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THE CAUSES OF GLOBAL WARMING AND WAYS TO SOLVE THEM

Bahram H. Aliev[1], Akif S. Aghbabali[2], Lalanda N. Faradjeva[1]

[1]Institute of Ecology, Baku, Azerbaijan

[2]Baku State University, Baku, Azerbaijan

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Abstract

The article notes the seriousness of the problem of global warming not only for the environment, but also for the economy, health and safety of people. The causes and consequences of the climate crisis are considered. It is noted that in order to solve the existing problem, it is extremely necessary to predict anthropogenic and natural factors that affect climate variability. And also, using the example of the development of the desertification process based on certain formulas, it is shown that in order to maintain environmental safety, it is extremely necessary to model all processes of natural phenomena.

Keywords: climate change, global warming, COP29, carbon dioxide, ozone, nitrogen, greenhouse effect, modeling, atmosphere, emissions, natural factors, anthropogenic factors.

*Corresponding author. Tel.: +994-55-668-85-08

E-mail address: aghbabali@bsu.edu.az; *ORCID ID:* 0000-0001-5793-9252

Introduction

Global climate change, accompanied by global warming, is tormenting our planet with increasing intensity. The planet is currently warming faster than at any time in human history. Rising air temperatures are altering weather patterns over time and upsetting the normal balance of nature. As a result of climate variability, the Earth's entire climate system is changing, and these changes affect the atmosphere, oceans, ice sheets, and the Earth's surface. Consequently, climate change leads to unpredictable consequences in agriculture, forestry, and also affects precipitation, water cycle, permafrost, ocean level, soil properties, etc. As a result, a climate crisis occurs, that is, floods, hurricanes, storms, droughts, desertification. In the ongoing climate catastrophe, scientists around the world adhere to two positions: the first is natural factors, that is, the first position is that global climate changes are a consequence of natural processes; the second position is purely anthropogenic factors, that is, caused by human activity. It has been determined that the main driving force in global warming is an increase in the content of carbon dioxide, methane, ozone, nitrous oxide in the atmosphere, which create the greenhouse effect. It is the greenhouse effect that leads to an increase in the temperature of the planet's surface, due to the accumulation of greenhouse gases in the lower layers of the atmosphere. The increased content of greenhouse gases in the atmosphere is primarily due to human activity, i.e.

anthropogenic factors. Therefore, it depends on us to reduce the effects of human influence on the climate. This is possible by adopting special decisions, holding events, implementing various international protocols, and holding climate conferences.

Recognizing the serious consequences of global warming, the United Nations holds annual climate conferences (COP).

The UN Climate Conference brings together leaders, experts, and activists from many countries to discuss the global challenges of climate change. This annual event, organized under the United Nations Framework Convention on Climate Change (UNFCCC), becomes a platform for developing strategies to reduce greenhouse gas emissions and adapt to the impacts of climate change. These forums are also called "Conferences of the Parties to the United Nations Framework Convention on Climate Change" (UNFCCC COPs).

I believe that holding the COP Conference on Climate Change will allow countries to come together to discuss this problem, to assess current and take new measures and decisions on joint actions to reduce greenhouse gas emissions and adapt to climate change.

International negotiations to combat climate change are part of a long process that began with the founding conference in Rio de Janeiro in 1992.

Therefore, hosting COP29 in Azerbaijan this year provides our country with a unique opportunity to assume the role of a major player in international efforts to combat climate change and create a platform to demonstrate its leadership in this area. At the same time, participation in COP29 provides a number of significant and significant advantages for Azerbaijan.

Preliminary

Climate change is one of the most pressing and discussed topics of our time. Average climate indicators are constantly changing. Global warming of the planet interests many scientists around the globe. At the Intergovernmental Madrid Conference in 1995, the United Nations (UN) declared global warming a scientific fact. Thus, the world learned that global warming is a reality. However, there are many disagreements and different opinions around this issue, but the Intergovernmental Panel on Climate Change believes that an increase in greenhouse gas concentrations will lead to warming of the lower layers of the atmosphere and the earth's surface, i.e. a climate crisis will occur. A climate crisis is a weather disturbance that occurs as a result of global warming, leading to the melting of glaciers, hurricanes, storm surges, floods, etc.

Global warming is damaging the interconnected natural systems of our planet, so drought and desertification are becoming inevitable everywhere from Europe to Africa.

However, it is difficult to say how much greenhouse gases and to what extent cause global warming. The fact is that over the past 100 years, the average annual global temperature has risen by 0.3-0.6°C. I note that in the entire history of observations, the record warming was noted in 2023.

The purpose of this article is to limit the extent of climate change.

Assessing the impact of anthropogenic factor on global warming. Emissions of carbon dioxide into the atmosphere have approached 7 billion tons, far exceeding the amount of carbon released into the atmosphere before the industrial era, but this is only a small fraction of the mass of carbon released into the atmosphere naturally. Carbon dioxide is released into the atmosphere by burning fossil fuels: coal, gas, petroleum products, oxidation of carbon in the soil. Respiration of animals, microorganisms, plants, decomposition of organic residues and other biological processes add up to about 200 billion tons of carbon dioxide per year entering the atmosphere.

Analysis of the impact of anthropogenic factors on climate change

Since 1958, the carbon dioxide content in the atmosphere has increased by 15%, its concentration has increased from 0.03% to 0.035%.

According to scientists, the possible consequences of global warming associated with anthropogenic impact will lead to changes in the weather and an increase in precipitation, melting of glaciers, which in turn will lead to a rise in the level of the World Ocean.

Changes in precipitation have been noted. For example, over the past 50 years, the USA and the former Soviet Union have received 10% more precipitation than in the past, and above the equator, the amount of precipitation has decreased by approximately 10%. Thus, changes in the amount of precipitation will lead to a shift in the zone of cultivation of agricultural crops to the northern regions.

Global climate warming, accompanied by an increase in carbon dioxide in the atmosphere, will lengthen the average day length of the planet, change the distribution of water resources, conditions of biota development, areas with unstable moisture may become dry, while humid areas will be even more saturated with moisture, tropical storms will become more intense. In turn, these processes together with other anthropogenic impacts lead to desertification of the territory.

An increase in average air temperature will lead to the disappearance of perennial ice; with an increase in average temperature by 1°C, the duration of the growing season will increase by 10 days [1, 2]. In tropical and subtropical regions, with climate change, the duration of the warm season will increase, which will entail the growth of late-ripening plant varieties. The impact of warming will primarily damage those areas that are most dependent on climatic conditions. These are the semi-arid subtropical and tropical regions of Africa, South America, and Central America [4]. The change in temperature will affect forestry: forest zones will shift. According to scientists' calculations, the shift of the forest zone may cover several hundred kilometers to the north, especially the boreal forests of the arid semi-arid strip. Reduction of forests will further increase the amount of greenhouse gases, especially CO_2, will also contribute to global warming, will increase soil erosion, there will be a change in biomass, temperature changes will affect plant communities, the corresponding animal populations, that is, some species of plants and animals will disappear. If climatic conditions change, it is possible:

- increase in the recurrence of droughts,
- decrease in grain yields,
- in northern countries grain production may increase,
- agricultural climate boundaries in some parts of the hemisphere could be shifted by even 1°C of warming,
- the boundary of the permafrost zone will shift, which could lead to the release of methane from the previously frozen layer and an increase in typical gases,
- reduction of annual runoff, which will lead to negative consequences in agriculture, water supply, hydropower,
- melting of glaciers, which will raise the level of the World Ocean, will lead to the flooding of large areas,
- as a result of natural disasters, population migration will become more frequent.

According to scientists' forecasts, **taking into account the current level of greenhouse gas concentrations in the atmosphere and the continuation of emissions**, by 2030 we should expect a rise in sea level of up to 30 cm [4], which will lead to changes in the terrain, coastal erosion, and an increase in the height of tides in river mouths and bays, large areas of fertile land will be lost. Most of the effects of climate change will persist for many centuries, even if emissions cease. The increase in atmospheric carbon dioxide concentration and its role in modern global warming has been discussed by the scientific community since the late 19th century, when the Swedish physical chemist Svante

Arrhenius formulated the concept of the "greenhouse effect". According to the scientist I.P. Semiletov, over the past hundreds of thousands of years, the concentration of carbon dioxide (CO_2) and methane (CH_4), the second most important greenhouse gas, have changed in a coordinated manner, and more importantly, in “tact” with the average planetary temperature (correlation coefficient 0.7 - 0.8) [5].

Nowadays, due to human economic activity (burning fossil fuels, deforestation, etc.), approximately 6-7 billion tons of excess atmospheric carbon in the form of CO_2 enter the atmosphere annually. About half of the anthropogenic CO_2 remains in the atmosphere, which is manifested in an increase in the greenhouse effect. The other part of the anthropogenic CO_2 is absorbed by the World Ocean.

Solar radiation is the main source of energy on Earth. According to the biological effect in the spectrum of solar radiation, ultraviolet and infrared parts of the spectrum are distinguished. Ultraviolet rays are short-wave radiation, harmful to all living things, delayed by the ozone layer of the atmosphere. The wavelengths of ultraviolet radiation lie in the range from 10 to 400 nm, only a small part of ultraviolet rays 300-400 mmk reaches the earth's surface. Ultraviolet radiation leads to the formation of mutations (ultraviolet mutagenesis). As is known, the formation of mutations can cause skin cancer, melanoma of the skin and its premature aging.

The long-wave part of the spectrum is infrared rays with a wavelength of more than 750 mmk and is an important source of heat. Unlike short-wave radiation, long-wave radiation is intensively absorbed by the earth's surface and its constituents: ozone, oxygen, carbon dioxide, water vapor, dust, etc. The long-wave radiation is absorbed by the atmosphere.

Thus, the ability of the atmosphere to trap thermal radiation creates a greenhouse or hothouse effect, due to which the earth maintains a thermal regime. Numerous determinations have established that not all solar energy reaches the Earth's surface at all times. Solar radiation is attenuated by 20% as it passes through the atmosphere. Consequently, the earth's surface receives 80% of the solar heat reaching the upper boundary of the atmosphere. Some of the heat falling on the earth is absorbed by it. Depending on the water or land surface of the earth depends on the amount of heat absorbed. The Earth's surface and the atmosphere, having received a certain amount of heat, begin to radiate it.

Methods for solving the problem of climate variability

It is known that over the past 100 years, the content of natural gases in the atmosphere has increased: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), tropospheric ozone (O_3). As a result of human activity, other gases that are not natural components also enter the atmosphere. The mixture of gases absorbs and emits radiation. In particular, greenhouse gases affect the Earth's climate, creating a greenhouse effect. It is known that the greenhouse effect is associated with anthropogenic and natural factors that contribute to the development of the desertification process.

Desertification results in the loss of biological productivity of lands. It is one of the most serious threats to humanity.

To solve this problem, it is extremely necessary to predict all factors (both anthropogenic and natural) that influence the process of desertification development. Therefore, it is necessary to consider the main criteria and their interrelations between anthropogenic and natural factors. To solve the interrelation, it is necessary to give a specifically accurate assessment of the factors influencing the desertification process by modeling.

Statement of the problem:

The desert W unites many areas R_1, characterized by low vegetation density P, the rate of change of the desert area has the following equations [3]:

$$\frac{\mathrm{ds}}{\mathrm{dt}} = \mathrm{N} + \mathrm{A}$$

(1)

here N- natural phenomena,

A – anthropogenic,

W – desert

S_W – desert area

The desert is characterized by the following formula:

$$W=\{R_i \mid \rho < \rho_{min}\} \quad (2)$$

here ρ is the characteristic of the vegetation cover bushiness, *Ri* - is the region.

The problem presented by equation (1) has the following features:

- changes in the area of deserted areas due to natural phenomena are described by differential, algebraic and transcendental equations;
- changes occurring due to anthropogenic activity can be described only in terms of expert assessments, but the assessment of the consequences of anthropogenic activity requires the use of mathematical modeling methods, mentioned above, which is reflected in Figure 1

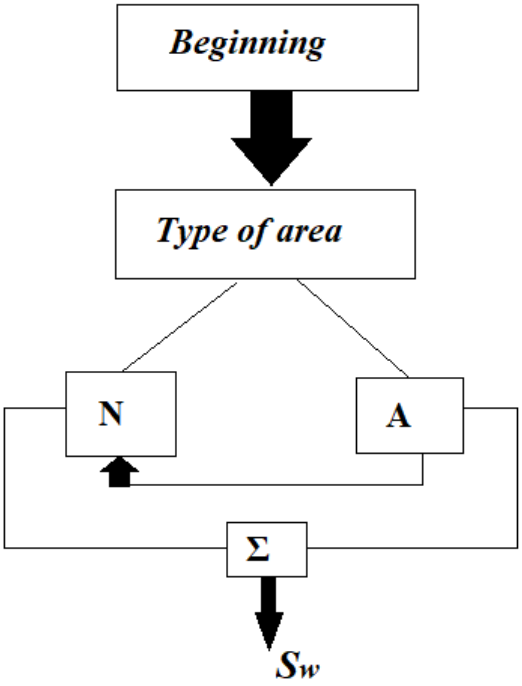

Fig.1. Hybrid task of expert assessments of desertification

To solve the above tasks, it is necessary to analyze the impact of natural conditions on desertification. The area of desert is equal to the sum of areas of plots of land:

$$S_w=\Sigma S_{wi} \div W_i<W \quad (3)$$

Taking into account (3), it is advisable to consider expression (1) in the following form:

$$\frac{dS_w}{dt} = \sum_{w_i<w} N_i + \sum_{w_i<w} A_i \ ,$$

in which the summation in the right-hand sides of the equation is carried out over the desertification areas of the territory under consideration.

Desertification from natural factors is associated:

- with insufficient soil moisture Bg,
- with soil salinization and carbonation Co,
- with insufficient humus G in the soil,
- development of natural soil erosion,
- development of natural soil deflation,
- development of anthropogenic factors, and so on,

It follows that the construction and study of the fundamental dependence is of primary interest:

$$\rho=\xi\beta_g+\zeta G+\upsilon\beta_\alpha+\eta S_g+\lambda C_g+\mu G+\theta\Delta$$

Here $\xi,\zeta,\upsilon,\eta,\mu,\lambda,\theta$ are empirical coefficients that must be determined for the region under consideration,

G - soil erosion;

Δ - soil deflation;

β_α - atmospheric air humidity;

S_g - salinity intensity;

C_g - soil carbonatization intensity

The parameters of the model can be easily identified by the multiple regression method. In this case, the parameters $\xi,\zeta,\upsilon,\eta,\lambda$ form a vector that is estimated by solving a system of normal equations using experimental data on ρ, β_α, G, β, S_g, C_g, d.

This model allows to take into account changes in vegetation cover density, soil fertility and is characterized by the value of P. It can be any of the following listed below and controllable indicators per hectare:

ρ_1 – number of plants per hectare;

ρ_2 - root volume;

ρ_3 - weight of fruits;

ρ_4 - volume of underground part of plants;

ρ_5 - average growth of plants h at $h>h_{min}$;

$\rho_1\rho_3$ - total weight of fruits per area;

$\rho_1\rho_4$ - total volume of aboveground part of vegetation cover.

These indicators are not universal and depend on the type of plants that make up the vegetation cover of a particular region. An alternative model that requires the collection of a large strategic material may be its reparametrization in the form:

$$S = \sum_{i} S_{Wi}(\beta_1 + \beta_{min}) + \sum_{I} S_{WI}(G_I < G_{min})$$
$$+ \sum_{K} S_{Wi}(S_k < S_{max})$$
$$+ \sum S_{W1}(C_1 + C_{max}) + \sum_{m} S_{Wm}(C_m > C_{max}) + \sum_{n} S_{Wn}(G_n)$$

where G is soil erosion.

One of the advantages of the model is that there are fewer requirements for the volume of static material. The desertification process is developing over time, so differential equations are used for description in combination with other methods of description.

Obviously, the conditions of a steady-state state can be obtained by equating the legal parts of the systems of differential equations to zero.

Conclusion: Studying desertification processes, we come to the following conclusion: natural and anthropogenic factors are the key issue. Anthropogenic and natural factors influencing desertification process prove once again that it is extremely necessary to model all processes (soil moisture model, soil temperature model, soil salinity model, air temperature model, soil erosion model, groundwater depth model, groundwater storage volume change model, air humidity model) in order to preserve ecological security. Next, optimize the restoration of desert regions. And all this together will solve the problem of anthropogenic and natural factors influence on desertification development process and thus significantly improve air quality and limit the scale of climate change.

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