

CLIMATE CHANGE IN THE REPUBLIC OF MOLDOVA - CAUSES AND THEIR INDUCED CONSEQUENCES

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Abstract

This study presented in the article directly correlates with a series of sustainable objectives regarding the causes of climate change in the Republic of Moldova and their consequences. For more than 100 years, specialists have known the meaning of the phrase "greenhouse effect". This process contributes to maintaining a warm atmosphere, preventing the Earth from cooling and becoming hostile to life (the average global temperature is + 15°C versus - 18°C in the absence of this natural greenhouse effect). Of course, a drastic way in the influence of climate change is effected by burning forests - made to obtain arable land, roads, housing or shopping centers - produces over 25% of global carbon dioxide emissions. The conclusion that can be drawn very easily is that the current heating is not caused by an intensification of the solar activity, but it is in close correlation with the emission of carbon dioxide. In the Republic of Moldova, the inventory of greenhouse gas emissions was carried out during the years 1990-2002, the reference year recommended by the UN being 1990. During this research period, the main place of the total emissions belongs to it CO₂. There is a considerable decrease in greenhouse gas emissions. The cause of the decrease is the closure of emission sources: factories, factories, etc. Comparative assessments with other neighboring territories, using data from the Center for Epidemiological Research of Natural Hazards (Belgium, Luviana University) allow us to ascertain that the risk of catastrophic flooding is 1-2 times in 10 years, which is less than in some regions of Romania, where they have the frequency of 2-3 times in 10 years. Systematic observations on climate indices in the Republic of Moldova, initiated since 1986, have shown gradual warming as a consequence of global warming. Climate change that has occurred over the years in the Republic of Moldova seems to have significant impacts on biodiversity, starting with the level of individual law and up to the level of ecosystem or biometrics.

Key words: *consequences of climate change, ecosystems, greenhouse gas emissions, vulnerability agriculture.*

INTRODUCTION

Climate is the multiannual regime of the weather or all the possible successive changes of the atmospheric processes that characterize the regime of the weather of a certain region.

In any specific locality, the weather can change very quickly from day to day and from year to year, even when the climate does not change. These changes involve variations in temperature, precipitation, wind and cloudiness.

Unlike time, the climate is generally affected by slow changes, for example, changes in the surface of the oceans, the land, and the inclination of the Earth's axis and the intensity of solar radiation. (Cazac et al., 2005).

In the second half of the century. XX, ideas about climate change are becoming more frequent, and in the 80^s, scientific evidence appeared regarding the risk of global climate change (Daradur et al., 2007).

For these reasons, a detailed assessment of the effects of climate change on economic, social and environmental aspects is needed now.

The list of human activities that lead to climate change is: electricity and heating: 30.6% - burning fossil fuels to produce electricity and heat is the biggest cause of climate change, according to the World Resources Institute (WRI). Emissions account for almost one-third of total greenhouse gas emissions. Transport: 14.8%. Production and construction: 13.3%. Agriculture: 11.1%. Burning of other fuels: 8.2% of this category includes wood and burned fuels in residential and commercial buildings, but also those used for agriculture; industrial processes: 5.8% - cement and aluminum production are the largest emitters of greenhouse gases; deforestation and land use change: 5.7% - forests prevent carbon emissions, and deforestation dramatically influences climate change; accidental

emissions: 5.3% - emissions associated with energy production are a factor of climate change. Waste: 3.1% - garbage dumps produce methane gas, which contributes to air pollution. The last ten years in the Republic of Moldova (1996-2005) compared to the multiannual period are characterized by a somewhat higher temperature regime. The average annual air temperature during this period averaged 8.7-10.4°C in the territory, which exceeds the norm by 0.5-1.0°C. It is worth mentioning that during these ten years the average annual air temperature reached its highest values during the 100-year period of instrumental observations - 9.7 and -11.5°C (2000). Its lowest values were reported in 1996 and 1997 and were 7.1-9.3°C. The lowest air temperatures (-21 and -30°C) were reported in December 1996, and the highest (37-40°C) - in July-August 2000 and July 2002, isolated exceeding historical maximums (IPCC, 2007; UNFCCC, 2007).

MATERIALS AND METHODS

The research method consisted in the bibliographic analysis of the chemical changes and the statistical analysis of the data. Climate change refers to statistically significant changes in the average state of the climatic parameters or their variability, observed over time, either due to changes occurring within the climate system or to the interactions between

its components, or because of the action of external factors natural or result from human activity. These changes involve variations in temperature, precipitation, wind and cloudiness.

An analysis of the climatic elements of the last century can serve as evidence for the argument of the existence of climate change. Thus, during the last century, at global level, the average terrestrial temperatures increased by 1°C. The rate of global warming has increased from 0.1°C per decade over the past 100 years - to 0.2°C per decade over the past few decades. Compared with the pre-industrial period (average for 1850-1899) the average temperature (on land and in the ocean) over the last century is 0.8°C higher.

In Europe there is a warming higher than the global average 2007 data show that average annual temperatures in Europe were 1.2°C higher than in the pre-industrial era in land areas, and 1°C higher in the combined space of the sea and land. Eight of the 12 years from 1996-2007 were among the hottest years after 1850.

Annual rainfall (Figure 1) in the 20th century showed a 10-40% increase in Northern Europe and a decrease (up to 20%) in some parts of Southern Europe. Average rainfall increased in most of Western and Northern Europe (by 20-40%); and in southern Europe and partly central Europe the winters were drier (Nedealcov, 1998; Taranu et al., 2009).

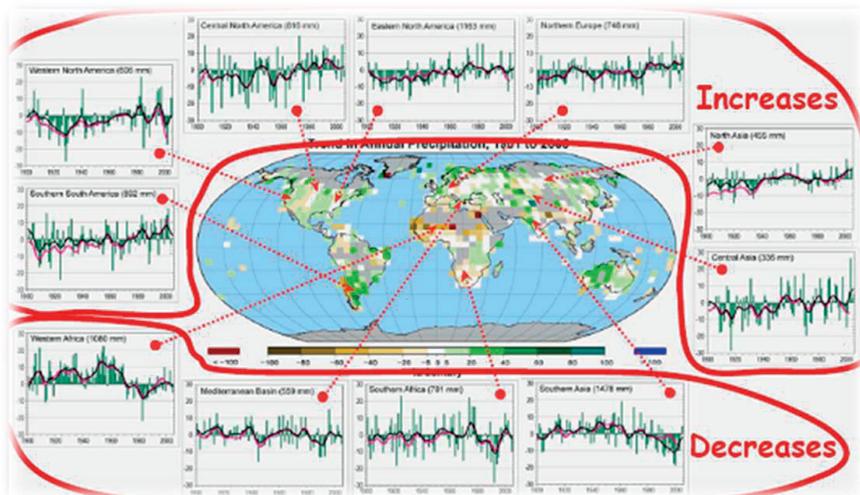


Figure 1. Changing the annual amount of global rainfall in the period 1900-2005

The global lifting of the air temperature was materialized by a series of changes that were observed and measured as: the increase of the global sea level by 0.1-0.2 m in the 20th century, the decrease by about 10% of the snow covered areas, compared to 1960, the retreat of the alpine glaciers from the nonpolar regions during the twentieth century. The warmest 10 years recorded were after 1991. Global evidence from the last decade shows that many natural systems are affected by regional climate change, many of which are also relevant to the Republic of Moldova (Mihăilescu et al., 2006; Nedealcov, 1998).

In the Republic of Moldova - part of Europe - there are also changes in climate. Under its current conditions, the average annual air temperature ranges from 8.0°C in the north (Briceni) to 10.0°C (Cahul, Comrat) in the south. The character of spatial distribution of air temperature is determined by the geographical situation and the extent of the southernmost territory. The analysis of the data, carried out by the specialists of the State Hydrometeorological Service, for a period of more than a century (1886-2004) shows us that since the end of the 19th century and until now the average annual temperature in Moldova has increased by 0.78°C (www.old.meteo.md).

On the territory of the Republic of Moldova the average annual amount of precipitation in the period 1996-2005 constituted on the territory 500-655 mm, which is close to the norm, calculated for the entire observation period. In some years, the amount of rainfall that has fallen has fluctuated to a considerable extent - from 300 mm (2003) to 890 mm (1998).

The most common natural hazards of hydrometeorological origin on the territory of the Republic of Moldova, according to the statistical data of the Center for Epidemiological Research of Natural Hazards (Belgium, Luviana University), are floods, droughts, strong winds, extreme temperatures. In the period 1992-2003, 90% of the total natural hazards in the Republic of Moldova were extreme hydrometeorological phenomena, the most numerous being the floods (50%), during which 92% of the total human victims, strong winds were recorded (25.5%) and droughts (12.5%).

According to the evaluations of the United Nations Development Program, 280 thousand

people suffer from catastrophic drought on average. For comparison, the average numbers for floods and earthquakes are 193 thousand and 19 thousand inhabitants respectively.

RESULTS AND DISCUSSIONS

The heating of the climate system can be seen in several ways. We assist in changing the temperature of the atmosphere, the surface of the oceans (the warming of the oceans descends to hundreds of meters depth) and in increasing their level. Rising temperatures in the troposphere and falling in the stratosphere are most likely caused by greenhouse gases and ozone depletion, respectively.

For more than 100 years, specialists have known the meaning of the phrase "greenhouse effect". Solar radiation passes through the Earth's atmosphere and reaches its surface. Instead of reflecting on the surface of the Earth and returning to space, the radiation stays in the atmosphere and produces a heating of it. The process contributes to maintaining a warm atmosphere, preventing the Earth from cooling down and becoming a hostile environment (the average global temperature is +15°C compared to -18°C in the absence of this natural greenhouse effect).

The current trends of modification of the natural risk factors in the Republic of Moldova, their frequency allows us to assume that the risk of manifestation of hydrometeorological hazards will continue to increase. Since the 1950^s (www.old.meteo.md), the number of destructive phenomena caused by the weather has increased 5.5 times globally, while the number of other extreme natural phenomena has increased only 2.4 times (Figure 2).

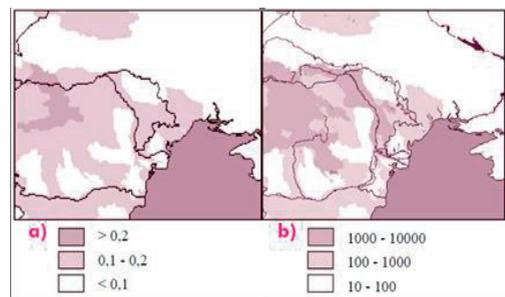


Figure 2. a - Distribution of the flood risk index (no/year); b - number of victims (no/year)

Comparative assessments with other neighboring territories, using data from the Center for Epidemiological Research of Natural Hazards (Belgium, Luviana University) allow us to find out that the risk of catastrophic flooding is 1-2 times in 10 years, which is less than in some regions of Romania, where they have a frequency of 2-3 times in 10 years.

There are obvious effects on aquatic systems, which are manifested by higher water leaks and early spring maximum flow in many rivers fed by snow, as well as surface water heating, which affects their thermal structure and water quality.

It is important to mention some consequences such as (Figure 3): reducing the water supply in the groundwater and lowering the water level in the wells, sometimes even drying them, which causes insufficient drinking water; increased mineralization of groundwater, concentration of inorganic pollutants in water, etc.

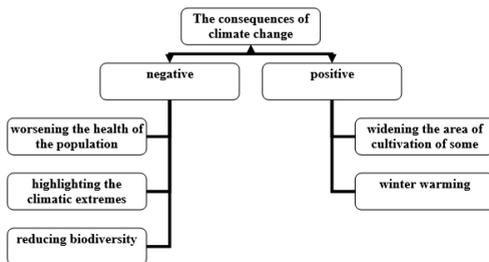


Figure 3. The consequences of climate change in the Republic of Moldova

Climate change of this size appears to have significant impacts on biodiversity, starting with the level of individual law and up to the level of ecosystem or biometrics. It is assumed that the climate in Moldova will change from semi-arid to arid, especially in the south and east of the country. Rising temperatures will force many living organisms to migrate to cooler areas in the northern part of the country, while new organisms will arrive here. Such movements can involve many species, including plants and trees (Mihăilescu et al., 2006; Дарадур, 2001).

Climate change is quite chaotic, with unexpected effects and difficult to anticipate. In Central and Eastern Europe, the scenarios show a decrease in precipitation, especially in the summer season. The water deficit will affect

cereal and grazing crops, with the orientation towards tolerant agricultural crops at high temperatures and hydrological stress being recommended.

However, some species of flora and fauna may have low elasticity when changing temperature and precipitation, because climate systems move faster than they can accept.

Some species will seek to settle at higher altitudes, in the Central part of the country (the forest area Codru), others will move further to the northern part of Moldova. Steppe plants, in general, adjust well to high temperatures, although, due to excessive grazing, the population of some species may shrink and disappear. Fragmentation of the landscape and human activity are all likely to increase the vulnerability to changing climatic conditions of steppe species with limited dispersal capacity, such as snowflakes (Andrieș, 1999; Banaru, 2001).

Droughts reduce the presence of water on the floodplains and intensify soil salinization processes. These developments can have a significant impact on grassland species by extending the surfaces with halophyte plants, well adapted to salt and drought conditions, and by reducing the areas occupied by flood tolerant plants such as. In general, forest ecosystems are more drought resistant; however, some oak species in the central and southern parts of the country may dry out in the event of a massive insect invasion. Floods and droughts or other extreme climatic phenomena (storms, hail, etc.) have an influence on human well-being, as they cause losses in the ecosystems on which human prosperity depends.

Agroecosystems and the livestock sector will suffer greatly from climate change. What is the action of changing the temperature of the environment on animals? Higher organisms have a constant body temperature, characteristic of the given species. For example, raising the temperature of the environment is accompanied by the need for the body to make extra efforts to maintain the constant temperature; breathing becomes more frequent, disturbances of the work of the cardiovascular system, often of the digestive system, as well as in the reproduction of animals. This set of deviations, of course, leads to a decrease in the level of animal productivity (Ursu, 2000).

The vulnerability of agriculture as a whole is based on two main components. First, it is determined by a permanent tendency to limit the spectrum of the species used. Currently, to satisfy 90% of the food requirements, the human uses only 0.5% of the total number of edible plant species. This condition has led to the so-called "genetic vulnerability", because for each climatic zone, the number of cultivated plant species is always decreasing, and the varieties and hybrids used are of a higher degree of kinship. Secondly, the vulnerability of agriculture is determined by the essential and very rapid changes, especially lately, of the environment (Mihăilescu et al., 2006; www.statistica.gov.md.)

In order to minimize the impact of climate change on the various systems and sectors of activity, a system of adaptation measures has been developed. The most important of these measures provide the elaboration and extension of forests, the adaptation of the management of natural resources to the principles of sustainable development of the basic sectors of the economy.

In particular, for the natural ecosystems the adaptation measures are: the extension of the protected areas for the most vulnerable ecosystems to climate change; creation or restoration of interconnected areas (creation of the ecological network) of fragmented and dispersed ecosystems; organizing the monitoring, in order to assess the stability of species and ecosystems according to climate change; directing their evolution vector towards increasing the resistance to these changes; elaboration and implementation of forest restoration and expansion programs; restoration of wetlands.

According to the above-mentioned conception, the environmental protection requirements will be integrated in the economic reform and in the sectoral policies.

In this way, the properties related to waste management, the reduction and capture of harmful emissions, the increase of energy efficiency, the use of renewable energy sources and the broadening of the spectrum of research on climate change would be taken into consideration. All these, in conjunction with other components of environmental policy, will determine a sustainable socio-economic development.

CONCLUSIONS

Soils of the Republic of Moldova are severely degraded and highly vulnerable to climatic conditions. They no longer have the capacity to cope with the drought, even the short one, and at national level, over the years; there is a decrease in agricultural productivity.

In the Republic of Moldova, research shows that in the coming years, climate warming will have a negative impact on autumn wheat. Similarly, maize and sunflower, which represent the main crops in the national agricultural sector, will suffer. However, such research must be carried out continuously, because the frequency of disasters differs, their geography changes and the degree of exposure.

For the natural ecosystems, the degree of vulnerability can also be conditioned by risk factors, such as the reduced surfaces, the degraded state, the fragmentary distribution, the insufficiency of the soil moisture, the unevenness of the distribution of precipitation.

In the conditions of climate change for the problems related to the adaptation of ecosystems to the new climate conditions, a particular current importance is the elaboration of the regional climate forecast.

The changes that take place, both at the climate level and at the level of the ecosystems, endanger the health of millions or even billions of people all over the world and are at this moment the biggest challenge of the 21st century. These changes globally threaten even the fundamentals of human health: access to adequate food resources, clean air, safe water and safe housing. For the Republic of Moldova, the priority areas in this regard are ecosystems, the agricultural sector and human health.

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