

RESEARCH ON THE IMPACT OF CLIMATE CHANGE ON THE ENVIRONMENT: A REVIEW

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Abstract

The climate changes in Romania are part of the global context, considering the regional conditions, with an increasing trend of dry summers. The research topic involves an analysis of the evolution of precipitation and periods of drought in recent years in conjunction with their impact on the environment, under the effect of climate change.

The increase in temperature, especially during the vegetation period and the large number of years in which evapotranspiration quantitatively exceeds precipitation, indicate the need for effective measures to regulate the water balance. From the distribution of precipitation in the vegetation periods, it was observed that in the warm period of the year the trend of decrease is greater than in the cold period, which implies a water deficit, now when the plants have the maximum water consumption (Smuleac Laura et al., 2020).

Key words: temperature, soil, precipitation, CO₂, drought.

INTRODUCTION

To date, predictions of European crop yields under climate change have been based almost entirely on the results of crop growth models. Although this strategy can provide good estimates of the effects of climatic factors, soil conditions and management on crop yield, these models usually do not capture all important aspects of crop management or relevant environmental factors.

For many environmental zones, there were signs of deteriorating agroclimatic conditions in terms of increased drought stress and a shortening of the active growing season, which in some regions is becoming increasingly tight between a cold winter and a hot summer. For most areas, there is a strong need for adaptation measures, either to increase soil water availability or to increase crop resistance to drought. The results suggest that there is a risk of an increase in the number of extremely unfavorable years in many climate zones, which could lead to greater inter-annual yield variability and pose a challenge to appropriate crop management (Trnka M. et al., 2011).

After surface water, groundwater is known to be the second largest freshwater storage in the world. Over the years, groundwater has come

under pressure to meet human needs around the world. Meanwhile, the most visible footprint of human activities is the impact of climate change. They have the potential to alter the physical and chemical properties of groundwater, thereby affecting its ecological functions (Phuong, U.D., 2024).

Worldwide, more than half of the population has inadequate access to drinking water for at least one month a year. An estimate shows that by 2050, 57% of the global population will live in regions facing severe water shortages (Boretti A., L. Rosa, 2019). Given that groundwater accounts for ~20% of global water use, holding 70 times more freshwater than surface water (Earman S., M. Dettinger, 2011), declines in both the quantity and quality of groundwater lead to severe pressure on global water resource management.

In arid and semi-arid regions where rainfall is limited, people use groundwater for domestic to industrial purposes. Along with the overexploitation of groundwater, its depletion has hindered economic development and created many difficult situations associated with health, education, and agriculture. As a result, the protection of groundwater becomes a matter of first concern, being even more critical under the influence of climate change.

Through changes in precipitation levels and atmospheric temperature, climate change affects both the quantity and quality of groundwater.

Climate change refers to the long-term alteration of global or regional climate components, which originates mainly from the increased accumulation of greenhouse gases, especially carbon dioxide (CO₂), in the atmosphere.

Climate change can also lead to an increase in rainfall and increase the possibility of flooding. Groundwater is naturally recharged from both diffuse recharge (i.e., rain-fed) and concentrated recharge through infiltration from surface water (Taylor R.G., 2013). Diffuse recharge occurs when precipitation falls on the ground and infiltrates into the water table. Both processes are dependent on precipitation, and therefore its change, either increasing or decreasing, can affect the quantity and quality of groundwater due to the transport of pollutants and the concentration of dissolved substances.

In arid and semi-arid regions, water from infiltration into the earth's crust is a large reservoir of soluble chloride and nitrate not only due to natural conservation over the years but also to long-term intensive agricultural practices (Gurdak J. et al., 2007). More severe torrential storms in these arid regions associated with climate change may encourage downward mobilization of these substances into the water table, making shallow aquifers susceptible to salinization and nitrate contamination (Cui Y. et al., 2020). If rainfall is more intense, there is a greater potential for surface runoff, which removes pesticides and other contaminants horizontally as well as vertically into deeper soil layers (Bloomfield J. et al., 2006).

Current climate simulations suggest that global warming will lead to a greater frequency of extreme hydrological events (floods and droughts). However, these results must be tempered by the fact that these current climate changes do not realistically represent many of the important processes for cloud and precipitation formation.

Warmed by sunlight and atmospheric radiation, water evaporates from the surface of oceans and land, moves with winds in the atmosphere, condenses to form clouds, and falls back to Earth's surface as rain and snow, some from it returning to the oceans via rivers (Rasmussen, R. M. et al., 2007).

Changes in the global and regional rainfall regime are expected to have a significant impact on the availability of water for plants and, implicitly, on the distribution, structure, composition, and diversity of populations (Foley, A., 2010; Vetter, T. et al., 2017; Bhaskaran, B. et al., 2012; Smuleac, Laura et al., 2020).

Some authors believe that decreases or increases in total precipitation because of climate change will affect hydrological cycles and plant growth (Alexander, L.V. et al., 2006). However, due to global climate change, rainfall intensity will increase, while total rainfall will remain unchanged (Asadih, Behzad & Krakauer, Nir., 2015; Beck, F. et al., 2015; Bronaugh, D., 2014; Li, Xin et al., 2018).

Measures aimed at soil conservation must be considered a priority, as soil is widely exposed to global climate change. Considering that billions of people around the world rely on agriculture for their food supply, more investment in research is needed, both in soil conservation and protection, and in optimizing agricultural practices (Walter, L. F. et al., 2023). Different types of land use, especially agriculture and forestry, are responsible for almost a quarter of greenhouse gas emissions. Rising temperatures, prolonged drought and flooding are putting pressure on the soil.

According to some authors, climate change and land use change can negatively influence soil biodiversity. To increase the resilience of soil biodiversity in the context of climate change, soil needs to be well managed for resilient production systems. Agricultural zoning can also be a valuable tool within integrated systems to reduce the effects of climate change. However, it is essential to constantly monitor environmental variations so that producers are better prepared for climate change. Finally, appropriate water management is essential for soil functioning as climate change exacerbates water deficit (Walter L. F. et al., 2023).

Environmental changes are caused by the growth of the world population, the increasing rate of consumption by human society and technological changes. The most important component of global change is climate change due to the evening effect, which will have a major impact on the environment and economic and social activities. Global warming has led to

an increase in the frequency of extreme events, with the rapid alternation between severe heat/drought and heavy rainfall/flooding becoming increasingly evident (Chen F., Chen Y., 2020).

Climate change affects all regions of the world. The ice sheet is melting, and the sea level is rising. In some regions, extreme weather and rainfall are becoming more common, while others are experiencing heat waves and drought (Apel H. et al., 2021; Jurcoane Maria Roana et al., 2023).

The evolution of precipitation in the Banat Plain in Romania was followed for a period of 146 years (1873-2019) and it turned out that the years are not constant, being years with more abundant precipitation, followed by dry years. It was found that in general the rainfall is decreasing, especially in the last 3 years. From the distribution of precipitation in the vegetation periods, it was observed that in the warm period of the year the tendency to decrease is greater than in the cold period, which implies a water deficit, exactly when the plants have the maximum water consumption (Smuleac, Laura et al., 2020).

The Banat hydrographic basin, located in the extreme south-west of Romania, occupies an area of 18393 km², which corresponds to a percentage of approx. 7.7% of the total surface of the country and includes the hydrographic network located between Mureş and Jiu, including the direct tributaries of the Danube between Baziaş and Cerna (http://www.old.anpm.ro/upload/121428_Mem_PPPDEI-).

From an administrative point of view, the Banat Hydrographic Basin is located in the West Development Region and the South-West Development Region, it fully occupies the administrative spaces of Timis and Caras-Severin counties and partially of Arad, Gorj and Mehedinti counties (<https://inundatii.ro/bazinehidrografice/bazinul-hidrografic-banat/>). At the level of the Banat hydrographic basin, the effects due to climate change on freshwater resources have direct negative repercussions on the water circuit. These negative effects are observed by changing the distribution of precipitation, such as the fall area, their amount, as well as their distribution in time (vegetation period, cold period of the year). These changes

in the water cycle in nature, because of climate change, have a stronger impact than global warming (Ziernicka-Wojtaszek, A., Kopcińska, J., 2020; Intergovernmental Panel on Climate Change, 2007; Smuleac, Laura et al., 2020).

The good quality of life, growth, nutrition, and development of all living beings depends directly or indirectly on the natural environment. Urbanization, agriculture, industrial activity, and greenhouse effects are the main causes of climate change worldwide. These climate changes are responsible for increasing carbon dioxide (CO₂) and temperature at the Earth's surface every year. All the components of the environment, i.e. air, water, and soil, are changing mainly due to human activities, especially due to changing lifestyles.

Climate change refers to any disturbance in the climate that can have a negative impact on living organisms, including humans, plants, and animals, which will have negative effects on the environment. With the increase in the earth's population and industrialization, the environment is disturbed daily. Due to carbon dioxide and other dangerous gases emitted by automobiles and industries, the air is continuously poisoned. Businesses release waste directly into the water without treating it properly, making it unsuitable for aquatic life. Plants act as filters that retain all pollutants to make the environment clean (Kabir M., 2023). The processes that take up and those that introduce CO₂ into the air are balanced so that their percentage remains at 0.032% through a carbon cycle equilibrium (Kabir M., 2023; Ramsden, E., 1997) (Figure 1).

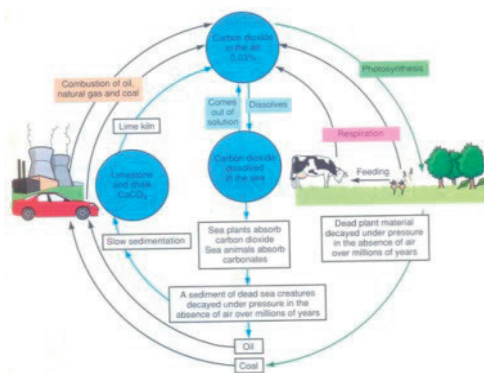


Figure 1. The carbon cycle (Ramsden, E., 1997; Kabir, M., 2023)

CONCLUSIONS

Increasing population without increasing plantations would completely affect the quality of life. Plants are natural purifiers of the environment. Due to the increasing concentration of carbon dioxide and global warming, the temperature of the earth is increasing day by day, which is causing disturbances in the environment.

This climate change is not beneficial, but rather causes damage to an ecosystem. So, human activities change the environment in a negative way.

Climate change is causing problems in many aspects, such as affecting the productivity rate of crops due to reduced rainfall, leading to losses in agriculture, impacting the country's economy. Rising temperatures cause many problems for humans, plants, and animals.

If we do not address rising CO₂ concentration and temperature as a critical issue, the destruction of habitat on the earth's surface will be even worse and the situation will spiral out of control.

In conclusion, climate change can be overcome by reducing greenhouse gas emissions, especially CO₂, through more plantations and by restoring water reservoirs.

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