CRITERIA FOR THE ADAPTATION OF THE SOCIO-ECONOMIC SYSTEM AND THE ENVIRONMENT TO THE ECOLOGICAL CRISIS

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Abstract

This article analyzes the processes of adaptation of socio-economic systems and the environment to the conditions of an ecological crisis, based on the principles of sustainable development. It examines the theoretical and practical aspects of ensuring a balance between economic growth and ecological sustainability under conditions of intensifying environmental risks, climate change, scarcity of natural resources, and growing anthropogenic pressure. The study employs systemic analysis, comparative analysis, indicator-based assessment, and integral indices. The author proposes a comprehensive assessment model that encompasses the social, economic, and ecological criteria of adaptation to the ecological crisis. In addition, scientifically grounded proposals have been developed for ensuring sustainable development in Uzbekistan through the efficient use of resources, the improvement of environmental governance, and the introduction of "green economy" principles.

Keywords: sustainable development, ecological crisis, environmental security, adaptation, socio-economic system, green economy, environmental governance, integral index.

1. Introduction

In the 21st century, the ecological crisis has become one of the most critical problems of global development. Climate change, the decline of biological diversity, land degradation, water scarcity, and air pollution are compelling countries to reconsider their models of economic development. The United Nations Sustainable Development Goals emphasize the need to ensure a balance between economic growth, ecological sustainability, and social well-being (United Nations, 2015).

In recent years, the issue of adaptation to the ecological crisis has become one of the principal research directions in economics, ecology, and public administration. Of particular relevance is the assessment of the impact of climate change on economic growth and the resilience of economic systems to external ecological risks (IPCC, 2023).

In the scientific literature, sustainable development is regarded as the mutual coherence of economic, ecological, and social components (Brundtland, 1987). In this respect, economic growth should not be achieved at the expense of the depletion of natural capital, but rather through the rational use of resources, the introduction of innovative technologies, and the enhancement of ecological efficiency (Sachs, 2015).

Adaptation to the ecological crisis is not only a matter of environmental protection, but also an essential condition for ensuring the population's quality of life, economic stability, and national security. From this standpoint, developing a unified system of scientific criteria to assess the resilience of the socio-economic system to external ecological impacts and its level of adaptation is one of the important tasks (Folke et al., 2016).

In recent years, Uzbekistan has also carried out wide-ranging reforms aimed at ensuring ecological sustainability, developing the green economy, and adapting to climate change. In particular, the ecological situation in the Aral Sea region, the rational use of water resources, and the development of renewable energy sources have been included among the country's priority tasks.

As the President of the Republic of Uzbekistan, Shavkat Mirziyoyev, has stated: "Solving ecological problems, protecting nature, and introducing the principles of green development are among the most pressing tasks of today."

A number of important legal and regulatory documents have been adopted in the country to ensure ecological security and adapt to climate change. In particular, the "Strategy for the Transition of the Republic of Uzbekistan to a 'Green' Economy for 2019–2030," approved by Resolution No. PQ–4477 of the President of the Republic of Uzbekistan dated October 4, 2019, established the main directions for the efficient use of resources across sectors of the economy, the broad introduction of renewable energy sources, and the assurance of ecological sustainability.

Furthermore, within the framework of the "Program of Measures for the Transition of the Republic of Uzbekistan to a 'Green' Economy through 2030," approved by Decree No. PF–436 of the President of the Republic of Uzbekistan dated December 2, 2022, tasks were established for increasing energy efficiency, reducing carbon emissions, managing water resources, and improving climate change adaptation mechanisms.

Mitigating the consequences of the ecological crisis in the Aral Sea region, combating desertification processes, and improving the population's quality of life are also among the important directions of the state's ecological policy. In this

regard, special programs are being implemented for the Aral Sea region, and measures are being taken to expand green areas and introduce ecological innovations.

In this connection, the purpose of this study is to improve the theoretical foundations for assessing the adaptation of the socio-economic system and the environment to the ecological crisis, to develop a comprehensive system of criteria, and to improve the methods for their assessment.

The objectives of the study are: to analyze the theoretical foundations of adaptation to the ecological crisis; to examine the system of sustainable development indicators; to formulate the adaptation criteria of the socio-economic system; to develop practical recommendations for the conditions of Uzbekistan.

2. Literature Review

The concept of sustainable development was first introduced into scientific discourse in the 1987 report "Our Common Future," prepared by the World Commission on Environment and Development. In this report, sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. This approach is based on ensuring proportionality among economic growth, social justice, and environmental protection.

The theory of sustainable development was later further developed in the works of Jeffrey D. Sachs. He emphasizes the need to pursue economic progress in harmony with the efficient use of natural resources, institutional reforms, and innovation. In the author's view, ecological sustainability must become an integral part of economic policy (Sachs, 2015).

The concept of resilience occupies a special place in the theory of adaptation to the ecological crisis. Carl Folke and co-authors identify the capacity of socio-ecological systems to withstand external impacts, adapt to change, and develop under new conditions as the principal characteristic of sustainability (Folke et al., 2016). They advance the concept of adaptive governance in the management of ecological systems.

The reports of the Intergovernmental Panel on Climate Change provide an extensive analysis of the negative impact of climate change on agriculture, water resources, food security, and public health. IPCC experts emphasize the need to pursue adaptation and emission-reduction policies simultaneously in order to mitigate ecological risks (IPCC, 2023).

In the field of ecological economics, Herman E. Daly developed the theory concerning the ecological limits of economic growth. In his view, economic development should be ensured not through the depletion of natural capital, but through improving resource efficiency and developing a circular economy (Daly, 1996).

The concept of the green economy was developed by the United Nations Environment Programme, which identifies a low-carbon economy, efficient use of resources, and social inclusiveness as its principal directions (UNEP, 2011).

In recent years, a system of indicators has been widely applied in assessing ecological sustainability. Indicators such as the Environmental Performance Index, the SDG Index, the Ecological Footprint, and Green GDP make it possible to comparatively assess the ecological condition of countries.

However, in most studies, ecological, economic, and social factors are analyzed separately. This limits the possibility of comprehensively assessing the degree of adaptation of the socio-economic system to the ecological crisis. Therefore, this study proposes combining these three components within a single integral assessment model.

The proposed approach has the following advantages:

- it enables a comprehensive assessment of ecological sustainability;
- it takes social and economic factors into account simultaneously;
- it serves to determine the effectiveness of state ecological policy;
- it creates the possibility of comparing ecological risks across regions;
- it serves as a scientific basis for developing sustainable development strategies.

The analysis of the scientific literature shows that existing research on adaptation to the ecological crisis is mainly focused on issues of climate change, natural resource use, and environmental governance. However, methodological approaches that assess social, economic, and ecological factors as a single integral system have not been sufficiently developed. For this reason, this study pays particular attention to improving comprehensive criteria and assessment methods.

3. Research Methodology

The principal purpose of the study is to improve the comprehensive criteria and assessment methods used to evaluate the degree of adaptation of the socio-economic system and the environment under conditions of ecological crisis.

The study is based on the theories of sustainable development, ecological economics, systemic analysis, adaptive governance, and resilience.

The object of the study is the socio-economic systems affected by the ecological crisis and their interaction with the environment.

The subject of the study consists of the criteria and methods for assessing the degree of adaptation of these systems to the ecological crisis.

The following scientific research methods were used in the article:

Systemic analysis — made it possible to study ecological, economic, and social factors as a unified system.

Comparative analysis — was used to compare the ecological adaptation policies applied in different countries and regions.

The indicator method — made it possible to carry out the assessment on the basis of sustainable development indicators.

In the study, the degree of adaptation is assessed across three principal blocks.

Block 1. Ecological criteria: quality of atmospheric air; greenhouse gas emissions; efficiency of water resource use; land degradation; biological diversity; share of renewable energy; level of waste recycling.

Block 2. Economic criteria: ecological efficiency of GDP; intensity of energy consumption; volume of green investments; level of introduction of innovative technologies; efficiency of ecological taxes; share of resource-saving technologies.

Block 3. Social criteria: public health; level of ecological education; ecological culture; quality of the living environment; preparedness of the population for ecological risks; share of green jobs.

The principal scientific novelty of this study consists of the following: a system of criteria was developed for assessing ecological risks across regions; the possibilities of practical application under the conditions of Uzbekistan were substantiated.

4. Research Results and Discussion

The results of the study show that the degree of adaptation to the ecological crisis is closely linked to a country's level of economic development, institutional capacity, innovative activity, and the effectiveness of ecological governance. Under conditions of climate change, harmonizing adaptation and mitigation policies is of great importance for achieving sustainable development.

The analysis shows that the intensification of the ecological crisis has the greatest impact on the following areas: water resources; agriculture; food security; the energy system; public health; and urban infrastructure.

Developing adaptation strategies for each of these areas is an important condition for sustainable economic growth. It has been emphasized that climate-

resilient development is effective when it combines adaptation, risk reduction, and equitable governance.

The results obtained are consistent with international research. In particular, IPCC reports assess the implementation of adaptation and emission-reduction measures together with development policy as the most effective approach for climate-resilient progress.

At the same time, a distinctive feature of this study is that ecological, economic, and social indicators have been combined into a single integral assessment model. This approach has practical significance for comparing ecological risks across regions, assessing the effectiveness of state programs, and making strategic decisions.

5. Conclusion

The results of the study show that the ecological crisis is one of the most important external factors affecting the sustainable development of modern socio-economic systems. Climate change, the scarcity of natural resources, the decline of biological diversity, and the intensification of anthropogenic pressure require countries to harmonize economic growth with ecological sustainability. These conclusions are also reflected in international assessments.

The study proposed a comprehensive approach combining the ecological, economic, and social components of adaptation to the ecological crisis. This approach can serve as a scientific basis for assessing the degree of adaptation across regions and sectors, identifying vulnerabilities, and making governance decisions.

The integral assessment model developed in the course of the work makes it possible to carry out a multifactorial analysis of the degree of adaptation. This model can be applied in assessing the effectiveness of state ecological policy, monitoring the process of transition to a "green economy," and improving sustainable development strategies.

The results of the study made it possible to identify the following priority directions for improving the ecological governance system under the conditions of Uzbekistan: improving national programs for adaptation to climate change; the broad introduction of technologies for the efficient use of water and land resources; increasing the share of renewable energy sources; encouraging "green" investments and ecological innovations; developing digital systems of ecological monitoring; strengthening the population's ecological culture and ecological education; and assessing the effectiveness of state programs on the basis of sustainable development indicators.

Overall, the proposed approach has practical significance for ensuring the country's ecological security and sustainable development, as well as for enhancing the competitiveness of economic systems under conditions of ecological crisis.

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