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STUDY ON THE IMPACT OF CLIMATE CHANGES ON ALIVE'S ORGANISMS

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Abstract: *The paper aims to briefly present the main problems regarding the impact of climate change on living organisms (humans, animals, plants), the measures taken so far to solve these problems and the actions that must be taken into account by the European Union and the states members. They propose increasing the resilience of health and social systems and emphasize the need to ensure adequate surveillance and control of climate change impacts on health, such as epidemiological surveillance, control of communicable diseases and the effects of extreme events. In general, climate change does not cause many new or unknown health risks, but it will intensify certain interactions between the environment and human health, with more drastic effects than at present. Most public health measures and systems already exist, but they need to be adapted to the new situation and new needs.*

Key words: *climate change, living organisms, health*

JEL classification: Q30, Q39, Q54

INTRODUCTION

As early as 1958 the World Health Organization defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1958; Studiu AEM/CCC/OMS). Later the definition was supplemented with the phrase "the ability to lead a socially and economically productive life". This has been contested by some critics, who appreciate that "health cannot be defined as a state, but must be seen as a continuous process of adaptation to the changing demands of life". Health is viewed as the functional and/or metabolic efficiency of a living organism (human, animal, plant), at any moment, both at the cellular and global level, absolutely all varying between optimal and zero (World bank report, 2010). The Lalonde Report suggested in 1974 that there are four determinants of health: "biology", "environment", "lifestyle" and "medical care" (Lalonde, 1974). Health is maintained through scientific research and practice and can be improved through collective and individual effort.

In this paper, we will analyze the impact of climate change on living organisms, respectively on their health and adaptation to new conditions of temperature, precipitation, humidity, etc. Climate change has been defined by the Intergovernmental Panel on Climate Change as: "a statistically significant change in either the mean state of the climate or its variability that persists over a longer period of time (Smit B., Skinner M. W. 2002; Smith P., Olesen J., 2010).

"According to the United Nations Framework Convention on Climate Change, they are "attributed directly or indirectly to human activity that alters the composition of the atmosphere at a global level and that adds to the natural variability of the climate observed during comparable periods" (O. Edenhofer, 2014; Richards M. B., Eva Wollenberg & Detlef van Vuuren 2018).

MATERIAL AND METHOD

According to the specialists Arseni O., Baltag D. and Boilă L.R., cited by Victor DONOS in his work "Documentation as a method of conducting doctoral research" published in July 2020, "documentation is a necessary stage of scientific research, with the aim of knowing the experience scientific in the field under investigation, in related fields and in other fields of knowledge of reality. Documentation is a multilateral process that outlines the means needed to disseminate documents and familiarizes with the subject of future research. In its essence, documentation is a process with a complex content that includes bibliographic documentation, direct documentation and specialist consultation"(Donos V., 2020).

As it appears from these definitions, the role of documentation is to create a starting point in the respective research, to determine what has been studied/discovered up to the time of the research, to identify the problems that remain unresolved or unclear and to try to solve them from the point from the point of view of the one doing the investigation. The basic tool of documentation is bibliographic research, which represents the activity of determining the sources and studying the data contained in books, treatises, monographs, scientific articles or published in specialized magazines on the respective topic, national and international databases. The first research method used in this paper is the "bibliographic research", which aims to study the existing works, articles and materials in the research scope of the paper focusing on the chosen topic.

The second method is the analysis based on statistical data provided by the National Institute of Statistics regarding the average amount of precipitation, multiannual average temperatures, floods and damage caused by them, afforestation, anti-hail systems, GHG reduction, deaths caused by the exacerbation of cardiovascular and pulmonary diseases , but also following the floods in Romania during 2016-2020. Based on them, the statistical indicators were calculated: the arithmetic mean, the standard deviation, the coefficient of variation, the annual growth rate and the linear trend equation. The formulas used to calculate these indicators are the known ones (Anghelache Constantin, Manole Alexandru, 2012 and Necula, R., Stoian, M. and Drăghici, M., 2016).

RESULTS AND DISCUSSIONS

Issues regarding the health of living organisms related to climate change are one of the main concerns of the European Commission. According to impact assessments carried out in a number of European countries, contained in the European Commission's White Paper, as early as 2009, climate change was predicted to influence the epidemiology of many diseases and health conditions (<https://www.eea.europa.eu/themes>). The effects of climate change on health are felt unevenly from one country to another or within the same country, as a result of the physical-geographical characteristics of each region. The state and evolution of nature depend on the capacity to adapt, the measures taken and the actions taken , as well as the accessibility of different categories of the population to these preventive and health care services. Some measures may be effective under current climate conditions, but in the case of accentuated or accelerated climate change, they may need to be strengthened or modified. (<https://bodyandface.ru/ro/senses/zdorove-cheloveka---kriterii-zdorovya-ponyatiezdorovya.vidy.html>).

Climate change affects people's health directly by increasing the number of cardiovascular patients and accentuating symptoms with periods of heat or cold, by changing human behaviors (forced migration), by increasing the transmissibility of diseases due to the decrease in the immunity

of organisms. In EU countries, mortality is estimated to increase by 1–4% for every one degree increase in average annual temperature. This means that heat-related mortality could increase by 30,000 deaths per year by 2030 and by 50,000 – 110,000 deaths per year by 2080 (PESETA Report). According to the same report, infectious diseases due to the multiplication of different pathogens against the background of rising temperatures will be more and more common. (<http://peseta.jrc.ec.europa.eu/docs/Agriculture.html>).

Thus, Europe could see a significant increase in morbidity due to vector-borne diseases, with a potential evolution of 20,000 additional cases per year by 2030 and 25,000 – 40,000 additional cases per year by 2080. Milder winters in certain regions have caused changes in mosquito and tick distribution areas, with the limit of their distribution area moving north and to higher altitudes. The spread of these insects increases people's exposure to Lyme disease (tick-borne) and encephalitis (mosquito-borne). Hot weather causes heat exhaustion and increases the risk of heart attacks. The risk increases if the weather is both hot and humid, which makes people sweat more and dehydrate. Whether it's snow, frost, or heavy rain, capricious, cold, or wet weather can affect people with heart disease to a greater extent than healthy people. For them, cold temperatures can trigger episodes of cardiac ischemia (deprivation of oxygen to the heart muscle), thus causing episodes of angina pectoris or even heart attacks. A rapid decrease in the temperature of the environment can lead to a sudden worsening of symptoms, to an increased risk of hospitalization and even death, say cardiologists, as the body is forced to make certain physiological "adjustments" to keep the body's normal temperature. They can be a real challenge for people with cardiovascular diseases, because the heart rate and blood pressure increase, the heart pumps blood harder and the blood's tendency to clot increases.

Romania's climate has changed a lot compared to 40-50 years ago, heat waves last longer, it snows less and less often, and extreme phenomena are multiplying. 40 years ago there were summer months when temperatures did not exceed +35 degrees, and at Christmas there was often frost and heavy snow. Now there are more and more frost-free days and more and more summer nights with temperatures above +20 degrees. Most cold records stand from 60-70 years ago, while many heat records were broken in the last 10-15 years.

Table no. 1 – Variation of environmental conditions in Romania, in the period 2016-2020

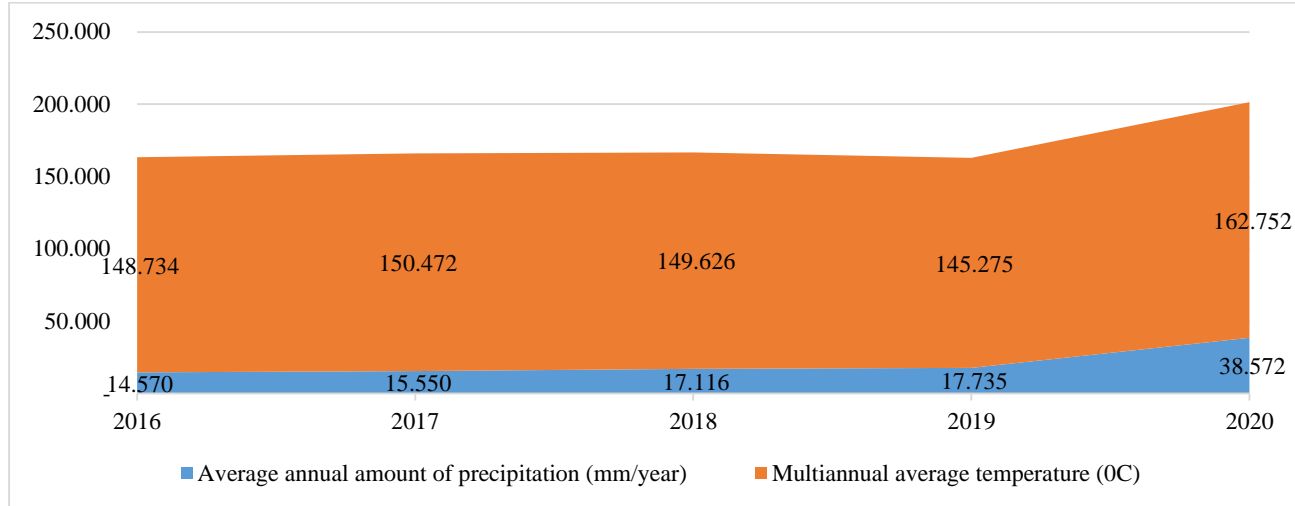
	Min	Max	Average	Deviation	Coefficient of variation	Annual rate
Average annual amount of precipitation (mm/year)	601	700	658.52	39.71545	0.06031	1.071555
Multiannual average temperature (OC)	9.94	11.18	10.598	0.521459	0.049204	-0.66778
Forest area (ha)	6,405,814	6,450,707	6,430,298	19,598	0.003048	0.174746
Forested areas (ha)	8,027	10,736	8,871	1,122.963	0.126591	-6.86736

Source: INS data processing (<http://statistici.insse.ro>)

The 30-year history of weather data for Romania shows us that the average annual precipitation calculated for the entire territory is 637 mm annually, with significantly higher values in the mountainous areas (1,000-1,400 mm/year) and progressively lower towards the east, in Bărăgan being below 500 mm/year, and in Dobrogea and the Danube Delta dropping below 400 mm/year. Average annual temperatures decrease slightly, from the south (10°-11°C) to the north (8.5°-9°C), due to the country's latitude and relief distribution. Also, the temperature decreases with the increase

in altitude, respectively by 6°C for every 1,000m. Average annual maximum temperatures range between 22°C and 24°C in summer and -3°C and -5°C in winter.

During the analyzed period, precipitation varied between 601 mm/year in 2019 and 700 mm/year in 2021, the driest month being January 202 with 8.9 mm/month, and the rainiest June 2018 with 155.5 mm/month, the calculated deviation being 39.71 mm/year. The multiannual temperature average was 10.59°C, falling within the limits recorded by meteorologists. The area occupied by the forest varied between 6,405 thousand ha and 6,449 thousand hectares, the increase of 44 thousand ha being extremely small (0.7%). Regarding the situation of afforestation with seedlings from nurseries, the increase was 3,588 ha (44.70%) (Table no. 1).

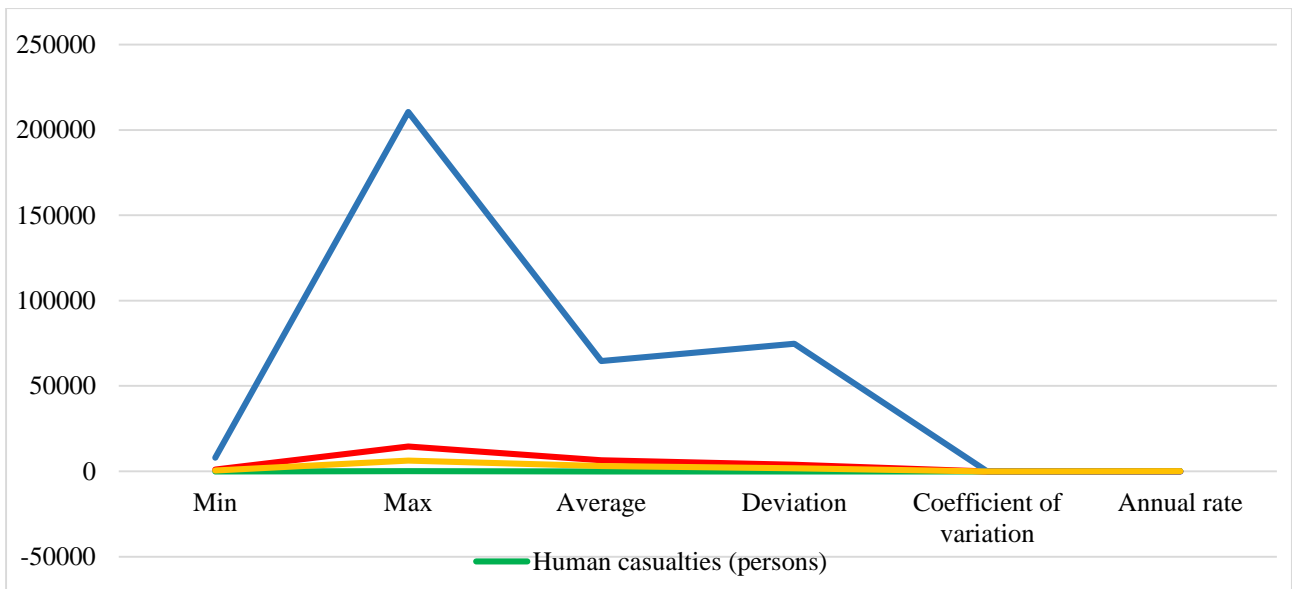


Graph no.1- The main causes of deaths caused by large temperature variations

Source: INS data processing (<http://statistici.insse.ro>)

In Romania, the number of injured and dead due to natural disasters was insignificant - 4 people/year on average during the analyzed period, compared to the number of people who died due to increased cardiovascular and respiratory diseases. Deaths caused by exacerbations of cardiovascular diseases increased at an annual rate of 27.55%, compared to those caused by exacerbations of respiratory diseases, which increased at a rate of 2.28% per year. (Graph no. 1).

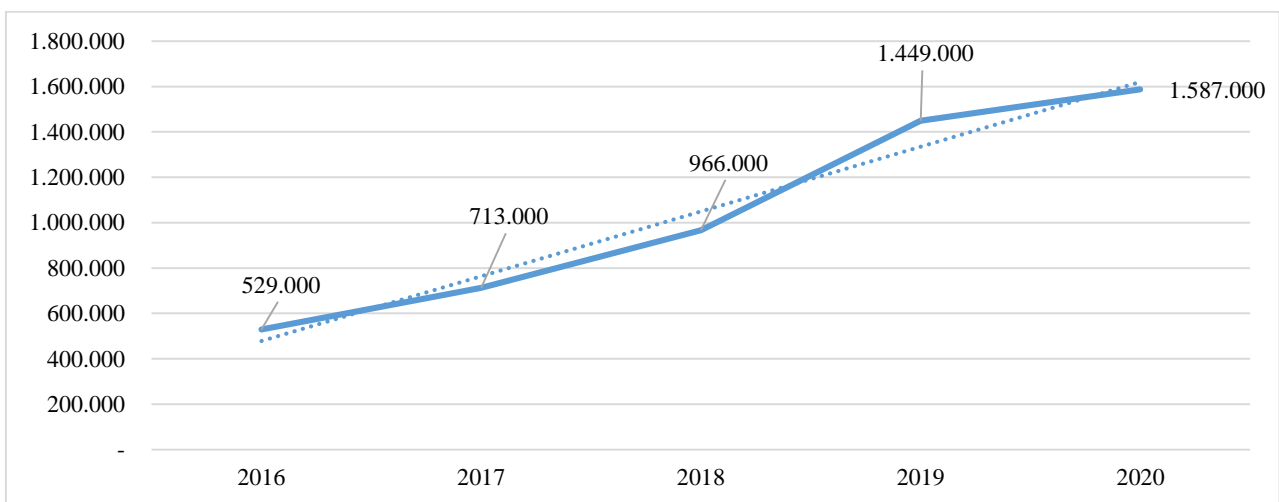
Heavy rainfall has been shown to cause a number of outbreaks of water-borne diseases as a result of the growth of pathogens or water contamination. Drastic reduction in precipitation in dry years and high temperatures seriously affect drinking water catchment systems and lead to insufficient water for daily hygiene essential to health. Climate change causes a number of water-related problems, not only through floods that cause property damage and loss of human life. (Chart no.2).



Graph no.2 - Annual damages caused by floods

Source: INS data processing

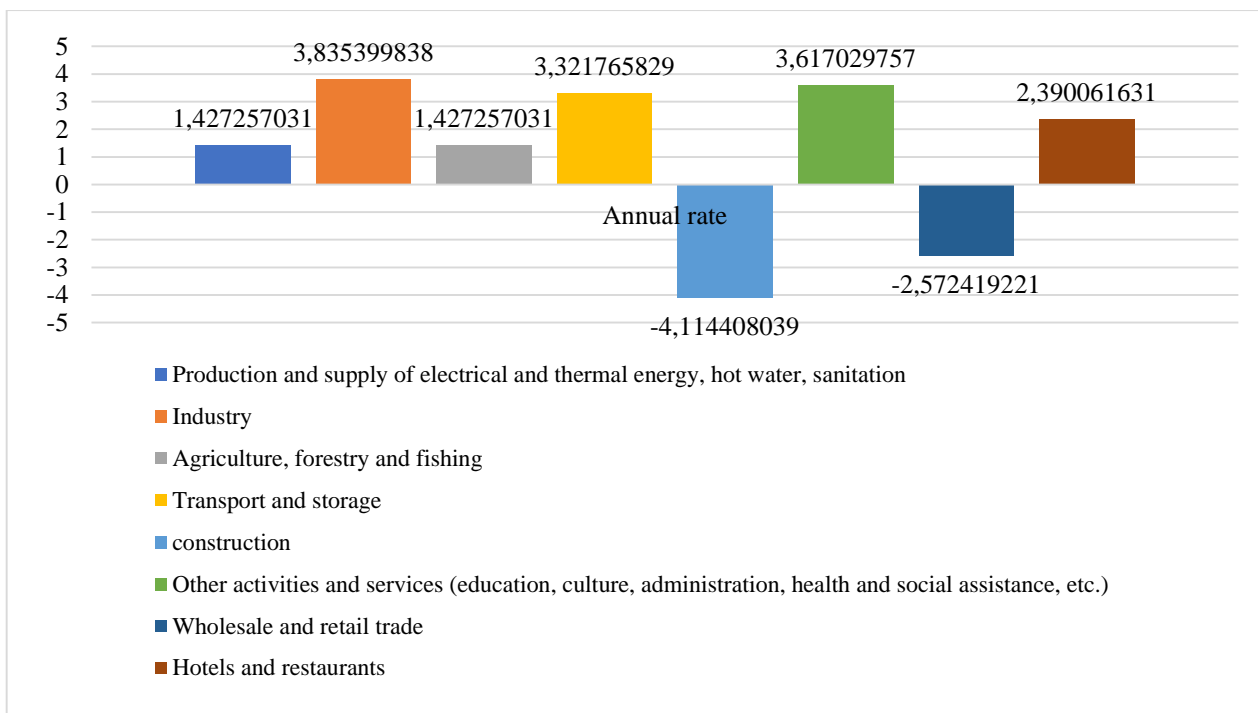
The area protected with anti-hail systems (ha) tripled during the analyzed period 2016-2020 (Graph no. 3).



Graph no. 3 - The surface protected with anti-hail systems (ha)

Source: INS data processing

In recent years, the EU member states have approved and implemented a series of measures to reduce air pollution and GHG, in Europe, the health risks caused by suspended particles and ozone, being significant. In Romania, an analysis of data on greenhouse gas emissions, by economic activity, shows that the main polluter is industry with an annual growth rate of 3.835% per year, followed by other activities and services with 3.61%/year and by transport and storage activities (3.321%/year). As we can see, agriculture had an annual growth rate of 1.427% in terms of GHG pollution. (Chart no.4).

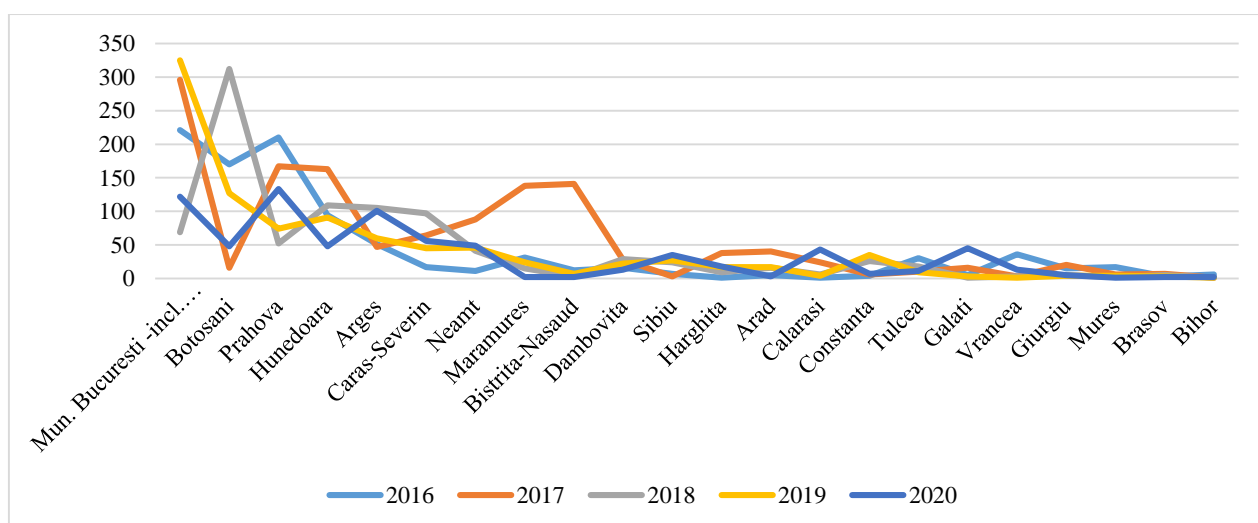


Graph no. 4 – The annual growth rate of greenhouse gas emissions, by economic activities

Source: INS data processing

It is estimated that ozone causes 21,000 premature deaths and more than 100,000,000 days with respiratory symptoms every year in Europe. A WHO study shows that climate variability and climate change have contributed to increased ozone concentrations in central and south-western Europe, and that climate-driven increases in ozone levels could pose an obstacle to current efforts to reduce this one.

At the national level, the budget for emergency situations was on average 3,792.52 million lei, representing 0.71% of the average multi-annual budget expenditure of 444,954.7 million lei, the number of ISU interventions caused by the occurrence of dangerous meteorological phenomena and/or associated being continuously decreasing at national level, from 1,615 in 2017 to 930 in 2020.



Graph no.4 - The number of ISU interventions, caused by the occurrence of dangerous and/or associated meteorological phenomena by county

Source: INS data processing

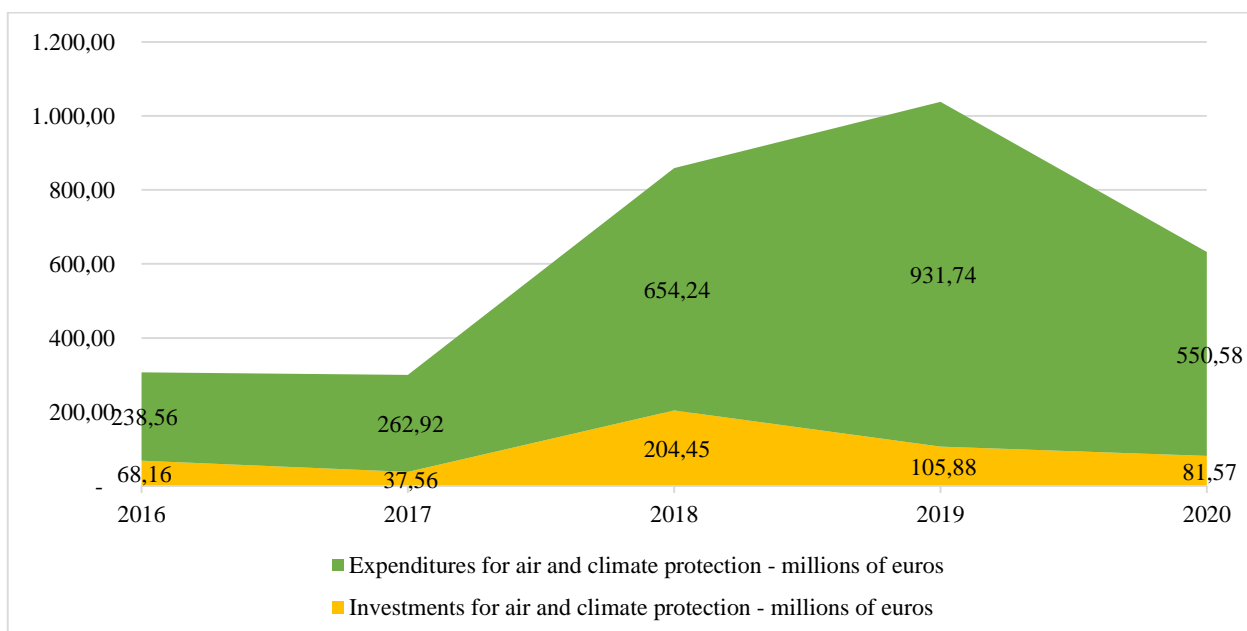
It is appreciated that health systems are vulnerable in relation to extreme climatic events, the demand for medical services increasing in direct proportion to the frequency of their production. This relationship is related to the degree of preparedness and response of the health system to emergency situations.

Table no. 2 – The situation of investments and expenses regarding air and climate protection

	2016	2017	2018	2019	2020
GDP - millions of euros	170,400	187,800	204,450	211,760	203,920
Share of Investments for air and climate protection in GDP	0.04%	0.02%	0.10%	0.05%	0.04%
Share of Expenditures for air and climate protection as a percentage of GDP	0.14%	0.14%	0.32%	0.44%	0.27%

Source: INS data processing

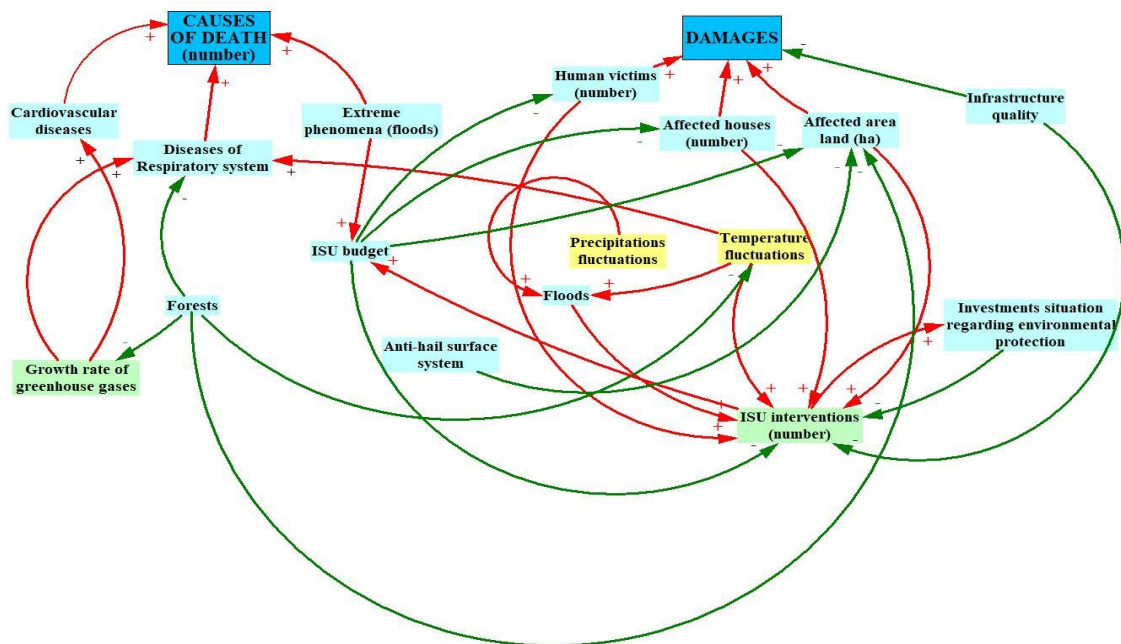
As can be seen from Table no. 2 and Graph no. 5 for air and climate protection, although the amounts increased until 2019, they do not even represent a percentage of Romania's GDP. Putting together all the analyzed elements, I created the cause-effect diagram, using the Vensim program, in which the main interactions at the level of the mentioned and analyzed variables are presented. Thus, the impact that climate change has on living organisms was analyzed by means of quantitative variables, such as: the number of deaths caused by cardiovascular diseases, diseases of the respiratory system or extreme phenomena, the size of the damage caused by climate change (the number of victims human losses, the number of affected homes, the quality of the road infrastructure, the size of the affected land surfaces).



Graph no. 5 – Amounts spent/invested for air and climate protection

Source: INS data processing

On the other hand, the effect variables were analyzed from a statistical point of view, within the present work and were represented by: the growth rate of GHG, afforestation, budget/number of ISU interventions, floods, anti-hail systems area, the level of investments regarding environmental protection, precipitation and temperature fluctuation. It is thus observed that the effect variables can be included in the typology of the measures taken by the state regarding climate change, of the instruments used in order to apply these measures, but they are also included in the typology of specific factors of the external environment, unpredictable, environmental or climatic (temperature , precipitation) (Chart no. 6).



Graph no. 6 - Cause-effect diagram regarding the impact of climate change on living's organisms

Source: own processing

Thus, in the paper it is observed that some variables were characterized by an increasing trend (blue color), and the level of other variables decreased (green color). The variables whose level cannot be precisely quantified are those characterized by an oscillating trend (yellow color). The "+" sign shows a directly proportional influence between the analyzed variables (red arrow color). For example, when the rate of growth of greenhouse gases is increasing, the level of deaths from cardiovascular or respiratory diseases increases. The "-" sign shows an inversely proportional influence between the analyzed variables (color of green arrows). For example, in a situation where the quality of the road infrastructure decreases, the number of ISU interventions increases. Interesting is the situation where, initially, the increase in the level of one value leads to an increase in the other analyzed value: for example, in the situation where the number of ISU interventions increases, this leads to an increase in investments regarding environmental protection. This last increase produces, in turn, a decrease in the number of ISU interventions, implicitly when the ISU budget decreases. Other examples of causal loop diagrams found at the level of figure xx: number of ISU interventions – ISU budget – human casualties – number of ISU interventions; number of ISU interventions - ISU budget - affected houses - number of ISU interventions; ISU budget - number of interventions - ISU budget; the situation of investments regarding environmental protection – number of interventions - the situation of investments regarding environmental protection. In the case of these types of links, it

is necessary for the strategic directions at the level of a state to mitigate the impact of climate change to act bilaterally, taking into account the evolution of the variables of interest, in a dynamic system of their interaction.

CONCLUSIONS

In conclusion, many regions around the world face challenges such as increasing frequency of extreme air temperatures, storms, floods caused by heavy rainfall or drought. Due to climate change, such extreme events will occur more often in the future. This trend will increase the risk of economic damage and life-threatening weather hazards. Climate Prediction provides a simple summary of complex climate change simulations for any location on Earth based on the various emissions scenarios in the IPCC report (2007). This must be realized, and the measures taken by governments must be implemented without any delay.

In general, climate change does not cause many new or unknown health risks, but it will intensify certain interactions between the environment and human health, with more drastic effects than at present. Most public health measures and systems already exist, but they need to be adapted to the new situation and new needs.

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