NATURAL DISASTERS, ECOSYSTEMS AND POLLUTION: PROBLEM ANALYSIS AND DECISION-MAKING FOR SUSTAINABLE DEVELOPMENT

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Abstract

This article presents a systematic approach to the study of the relationship between natural disasters, ecosystems, pollution and sustainable development. The study is based on an analysis of the available data, as well as the latest scientific research in this area.
The main focus is on identifying the main causes of natural disasters and their impact on ecosystems, which, in turn, leads to environmental pollution and disruption of sustainable development. The authors of the study propose a number of recommendations and measures that can be used to make informed decisions and move towards sustainable development in a disaster risk environment.
In particular, the study focuses on the importance of taking environmental and social factors into account when developing disaster risk management strategies and ensuring sustainable development. This includes the development and implementation of effective measures to reduce the environmental impact on the environment, ensuring social justice and equality, as well as strengthening institutional mechanisms and structures for risk management.
In order to achieve sustainable development, it is necessary not only to eliminate the consequences of natural disasters, but also to prevent their occurrence in the future. This requires an integrated approach that will take into account the interrelationships between various factors such as climate change, environmental processes and socio-economic conditions.

Keywords: natural disasters, ecosystems, pollution, sustainable development

I. Introduction

The page of human history is filled with numerous natural disasters such as earthquakes, floods, hurricanes and fires. These natural disasters not only threaten people's lives, but also have a serious impact on the environment and ecosystems. In recent years, the frequency and intensity of natural disasters have increased significantly, which poses serious challenges to sustainable development.

One of the main problems associated with natural disasters is the destruction of ecosystems. As a result of strong earthquakes or floods, natural habitats of animals and plants can be completely destroyed. This leads to loss of biodiversity and imbalance in ecosystems. Many species of animals and plants that are important links in food chains and perform important functions in ecosystems may be completely extinct. This can have serious consequences for other species and for the ecosystem as a whole [1].

Another problem associated with natural disasters is environmental pollution. Chemical emissions such as oil spills or emissions of hazardous substances from factories can occur during natural disasters. This pollutes the soil and water, which can lead to poisoning of animals and plants. In addition, environmental pollution can cause long-term consequences, such as

deterioration of soil and water quality, which leads to limited resources and complication of ecosystem restoration processes.

The impact of natural disasters on ecosystems can also lead to disruption of the cycles of nutrition and processing of organic matter. Natural processes, such as the decomposition of plant waste, contribute to the formation of nutrients for plants and further enrich the soil. However, as a result of natural disasters, these processes can be disrupted. For example, flooding can erode soil, carry away plant residues and deprive ecosystems of the necessary resources for restoration.

For sustainable development, it is necessary to develop strategies and take measures to adapt ecosystems to natural disasters. Important steps are the creation of nature reserves and nature reserves to preserve unique ecosystems in which species that require special attention for conservation can develop. It is also necessary to strengthen natural barriers, such as forest belts or reef systems, to mitigate the effects of floods and hurricanes.

However, it must be borne in mind that natural disasters cannot be completely prevented. Therefore, it is equally important to develop strategies for ecosystem restoration after natural disasters. Not only agriculture, but also forestry, fishing and other economic activities must take into account the long-term effects of natural disasters and their impact on ecosystems. [6,7].

Solving the problem of the impact of natural disasters on ecosystems requires an integrated approach and concerted efforts by States, international organizations and the public. It is necessary to conduct scientific research and develop new technologies to adapt ecosystems to changes caused by natural disasters [1]. In addition, the general public should be aware of the importance of ecosystem conservation and the need to take decisive steps for sustainable development. If we don't do this today, the consequences will be catastrophic for our planet and future generations.

II. Methods

One of the important methods that researchers can use is modeling. Using computer models, it is possible to study various scenarios of the impact of natural disasters on ecosystems, as well as to assess the effects of pollution on various components of the environment. Modeling makes it possible to predict the possible effects of climate change carry out risk calculations and develop appropriate strategies.

When studying this issue, a key aspect is the analysis of the impact of natural disasters and pollution on ecosystems. Various types of ecosystems are used for research - polar and temperate, oceans, forests, water resources and other elements of the natural environment. The assessment of the devastating impact of natural disasters makes it possible to determine the vulnerability of various ecosystems and develop effective measures for their conservation and restoration. An important aspect of the article is also the analysis of environmental pollution and its impact on ecosystems.

The study of various sources of pollution, including industrial emissions, vehicle emissions, as well as agriculture, allows us to identify priority areas in the fight against this problem. The main goal is to develop innovative and environmentally friendly technologies, as well as to take measures to reduce emissions and improve energy efficiency.

III. Results

Natural disasters such as hurricanes and floods are one of the main threats to ecosystems and sustainable development. In recent years, the number of such disasters has increased, which has led to serious environmental pollution and destruction of ecosystems. Pollution is also a serious problem, as it is caused by various sources such as industrial enterprises and transport. For many centuries, people have had the most negative impact on the state of the environment around us.

To date, the ecological state of the planet has forced humanity to begin taking active actions to maintain the current state and gradual recovery.

Table 1 shows us the dynamics of greenhouse gas emissions by sector from 2005 to 2021.

Table 1: *Greenhouse gas emissions by sector (million tons of CO2 equivalent per year).*

The name of the indicator	2005	2010	2015	2016	2017	2018	2019	2020	2021
Energy industry	1590,2	1639,3	1611,3	1606,1	1637,0	1688,7	1682,3	1593,8	1679,1
Industrial processes and the use of industrial products	212,4	204,4	228,0	228,2	243,0	252,3	246,3	254,4	259,5
Agricultural industry	106,8	105,4	110,5	114,3	115,2	114,8	116,4	118,8	121,3
Land use, land-use change and forestry	-539,7	-698,1	-583,3	-615,3	-602,9	-577,3	-550,5	-557,6	-506,6
Wastes	61,2	70,3	83,4	85,5	87,5	89,5	91,4	94,1	96,7
Total, excluding land use, land use change and forestry	**1970,6**	**2019,4**	**2033,3**	**2034,0**	**2082,6**	**2145,2**	**2136,5**	**2061,1**	**2156,6**
Total, taking into account land use, land use change and forestry	**1430,9**	**1321,3**	**1450,1**	**1418,7**	**1479,7**	**1568,0**	**1586,0**	**1503,5**	**1650,0**

A source: https://rosstat.gov.ru [5]

Greenhouse gas emissions are one of the main factors affecting climate change and ecosystem disruption. They lead to global warming, which, in turn, causes many negative consequences for the environment and sustainable development of countries.

Sectoral analysis of greenhouse gas emissions shows that the most significant sources are energy, industry and transport. Each of these sectors contributes to the disruption of the ecosystem and ultimately affects the sustainable development of the country.

Energy - Greenhouse gas emissions from energy account for approximately 73-77% of total emissions. This is mainly caused by the use of fossil fuels - coal, oil and natural gas. This leads to atmospheric pollution and disruption of climatic conditions.

Industry - Emissions from industry account for about 12-16% of total emissions. Atmospheric pollution occurs due to the use of fuel in the production process, as well as due to emissions from industrial enterprises.

Transport - The transport sector is the third largest source of greenhouse gas emissions. This is due to the use of cars, airplanes and other modes of transport that emit carbon dioxide and other harmful substances into the atmosphere.

The impact of greenhouse gas emissions on the sustainable development of countries is manifested in the following aspects:

Climate change - greenhouse gas emissions cause global warming, which, in turn, leads to negative consequences such as sea level rise, droughts, floods, hurricanes, etc. These climate changes disrupt the ecosystem and make it less habitable.

Economic losses - greenhouse gas emissions also have a negative impact on the economy. For example, they can lead to lower crop yields, which in turn can cause food shortages and economic problems. In addition, climate change can lead to damage to infrastructure such as roads and bridges, which can also affect the country's economy.

In order to minimize the impact of greenhouse gas emissions and ensure the sustainable development of countries, it is necessary to take measures to reduce emissions and adapt to climate change. This may include switching to cleaner energy sources, improving energy efficiency, developing public transport, etc.

Table 2: *Total number of natural emergencies that occurred in the territory the Russian Federation for 2010-2021.*

		among them:											the number of deaths as a result of emergencies, people
	total,ed	earthquakes and volcanic eruptions	dangerous geological phenomena	storms, hurricanes, tornadoes, squalls	snow avalanches	heavy rain, snowfall, large hail	frost, drought	marine hydrological hazards	separation of coastal ice	dangerous hydrological phenomena	major wild fires	ground water level rise	
2010	118	8	-	3	1	6	20	-	14	8	58	-	37
2011	65	4	-	2	-	2	2	-	13	17	25	-	2
2012	148	2	1	9	-	12	18	-	8	21	77	-	185
2013	116	5	2	6	1	22	48	1	4	16	11	-	6
2014	44	-	1	10	-	16	3	-	2	7	5	-	11
2015	45	-	-	4	-	11	16	-	-	4	7	3	43
2016	54	-	2	6	-	21	7	-	1	15	2	-	3
2017	42	-	2	3	1	14	4	-	-	13	5	-	33
2018	44	-	-	1	-	11	14	-	1	12	5	-	8
2019	49	-	2	2	1	9	12	-	-	17	6	-	34
2020	104	2	1	20	-	6	13	7	1	29	25	-	4
2021	110	-	2	27	3	10	14	-	2	28	24	-	24

A source: https://rosstat.gov.ru [5]

Table 2 shows us the dynamics of the number of natural disasters that occurred on the territory of the Russian Federation in 2010-2021.

In 2023, the number of dangerous weather events in Russia increased by 22%. Experts define such phenomena as a threat to human health or significant economic damage. Among them are abnormally high or low temperatures, heavy rains, hurricanes, floods, droughts and forest fires. Last year, 1,191 natural disasters were recorded, compared with 976 in the previous year. The year 2023 took the second place in this indicator in the history of observations of the Hydrometeorological Center, second only to 2021, when 1,205 dangerous phenomena were registered. During this period, only the number of days with abnormal heat decreased by 48% [5].

Any natural disaster brings with it significant losses both in material and human terms.

Let's discuss the Kashmir earthquake that occurred on October 8, 2005 at about 8:50 a.m. local time. This earthquake was rated at 7.6 on the Richter scale and led to the destruction of many buildings. The capital of Kashmir was severely damaged, killing more than 10,000 residents of the city. As a result of the disaster, the main minaret of the mosque was also destroyed.

This earthquake is considered one of the most severe in South Asia. About 4 million people were left homeless, and more than 30,000 buildings were destroyed. Pakistan has suffered huge financial losses estimated at 12 billion US dollars [3].

Let's also consider the flood that occurred in the Irkutsk region in 2019. The Oka River in the city of Tulun has reached its maximum level of 14 meters (with an acceptable value of 700 cm). Scientists called the cause of the flood the heavy rains that have recently fallen in the region. The only highway connecting Moscow with Siberia and the Far East was damaged, and more than

6,000 houses were flooded. The financial damage to the region was estimated at more than 27 billion rubles. The authorities of the Irkutsk region announced the day of remembrance of the victims of the flood on July 12, 2019.

Terrible floods have occurred in the Sochi region and some areas of the Krasnodar Territory. Due to the prolonged rains, as much precipitation fell in a day as usually falls in a whole month. Rivers overflowed their banks, flooding residential buildings and boarding houses, roads and highways in villages were seriously damaged. Three weeks later, the scenario was repeated: another month's rainfall, new floods and people died.

In regions with extremely high levels of environmental stress, a significant part of the territories already exceed the permissible limits of the economic capacity of ecosystems. In areas with a high level of environmental stress, these limits have not yet been reached, but they are approaching. Continuing to increase production in these conditions at current levels of technology and economic structure will lead to complete degradation of natural systems, complete exhaustion of resource opportunities, and the formation of sustainable sources of diseases among the population.

In areas with a relatively high level of environmental stress, the economic capacity of ecosystems is mostly exhausted. Changes in the economic structure are needed, taking into account the use of new technologies, the construction of wastewater treatment plants and the restoration and reclamation of landscapes.

Areas with an average level of environmental stress retain the economic capacity of ecosystems. It is possible to maintain the current economic structure, provided that new technologies are introduced and treatment facilities are created.

Regions with a relatively low level of environmental stress make it possible to continue increasing production and partially develop new territories that are not included in the system of specially protected natural zones.

In regions with low or very low levels of environmental stress, the full economic capacity of ecosystems is maintained according to the Concept of Sustainable Development of the Russian Federation.

The National Security Strategy of Russia until 2020 (Strategy 2020) was approved by Decree of the President of the Russian Federation dated 05/12/2009 No. 537 and includes section IV "Ensuring national security", where there is a special subsection 8 "Ecology of living systems and effective use of natural resources".

The 2020 Strategy focuses on the fact that national security in the environmental sphere is influenced by such negative factors as the depletion of world reserves of mineral, aquatic and biological resources and the presence of ecologically unfavorable regions in Russia. In addition, national security in this area is complicated by the presence of a large number of hazardous industries that violate the ecological balance, including non-compliance with sanitary, epidemiological and sanitary standards for drinking water. Radioactive waste from the non-nuclear fuel cycle remains outside regulatory regulation and control. All this leads to an increase in the strategic risk of depletion of the country's most important mineral reserves and a decrease in the production of many key minerals.

IV. Discussion

The Russian Federation is actively working to reduce the negative impact of natural disasters and pollution on the sustainable development of the country. The measures taken to do this include:

• Creation and implementation of programs to prevent and minimize the consequences of natural disasters, as well as to restore territories after them. Within the framework of these programs, measures are being taken to strengthen infrastructure, prepare the population for action in extreme situations, organize timely notification and evacuation.

• Improvement of the system of monitoring and forecasting of natural disasters. Modern technologies and tools are used to track natural disasters and provide early warning about them. This makes it possible to take measures to protect the population and reduce possible losses [3].

• Implementation of environmentally friendly and energy efficient technologies. This includes the development and use of renewable energy sources, reducing emissions of pollutants into the atmosphere and water bodies, as well as waste disposal.

• Development of the system of environmental protection and control over compliance with environmental legislation. This includes conducting regular inspections at enterprises and organizations, as well as imposing fines and other sanctions for violations of environmental norms and rules. Conducting educational and awareness-raising programs aimed at improving the ecological culture of the population. This includes environmental lessons in schools and universities, thematic events and actions, as well as information through the media.

• Cooperation with international organizations and countries to share experience and knowledge in the field of prevention and elimination of consequences of natural disasters and environmental pollution. All these measures are aimed at ensuring the sustainable development of the country, preventing the negative consequences of natural disasters and protecting the environment from pollution.

In addition, other actions are being taken:

Firstly, programs are being developed and implemented to prevent and minimize the consequences of natural disasters, as well as to restore territories after their impact. Measures are being taken to strengthen infrastructure and prepare the population for action in extreme conditions.

Secondly, the system of monitoring and forecasting of natural disasters is being improved using modern technologies and tools. This allows you to warn in advance about possible natural disasters and take measures to protect the population.

Thirdly, environmentally friendly and energy-efficient technologies are being introduced, including the development and use of renewable energy sources, and the reduction of pollutant emissions.

The system of environmental protection, monitoring compliance with environmental legislation and conducting educational programs to improve the ecological culture of the population is also being developed.

Finally, cooperation is being carried out with international organizations to share experience in the field of prevention and elimination of consequences of natural disasters and protection of the environment from pollution.

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