ENVIRONMENTAL POLLUTION: GLOBAL PROBLEM AND NATIONAL SOLUTIONS

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Abstract: This article analyzes global and regional environmental problems emerging in the 21st century, focusing specifically on the causes and consequences of environmental pollution. Using Uzbekistan as a case study, it examines the main sources of air, water, and soil pollution, as well as the impact of industrial, transport, and agricultural activities on the ecological state. The Aral Sea disaster is evaluated as a major environmental crisis, highlighting its socio-economic and health-related consequences. Furthermore, the article discusses national policies, legal frameworks, and the prospects for implementing "green" technologies aimed at mitigating environmental problems, and proposes practical measures to ensure ecological sustainability.

Keywords: environmental pollution, anthropogenic factors, air pollution, water pollution, soil pollution, Aral Sea disaster, industrial and transport emissions, agricultural chemicals, environmental safety, "green" economy, sustainable development.

In the 21st century, human civilization has come under an unprecedented anthropogenic burden. Rapid industrial development, accelerated urbanization, and population growth have negatively impacted the environment, leading to global ecological problems. Environmental pollution poses serious threats not only to nature but also to human health, economic stability, and the well-being of future generations. Uzbekistan has not remained immune to these processes. Regional environmental challenges, including the Aral Sea disaster, harmful emissions from industrial enterprises and transportation, and the improper use of chemical fertilizers and pesticides in agriculture, have adversely affected the country's ecological state. Therefore, a thorough study of the causes of environmental pollution, analysis of its consequences, and the development of effective solutions are among the most pressing tasks today.

Environmental pollution refers to the introduction of any substance, energy, or phenomenon into the natural environment that alters its physical, chemical, and biological properties, causing harm to living organisms—including humans—ecosystem stability, and material resources [1, p.25]. Pollution can be natural (e.g., volcanic eruptions, forest fires) or anthropogenic (resulting from human activity). Currently, anthropogenic pollution is the main cause of the global environmental crisis [2, p.78]. The primary sources of anthropogenic pollution include industrial enterprises, thermal power plants, transportation, agriculture, and household waste.

Air pollution is characterized by the addition of harmful gases (carbon dioxide, sulfur oxides, nitrogen oxides), dust, and aerosols into the atmosphere from industrial and transport activities. This leads to global problems such as acid rain, the greenhouse effect, and ozone layer depletion [3, p.112]. According to the World Health Organization, air pollution causes millions of premature deaths annually.

Water pollution occurs when industrial and domestic wastewater, petroleum products, and chemical substances used in agriculture enter water bodies (rivers, lakes, groundwater). This results in the disruption of aquatic ecosystems, the extinction of aquatic organisms, and the deterioration of drinking water quality [4, p.55].

Soil (lithosphere) pollution arises from the excessive deposition of industrial waste, household garbage, pesticides, and mineral fertilizers onto the soil. Soil contamination reduces fertility, threatens food security, and allows harmful substances to enter the human body through the food chain [1, p.98].

In Uzbekistan, industries such as mining and metallurgy, energy, chemical production, and construction materials are the largest sources of environmental impact. Industrialized regions include Olmaliq, Navoiy, Bekobod, and the Fergana Valley, where air pollution remains high. According to the Ministry of Ecology, Environmental Protection, and Climate Change of the Republic of Uzbekistan, industrial enterprises emit over 2 million tons of harmful substances into the atmosphere annually.

The **transport sector**, particularly in major cities, is one of the primary sources of air pollution. Most vehicles in the country are outdated and use fuels that do not meet modern environmental standards, exacerbating the situation. In Tashkent, 70–80% of harmful emissions in the air are attributed to road transport [6, p.41], negatively affecting public health, especially respiratory and cardiovascular diseases.

Uzbekistan, as an agrarian country, has for many years used mineral fertilizers and pesticides without sufficient control, leading to severe contamination of soil and water resources. Particularly during the cotton monoculture period, defoliants and pesticides accumulated in the soil and adversely affected human health through the food chain. Today, measures are being taken to mitigate these effects through the adoption of organic farming and biological protection methods [4, p.89].

The drying of the Aral Sea, the largest ecological disaster in Central Asia, is directly linked to human activity. The extensive diversion of the Amu Darya and Syr Darya rivers for irrigation led to the shrinkage of the sea, resulting in the formation of the Aralkum desert. Toxic salts and dust rising from the seabed spread over millions of hectares, disrupting the regional ecosystem, harming public health, and causing socio-economic problems [7, p.47]. Mitigating the consequences of this disaster remains a task of national and international significance.

The government of Uzbekistan has implemented extensive measures for environmental protection and the rational use of natural resources. Key legal frameworks include the Law on Environmental Control (2013), the Law on Waste (new edition, 2019), and the Environmental Protection Concept of Uzbekistan through 2030 [8]. These documents provide a legal basis for improving the environmental situation, managing waste, and transitioning to a "green" economy.

Particular attention is being given to **"green" technologies**, especially renewable energy sources (solar and wind). Large photovoltaic power plants are being constructed to utilize the country's significant solar potential. Measures to reduce industrial impact include modernizing outdated equipment, installing dust and gas purification systems, and applying water-saving technologies [9, p.15].

Analyses indicate that environmental pollution remains a pressing issue for Uzbekistan, with serious ecological, social, and economic consequences. The intensive development of industry, transport, and agriculture places significant pressure on air, water, and soil resources. The Aral Sea disaster exemplifies a regional environmental crisis. At the same time, the country has implemented systematic policies to address environmental challenges, improve legislation, and introduce green economy principles and resource-efficient technologies.

Recommendations for effective implementation include:

1. **Strengthening environmental control in industry:** Fully implement the "polluter pays" principle and encourage enterprises to equip themselves with modern purification technologies.

2. **Developing green transport:** Electrify public transport, expand bicycle infrastructure, and accelerate the transition to eco-friendly fuel standards.

3. **Promoting sustainable practices in agriculture:** Support organic farming and expand water-saving irrigation technologies (drip and sprinkler irrigation).

4. **Enhancing environmental awareness:** Strengthen ecological education among the population, especially youth, and promote awareness through mass media.

5. **Expanding international cooperation:** Restore the Aral Sea region, manage transboundary water resources, and cooperate with international organizations and donors on climate adaptation initiatives.

Implementation of these comprehensive measures will ensure a sustainable ecological situation in Uzbekistan, protect public health, and preserve a favorable environment for future generations.

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