coverage with sanitation services (%)	-0.31	-0.21	0.31	1	0.79	-0.24
Harvested wood mass (thousands of cubic meters)	-0.29	-0.24	0.22	0.79	1	-0.26
The volume of distributed water (thousand m^3 a year)	0.83	0.9	0.42	-0.24	-0.26	1

Source: (TEMPO Online, n.d.)

4. Results and discussions

From the analysis of Spearman correlations between the 6 analyzed indicators, the following values result:

The correlation between the Population connected to wastewater treatment plants (people) and Wastewater discharged (thousand m3/year) is a positive and strong one of 0.98, which demonstrates that at the regional level, the population connected to wastewater treatment plants also records a decrease in the quantities of wastewater. There is a strong positive correlation between the population connected to wastewater treatment plants and wastewater discharged, because: more people, means more wastewater – An increase in the population connected to wastewater treatment plants means that more households and economic activities discharge their wastewater into centralized systems. The amount of wastewater generated is generally directly proportional to the number of connected inhabitants because each person consumes a certain amount of water daily.

Other additional factors can influence this correlation, such as average water consumption per person, system losses, treatment efficiency level, industrial activities connected to the network, etc.

The correlation between the Population connected to wastewater treatment plants (people) and the quantity of household waste kg/capita/year obtained the value of 0.67 which represents a moderately positive correlation, but it will not be as strong as the one above because several external variables influence household waste. The quantity of household waste may depend on lifestyle, consumption level, and degree of urbanization. For example, in urban areas where the population is concentrated, household waste may be higher compared to rural areas, and this could be correlated with the number of inhabitants connected to the treatment systems. Also, if the population is connected to a centralized wastewater treatment system, this may indicate a better infrastructure, which could also lead to a more efficient management of household waste. However, if the population has high consumption habits, this could increase waste production.

The correlation between the population connected to wastewater treatment plants and the volume of water distributed is positive and strong, at 0.83, because water distribution networks and sewage networks are interconnected in urban and semi-urban areas. So, the more inhabitants are connected to a wastewater treatment system, the greater the volume of water will be required to meet their needs. Thus, population growth is reflected in an increase in the volume of water distributed. Water networks can be designed to handle larger volumes as the population grows. Also, depending on the infrastructure and technology used, there is the possibility that some consumers use more water due to the increase in the standard of living.

The correlation between wastewater discharged and the volume of water distributed is 0.90, a positive and strong one because most of the water distributed ends up being used and discharged as wastewater.

Moreover, higher water consumption means more wastewater. For example, in an urban area well equipped with sewage infrastructure, over 70-90% of the water distributed can end up being discharged as wastewater. There is a system of interdependence because distributed water and wastewater are directly linked to the urban and industrial infrastructure. An increase in the volume of water distributed usually leads to a proportional increase in the amount of wastewater collected and treated. But, some factors can influence the ratio between the two: Some of the distributed water may be lost through leakage, infiltration or evaporation before it reaches the point of being discharged as wastewater; Some water is used without being discharged as wastewater (e.g. irrigation, industrial processes where water is absorbed into the final product or water recycling); Modern technologies (e.g. low-water toilets, water recycling systems) can reduce the amount of water discharged, thus diminishing the correlation.

The counties within the South East Region were divided into 3 clusters based on the average ranks obtained. The counties that record the best performances in implementing environmental policies are the ones that obtain the highest ranks (Fig. 1).

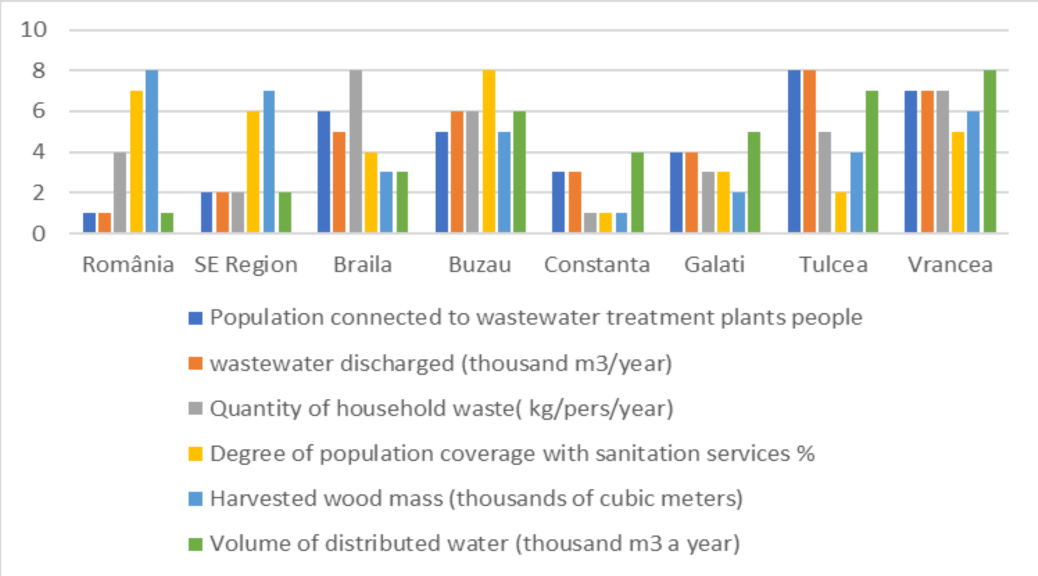

Figure 1. Average ranks obtained by counties in the South East Region during 2006-2020 (points)

Source: (TEMPO Online, n.d.)

Cluster 1 includes 2 counties that obtain the highest average ranks, ranging between 5.66 – 6.66 respectively: Tulcea, Buzău and Vrancea. These obtained high values requiring improvements and revisions of environmental policies and implemented measures.

Cluster 2 includes Brăila county with average ranks, ranging between 4.00 – 5.00, it is in the middle in terms of implementing environmental policies and managing resources. Although Brăila successfully implements environmental policies, it still requires improvements in some areas.

Cluster 3 includes 2 counties that register the best average rank values, ranging between 2.1 – 3.5 respectively: Constanța and Galați, which indicates a good implementation of environmental policies and efficient management of resources. From the analysis of the average ranks, it is found that Constanța ranks first in terms of environmental policies, followed by Galați.

5. Conclusions

The analysis of the implementation of the environmental policy in the South East Region is carried out through a set of indicators belonging to the following components of the environmental policy: Volume of water distributed (thousands of cubic meters/year), Population connected to wastewater treatment plants (number of people), Wastewater discharged (thousands of cubic meters/year), Quantity of household waste collected per capita (kg/capita/year), Degree of coverage of the population with sanitation services (%), Quantity of household waste collected per capita, Investments in environmental protection (thousands of lei), Harvested wood mass (thousands of cubic meters), for the period 2006 - 2020, for each county.

The set of indicators includes effort indicators (Volume of water distributed, Investments in environmental protection, Harvested wood mass) and effect indicators (Population connected to wastewater treatment plants (no. of people), Wastewater discharged (thousands of cubic meters/year), Amount of household waste collected per capita (kg/capita/year), Degree of coverage of the population with sanitation services (%), Amount of household waste collected per capita.).

Through the rank method, the indicators were ranked, resulting in an average rank for each county. The average rank was calculated as the arithmetic mean of the ranks of the 6 analyzed indicators. The distribution of average ranks per county in the South East Region was divided into 3 clusters. From the analysis of the average ranks, it is found that Constanța occupies the first place in terms of the performances obtained by environmental policies, followed by Galați and Brăila. Brăila is part of the cluster that records performances in environmental policy, obtaining the best ranks in the region for harvested wood mass per capita.

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