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Impact of Air Protection Approachesunder the Sustainable Development Strategy on Respiratory Disease Deaths in Romania

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ABSTRACT:*The aim of the research is to determine whether there are causal relationships and to determine the impact that the air protection indicators under objective 11 of the Sustainable Development Strategy can have on the number of deaths from respiratory diseases.Quantitative analyses of the variables under study were carried out, then correlation coefficients were determined, and an econometric model was built.It was found that the covid-19 pandemic of the last two years had a much greater influence on the number of deaths than the indicators studied in SDG 11, which influenced the validity of the model, but it could be determined, with a higher error limit, that investments in air protection and the production of air protection goods and services have a naturally inverse proportional influence on the number of deaths from restorative diseases.*

Keywords*-air protection, impact, respiratory disease deaths,Romania, sustainable development*

I. INTRODUCTION

The universally valid definition of sustainable development is that used in the Brundtland Report: "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" [1].

At the Romanian level there is the Department for Sustainable Development affiliated to the Romanian Government, and within this department there is the "National Strategy for Sustainable Development of Romania 2030" [2] in which it is specified that "Sustainable Development represents, in the Romanian context, the desire to achieve a balance, a synthesis between the aspirations of the citizen born free, the society on which it depends and by which it is defined and the context that allows self-realization.This balance starts from the human being, the central actor who seeks individual balance and favourable conditions to achieve it. Favourable conditions are influenced by society, which must support and motivate him, and by the environment in which he finds himself and can find his balance. The role of the state in the context of sustainable development is to help achieve this balance, not only for the citizens of today, but also for future generations."

The key elements of the unanimously accepted concept of sustainable development, namely that sustainable development must "consider global, European and national economic, social and environmental realities, with a time horizon that looks across generations, meeting "the needs of the present generation without compromising the ability of future generations to meet their own needs."[3], [4].

At the level of the Sustainable Development Strategy, there are seventeen Sustainable Development Goals, each of which is monitored by a set of indicators. Objective 11 "Sustainable cities and communities" aims to ensure the conditions for a dignified life for citizens in urban and rural communities through access to adequate, safe and affordable housing and basic services; access to efficient, affordable and accessible public transport for all; promotion of the smart-city concept; strengthening efforts to protect and safeguard cultural heritage; reducing negative environmental impacts in cities, including by paying special attention to air quality and the environment in general.One of the objectives of the object is "To reduce the effects of air pollution on human health and the environment by giving special attention to air quality".[5].

Taking into account the monitored indicators of the sustainable development goal number 11, and one of the targets, described above, this research was carried out to highlight the impact of air protection measures, within the sustainable development strategy, on deaths from respiratory diseases in Romania.

The literature shows that there are no statistically significant causal relationships between investments and costs for air protection and stationary emissions. An increase in the absolute value of investments in air protection does not lead to a reduction in emissions either each year or at relevant time intervals.[6]. Thus, there is a possibility that in

Romania, too, investment in air protection is not correlated with the production of air protection goods and services or air protection expenditure, but there is a causal relationship with the number of deaths. [7].

II. MATERIAL AND METHOD

In the European Sustainable Development Strategy, the 2030 Agenda, there are several targets to achieve this level of sustainable development.Each objective has several indicators.Under Objective 11 "Sustainable Cities and Communities" these and other indicators that are the subject of this paper are monitored, i.e. the number of deaths from respiratory and cardiovascular diseases, investment in air protection and the production of air protection goods and services.Data on these indicators were taken from national databases, namely the National Institute of Statistics (NIS).

In order to determine the correlations between these variables, and the impact they may have, the first step was the quantitative and qualitative analysis of the dynamics of the variables, then the Pearson correlation coefficient was used to determine the causal relationships between these variables, and finally the regression model was used to determine the regression equation, i.e. how the number of deaths due to respiratory diseases (dependent variable) is influenced by the independent variables: investments for air protection and production of goods and services for air protection.

III. RESULTS AND DISCUSSIONS

This research aims to examine whether measures to combat air pollution influence the number of deaths from respiratory diseases. For this purpose, a quantitative analysis of the main variables to be considered in the model is proposed as a first step.

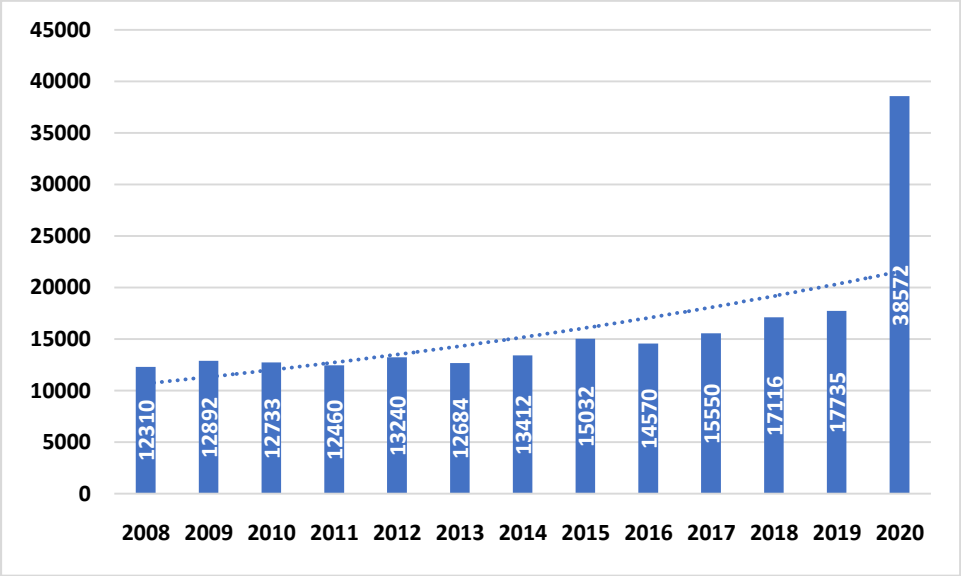

Figure 1. Dynamics of the number of deaths due to respiratory diseases

Source: authors' processing based on NIS data, [8]

As can be seen in Fig. 1, the number of deaths due to respiratory diseases showed an upward trend over the period analysed, with an exponential increase, unfortunately, in the last year analysed, i.e. 2020, when a state of emergency (lockdown) was declared with regard to infection with the Sars-Cov-2 virus, which directly affects the respiratory system, and remedies had not yet been discovered.

It is noted that in the first year the number of deaths reached 12.3 thousand people, and this increased to 17.7 thousand people in 2019, and in the last year, due to the health crisis (covid-19) reached a maximum of 38.5 thousand people. On average, between 2008 and 2019, about 14.1 thousand people died each year from respiratory diseases, and in 2020 the figure was 2.7 times higher. Analysing the growth rate over the whole period, it was about 10% per year, but here the last year analysed, 2008-2019, had a very strong influence, the average annual rate was 3.4%.

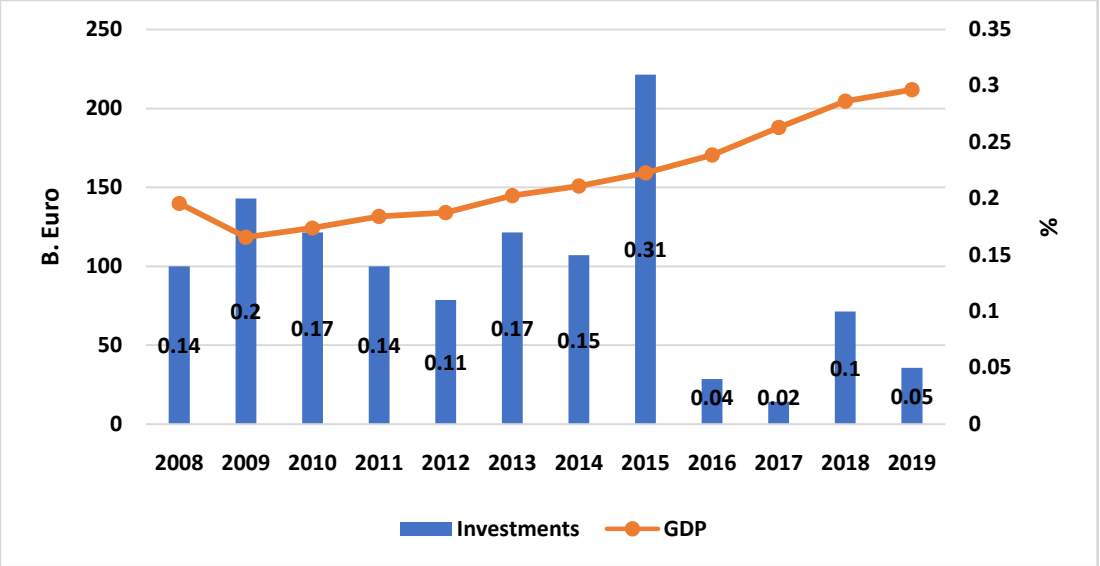

Figure 2. Dynamics of investment in air and climate protection as a percentage of GDP

Source: authors' processing based on NIS data, [8]andNBR [9]

Figure 2 shows the analysis of the dynamics of air protection investments in Romania as a share of GDP in the period 2008-2020. As can be seen, the share of air protection investments varies greatly, ranging from 0.02% of GDP in 2016 to 0.31% in 2015, with the lower and upper limits being very close over time. Also considering the graphical representation of the Gross Domestic Product, which is increasing and in the last period investments are decreasing, it can be considered that the latter show a constant trend in terms of value. These fluctuations are due to the funding programmes that support these air protection investments, depending on the programming period.

On average, the share of investment in air protection was 0.13% of GDP, but there was a deviation of 0.08 percentage points from this figure, resulting in a very high coefficient of variation of 63%, so it is estimated that investment is not homogeneous, showing an oscillating dynamic, which will most likely affect the final goal.

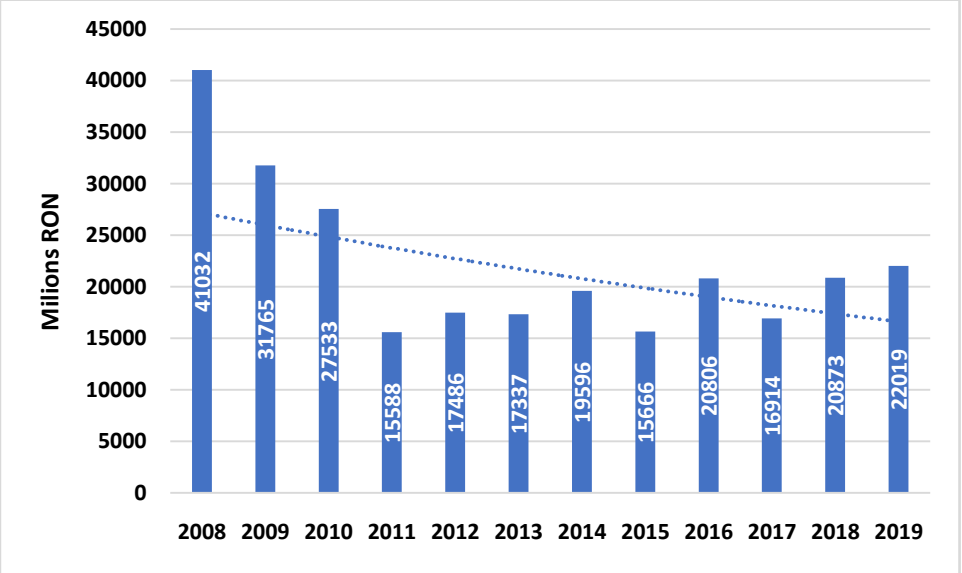

Figure 3. Dynamics of production of environmental goods and services for ambient air and climate protection

Source: authors' processing based on NIS data, [8]

As regards the analysis of the dynamics of the production of environmental goods and services related to air protection, it can be seen from Fig. 3, that the highest value of production was recorded in the first year analyzed, being 41 billion lei (11.1 billion euros), and the lowest value of production of goods and services related to air protection was recorded in 2011, being 15.6 billion lei (3.68 billion euros).

On average, the value of production of goods and services related to air protection amounted to 22 billion lei, as shown in the figure, with a downward trend, the average rate of change being -5.5% per year.

To identify the existence of links between variables, the Pearson correlation coefficient between the indicators analysed was determined, coefficients found in Table 1.

Table 1. Determination of Pearson coefficients between variables

	Deaths - respiratory diseases	*Investment in air and climate protection as a percentage of GDP*	*Production of environmental goods and services for ambient air and climate protection*
Deaths - respiratory diseases	1		
Investment in air and climate protection as a percentage of GDP	-0,39843	1	
Production of environmental goods and services for ambient air and climate protection	-0,30722	0,065581	1

Source: Authors' own research.

As can be seen from Table 1, there are no very close relationships between the variables, none of the correlation coefficients exceed 0.5. However, there are low causal relationships between deaths from respiratory diseases and investments and production of goods and services for air protection.Thus, for both investment and production of goods and services, negative values of the correlation coefficients are recorded in relation to the number of deaths, so that the relationships between variables are inversely proportional, as is natural, when investment and production of air protection goods increase, the number of deaths decreases. These values being between 0.25 and 0.5 (respectively 0.3 and 0.39) it can be considered that the causal relationship exists, but it is weak in intensity.

Looking from another perspective, i.e. whether investments in air protection are correlated with the production of goods and services, it is noted that this is surprisingly not the case, with a correlation coefficient close to zero. This is due to the dynamics of the indicators analysed, with investment not being continuous, fluctuating greatly from one year to the next, and production of goods and services showing a downward trend. These differences have led to a situation where there is no causal effect between these two variables.

Given the first variables analysed, we considered a regression model between the dependent variable, i.e. the number of deaths, and the two independent variables, i.e. air protection investments and the production of air protection goods and services. The run of this model is shown in Table 2.

Table 2. Regression model between the number of deaths and air protection investment and production

Regression Statistics	
Multiple R	0,487958
R Square	0,238103
Adjusted R Square	0,068792
Standard Error	1791,621
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	9028231	4514116	1,406307	0,294126
Residual	9	28889164	3209907		
Total	11	37917395			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	16853,53	1837,891	9,170034	7,32E-06	12695,93	21011,12
Investment in air and climate protection as a percentage of GDP	-8914,65	6841,914	-1,30295	0,224941	-24392,1	6562,831
Production of environmental goods and services for ambient air and climate	-0,06843	0,07068	-0,96819	0,358248	-0,22832	0,091458

protection

Source: Authors' own research.

As can be seen from the econometric model, the correlation coefficient (Multimple R) almost reaches the threshold of 0.5, i.e. 0.488, which means that the variables are correlated with each other, i.e. that the number of deaths is influenced by investments in air protection and in the production of air protection goods and services, and a coefficient of determination value of 0.23 is also observed.

Analyzing the table of coefficients, it can be seen that the level of significance unfortunately exceeds the value of 0.05, i.e. 5%, the maximum allowed in the case of error, thus, it cannot be said that the values of the coefficients are within the 95% probability limit, registering a lower probability, because from the model and from the value of the coefficient of determination, it appears that not only these variables influence the number of deaths, which is known and confirmed by the situation of the last year, when the covid-19 pandemic took hold, almost tripling the number of deaths.

However, it is possible to determine the regression equation, in which the number of deaths from respiratory diseases are influenced by the share of air protection investments and the value of production of air protection goods and services, as follows:

Number of deaths from respiratory diseases = -8914.6 * investment air protection -0.068 * production of goods and services air protection

In other words, an increase in investment by one unit can reduce the number of deaths by 8915 units and an increase in the production of goods and services by one unit can reduce the number of deaths by 0.07 units.

IV. CONCLUSION

In order to determine the influence that sustainable development measures on air protection can have on the number of deaths due to respiratory diseases, the dynamics of the main variables included in the model were analysed, correlations were determined, and the regression equation was determined.

As regards the analysis of the dynamics of the variables, the following was found. The number of deaths due to respiratory diseases shows an upward trend, with an average annual increase of 3.3%, but in the last year analysed, 2020, due to the Covid-19 pandemic, a disease that attacks the respiratory system, and a year in which remedies were not so diversified, there was an exponential increase in the number of deaths, 2.7 times more.Studying the dynamics of investments for air protection, a very oscillating trend was observed, the minimum and maximum reached in the period under analysis being recorded in two consecutive years, the variation of the share of investments for air protection in Gross Domestic Product was around 60%, i.e. an inhomogeneous data series.This is due to poor management of funding programmes in this area. The last variable analysed, in terms of dynamics, was the production of air protection goods and services, which unfortunately showed a downward trend, given that investments are very fluctuating.

A study of the correlation coefficients betw]een these variables shows an inversely proportional and weak relationship between the number of deaths due to respiratory diseases and investment and production of air protection goods and services.Given the high dispersion of investments, they are not correlated with the production of goods and services for environmental protection, so it can be concluded that a solution in this regard would be to determine a plan, a working strategy to maximize the efficiency of investments.

Although the econometric model based on these variables has certain limitations, and the value of the coefficients may have a null value, and even if the results of the model cannot be validated with 95% probability, due to the fact that not only these variables influence the number of deaths, which is well known from the fact that the health situation in the last two years has influenced this indicator much more, it can still be considered that there are certain influences.Thus, if the level of investment in air protection increased by 0.01 percentage points of Gross Domestic Product, then the number of deaths would be reduced by about 90 people, and if the value of production of goods and services for air protection increased by 100 million lei, then the number of deaths from respiratory diseases would be reduced by about 7 people.

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