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DYNAMICS OF SUSTAINABLE DEVELOPMENT AND ITS EFFECTS ON EDUCATION, AGRICULTURE AND ENVIRONMENTAL PROTECTION IN THE SOUTH EAST REGION, ROMANIA

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Abstract

The study aims to analyze the implementation of environmental policies in Romania's Southeast Region, taking into account the variations between counties that impact both the development and application of these policies, each component is evaluated through several environmental indicators at the level of all counties, by using Tempo online database. The analysis is structured around six key indicators, which have been ranked and prioritized. Throughout the research process, several secondary objectives were achieved, and initial hypotheses were formulated, which are later tested and validated in the concluding section of the article. The objective of the research falls within the current guidelines of PAM 8, which aims to analyze the performance of environmental policies in the region. In the analyzed period 2003-2023, the counties of the Southeast Region are ranked, based on the indicators environment, using the Spearman correlation coefficient. The results suggest the environmental performances achieved by each county, as well as the proposed measures for environmental management in the coming period.

Key words**:** *Spearman***,** *organic products, environmental policy, Romania*

INTRODUCTION

The environmental policy promoted by the EU considers several components: economic-financial analysis, waste management analysis, greenhouse gas emissions analysis, energy efficiency analysis, and biodiversity analysis [4], [11], [15].

The environmental policies in force today worldwide have been achieved through a broad process of evolution, adoption and adaptation [1], [2]. In the European Union, the integration of environmental policies has been widely accepted as a principle in the development of European policies [6], [13]. Environmental problems are complex, they involve systemic interdependencies, which often accumulate over long periods and large spatial areas [3], [5].

Each component plays a crucial role in implementing coherent and effective policies aimed at achieving the sustainable development objectives set by each European Union Member State. This study explores environmental performance at the regional level as part of an ongoing research effort, designed to provide a clearer definition of "development" while offering certainty to key stakeholders and institutions. [10], [12].

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 [7], [8]. To achieve this objective, an assessment is necessary by comparing territorial units in terms of: the application of environmental taxes in Romania; assessment of vocational education and training; analysis of sustainability and the environment; economic development of the economy and agriculture through the use of resources. Along with this, the research

targets 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, but also with national strategies in Romania regarding sustainability.

Starting from sustainable production and consumption in the EU and Romania, the objectives can be structured as follows:

O1.Reducing the number of technical high schools with an environmental protection profile through the formation of specialized human resources

O2. Determining the main factors leading to the increase in degraded and unproductive land areas

O3. Analyzing the impact of per capita GDP growth on rural development and the modernization of agricultural infrastructure.

O4. Evaluating how the reduction in natural fertilizer use affects soil quality and agricultural productivity.

O5. Determining the degree of adoption of sustainable agricultural practices and its correlation with the use of natural fertilizers.

For the South East Region, the specific objectives of the research include:

Os1. Developing the infrastructure for education and proposing solutions for their revitalization.

Os2. Stimulating green SMEs, the efficiency of ecological rehabilitation measures and their impact on affected lands[16].

Os3.Analysis of the correlation between the afforestation rate and the reduction of desertification risks;

Os4.Comparing the pace of economic growth in the counties of the Southeast region and identifying the factors that influence these differences[16].

Os5.Evaluating the impact of national and regional policies on economic growth in rural areas.

MATERIALS AND METHODS

To analyze the performance of environmental policies implemented in the South East Region, the Spearman coefficient method was used [9], [14]. This reserves for many statistical units used and classifies more territorially, based on a set of indicators.

The proposed set of indicators for assessingthe performance of environmentalpolicies in Romania over thepasttwodecades (2003-2023) consists of sixkeyindicators, as presented in Table 1.

Table1. Average values of environmental indicators in the counties of the South East Region from 2003 to 2023

	The growthrate of the number of technical high schools with an environmental protection profile (%)	The growth rate of areas with degraded and unproductive lands (%)	The growth rate of GDP/capita (%)	The growth rate of forested areas (%)	The growth rate of areas equipped with irrigation works (%)	The growth rate of quantity in natural agriculture (%)
România	-74.9	2.08	1618	3.8	-0.24	-51
SE Region	-73.3	1.99	1319	2.1	1.11	-57
Braila	-75	1.61	1302	18.2	-0.7	88
Buzau	-80	1.41	1316	1.2	-0.40	-74
Constanta	-62	3.27	1522	4.8	-0.36	-100
Galati	-66	0.8	1016	1.4	6.8	-100
Tulcea	-71	2.81	1595	3.2	4.7	-96

Source: Author's calculations based on Tempo online data [17].

It is about: growth rate of the number of technical high schools with an environmental protection profile, Growth rate of degraded and unproductive areas (%), Growth rate of area (%), Growth rate of growth of %) Growth rate of areas arranged with irrigation works (%), Growth rate of quantities of natural fertilizers in agriculture (%). 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 presented previously.

Thus, each statistical variable is assigned a rank according to its value (in ascending or descending order):

- if the indicator has a positive relationship with performance (e.g. Area occupied by degraded land, rank 1 is assigned to the minimum value).
- if the indicator has a positive relationship with performance (e.g. GDP/capita), rank 1 is assigned to the maximum value.

Table 2. Ranking of counties in the South East Region, based on environmental indicators, from 2003-2023

	Growth rate of the number of technical high schools with an environmental protection profile (%)	Growth rate of areas with degraded and unproductive lands (%)	Growth rate of GDP/capita (%)	Growth rate of forested areas (%)	Growth rate of areas equipped with irrigation works (%)	Growth rate of quantity in natural agriculture (%)
România	5	6	1	3	5	3
SE Region	4	5	4	5	4	4
Braila	6	4	6	1	8	1
Buzau	7	3	5	7	7	5
Constanta	1	8	3	2	6	7
Galati	2	1	8	6	1	8
Tulcea	3	7	2	4	2	6
Vrancea	8	2	7	8	3	2

Source: Author's calculations based on Tempo online data [17].

Calculation of the average rank for each county. The place of the territorial units (counties) is established based on the arithmetic mean of all ranks of the 6 statistical variables (Table 2).

Spearman coefficient analysis

The difference between the ranks of each pair of observations (d) and the square of the differences (d2) is calculated.

The Spearman correlation coefficient is calculated as follows:

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

rs = Spearman's coefficient

n = number of observations

$\sum d^2$ = sum of squares of differences between ranks

Spearman correlation coefficients range from -1 to +1 and are interpreted as follows:

A value of +1 indicates a perfect positive correlation, meaning the two indicators are directly proportional—when one increases, the other increases proportionally.

A value of -1 signifies a perfect negative correlation, meaning the two indicators are inversely proportional—when one increases, the other decreases proportionally.

0 – indicates that there is no significant linear correlation between the two analyzed indicators. The results regarding the values of Spearman's correlation coefficients are presented in Table 3, which we present as follows:

The strongest negative correlation is between the growth rate of degraded lands and GDP/capita ($\rho=-0.88$), which suggests that counties with more degraded lands tend to have a lower GDP per capita. Between the growth rate of technical high schools and Growth rate of quantity in natural agriculture ($\rho=0.79$), there is an inverse relationship between the development of technical schools and the increase in production in natural agriculture. Moderate positive correlations emerged between GDP/capita and the growth rate of divided areas ($\rho=0.48$), which suggests that more administratively divided counties may have a higher GDP per capita. Between the growth rate of technical high schools and the growth rate of divided areas ($\rho=0.43$), it is indicated that counties with more technical high schools tend to be more administratively divided. Weak or almost non-existent relationships are noted between the growth rate of degraded lands and Growth rate of

quantity in natural agriculture (ρ=0.12), which means that degraded lands do not seem to significantly influence production in natural agriculture.

Table 3. Spearman's correlation coefficients

	Growth rate of the number of technical high schools with an environmental protection profile (%)	Growth rate of areas with degraded and unproductive lands (%)	GDP/capita (%)	Growth rate of forested areas (%)	Growth rate of areas equipped with irrigation works (%)	Growth rate of quantity in natural agriculture (%)
Growth rate of the number of technical high schools with an environmental protection profile (%)	1	-0.47	0.26	0.42	0.33	-0.78
Growth rate of areas with degraded and unproductive lands (%)	-0.47	1	-0.88	-0.66	0.23	0.11
GDP/place (%)	0.26	-0.88	1	0.47	-0.16	-0.02
Growth rate of forested areas (%)	0.42	-0.66	0.47	1	-0.47	0.11
Growth rate of areas equipped with irrigation works (%)	0.33	0.23	-0.16	-0.47	1	-0.47
Growth rate of quantity in natural agriculture (%)	-0.78	0.11	-0.02	0.11	-0.47	1

Source: Author's calculations based on Tempo online data [17].

RESULTS AND DISCUSSIONS

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

1.Impact of the decrease in the number of technical high schools with an environmental protection profile:

Negative correlation with the area of degraded and unproductive land (-0.47) → The reduction in technical high schools with an environmental protection profile is associated with an increase in degraded land. This may indicate a decrease in specialists capable of implementing soil conservation solutions.

Negative correlation with the amount of natural fertilizers used (-0.78) → The reduction in the number of high schools may affect farmers' knowledge of organic farming practices, leading to a lower use of natural fertilizers.

Positive correlation with GDP/capita (0.26 → A smaller number of environmental high schools may mean less specialized education, which may affect the economic development of the region.

2. Correlation between degraded land and other indicators: Negative correlation with GDP/capita (-0.88)→ Regions with more degraded land tend to have lower GDP, indicating a negative economic impact of land degradation.

Negative correlation with forest area (-0.66)→ The increase in degraded areas is correlated with a decrease in forested areas, suggesting a lack of ecological rehabilitation measures through afforestation.

3. Correlation between GDP/capita and environmental factors Negative correlation with the area of land developed with irrigation works (-0.16) → A decrease in irrigated areas can harm GDP since irrigation is essential for agricultural productivity. Negative correlation with the amount of natural fertilizers (-0.22) → Decreased use of natural fertilizers can lead to soil degradation, affecting agricultural productivity and, implicitly, regional GDP.

4. Correlation between forested areas and agricultural sustainability

Negative correlation with the area of irrigated land (-0.47) → A conflict between afforestation and the expansion of irrigated areas suggests competition for land.

Negative correlation with degraded land (-0.47)→ Afforestation does not seem to be effective enough to reduce degraded areas.

5. Correlation between irrigated areas and natural fertilization Negative correlation with natural fertilizers (-0.47) → Regions with more irrigation tend to use less natural fertilizers, which could indicate a shift towards intensive agriculture and the use of chemical fertilizers.

By county, the Spearman correlation analysis can be summarized as follows:

In *Brăila County*, GDP/capita (+1302%) is increasing, but the number of environmental technical high schools has decreased (-75%); The forested area has increased significantly (+18.2%), which could have a positive impact on the stability of ecosystems; The area arranged for irrigation has decreased (-0.7%), which may affect agricultural productivity; Natural fertilizers have increased massively (+88%), which could indicate a trend towards more sustainable agriculture.

In *Buzău County*, results over the last 20 years show that GDP/capita has increased (+1316%), but the number of environmental technical high schools has decreased drastically (-80%); The forested area has increased very little (+1.2%), which suggests a lack of investment in this direction; The area arranged for irrigation is decreasing (-0.4%), affecting agricultural probability; Natural fertilizers used have decreased dramatically (-74%).

In *Constanța County*, the results show how GDP/capita (+1522%) has one of the highest increases, at the same time, the Forested Area increases (+4.8%), which shows the efforts for environmental protection. The irrigable area is decreasing (-0.36%), which can influence agricultural production, in the long term. Natural fertilizers have completely decreased (-100%), which suggests an agriculture based only on chemical fertilizers.

In *Galați County*, the results summarize how GDP/capita (+1016%) has the lowest increase among the counties, the Forested Area increases slightly (+1.4%); The irrigable Area Increases considerably (+6.8%), which shows investments in agriculture.

Natural fertilizers are decreasing massively (-100%), which indicates a more intensive agriculture.

In *Tulcea County*, the evolution of indicators shows how GDP/place (+1595%) is almost at the level of Constanța; The forested area has increased (+3.2%); The irrigable area has increased significantly (+4.7%); Natural fertilizers are decreasing (-96%).

The general conclusions for the South-East Region can be summarized as follows: The increase in GDP in all counties indicates a significant economic development;

The reduction in the number of environmental technical high schools (-73% in the SE Region) suggests a decrease in interest in environmental education;

Afforestation is increasing, but with differences between counties (Brăila +18.2% vs. Buzău +1.2%).

The irrigated area varies, with notable increases in Galați (+6.8%) and Tulcea (+4.7%), but decreases in other counties.

The use of natural fertilizers is decreasing sharply in most counties, except Brăila (+88%).

Environmental education is essential – The decrease in the number of technical high schools for environmental protection has negative effects on the sustainable use of natural resources and the economy.

➔ A recommendation here includes investing in vocational training and promoting environmental education.

Land degradation affects the economy of each county – GDP is closely linked to the state of the soils, and the lack of rehabilitation measures can affect rural development.

➔ Recommendation includes an increase in forested areas and the promotion of sustainable agricultural practices.Afforestation and irrigation must be balanced – The expansion of irrigated agricultural areas must not negatively affect afforestation and land protection.

➔ A recommendation would be better-integrated management of agricultural and forest lands.

Natural fertilizers must be promoted – There is a trend towards reducing their use, which may affect soil quality and the sustainability of agriculture.

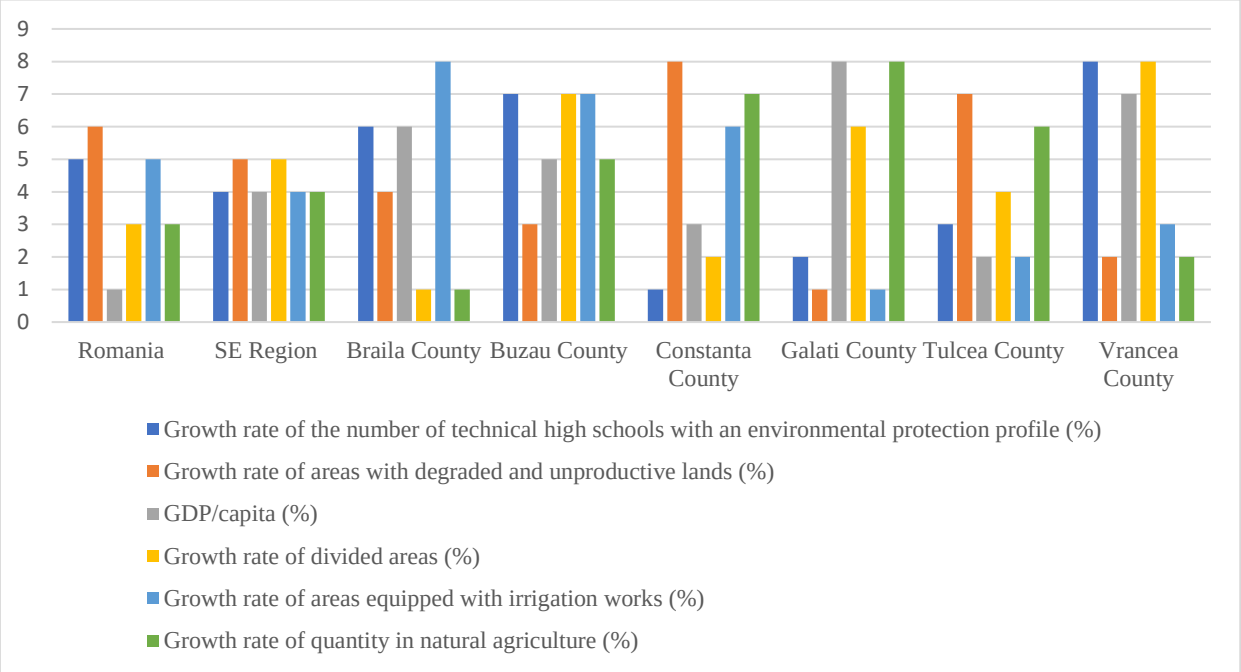

Fig. 1. Average ranks obtained by counties,in the South East Region during the period 2003-2023 (points)
Source: Author's calculations based on Tempo online data [17].

➔Recommendation: Incentives for farmers using organic practices.

CONCLUSIONS

The analysis of the implementation of environmental policy in the South East Region is summarized by county as follows:
Brăila County stands out for its accelerated GDP growth and a large increase in forested areas, but irrigation is in decline. On the other hand, the increase in natural fertilizers shows a possible interest in sustainability.
Buzău County records economic growth, but the lack of support for environmental education and the reduction in the use of natural fertilizers may raise issues regarding long-term sustainability.
Constanța County has a growing GDP and a positive trend in afforestation, but the complete abandonment of natural fertilizers may lead to soil degradation.
Galați County is investing in irrigation, which can help agricultural production, but the lack of natural fertilizers may be a problem in the long term. Over thepast 20 years, Tulcea County has experienced balanced development, marked by GDP growth and increased investments in irrigation. However, the significant decline in natural fertilizer use raises concerns about potential long-term impacts on soil fertility.

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