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AIR POLLUTION IN CITIES OF UZBEKISTAN: CAUSES AND CONSEQUENCES

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Abstract: This article analyzes air pollution in cities of Uzbekistan, its main causes, and consequences. The study examines the concentrations of nitrogen oxides, sulfur dioxide, carbon monoxide, particulate matter, and other pollutants in urban air. Additionally, sources of pollution, meteorological factors, and their effects on the environment and human health are investigated. Based on the results, recommendations for improving air quality are provided.

Keywords: Cities of Uzbekistan, air pollution, nitrogen oxides, sulfur dioxide, carbon monoxide, particulate matter, industrial emissions, transport pollution, ecology.

Atmospheric air is an indispensable and vital natural resource for human life and nature. Clean and healthy air plays a crucial role not only in ensuring human health but also in maintaining ecological balance, supporting biodiversity, and stabilizing the climate. Therefore, the quality of atmospheric air and the issues of its pollution are considered one of the global environmental problems. In recent years, especially in the major cities of the Republic of Uzbekistan, population growth, increased activity of industrial enterprises, growth in the number of vehicles, and urbanization processes have significantly influenced atmospheric pollution. These factors lead to the large-scale introduction of harmful gases, dust particles, and other pollutants into the air. Atmospheric pollution poses risks not only to human health but also damages ecosystems, including plants, animals, terrestrial, and water resources. Furthermore, harmful substances in the air exacerbate climate change, which in turn causes widespread socio-economic problems.

The problem of atmospheric air pollution in cities of Uzbekistan manifests itself as a serious threat to public health, ecological stability, and the economy. Particularly in large cities such as Tashkent, Samarkand, Namangan, Bukhara, and Navoi, the abundance of industrial enterprises and transport flows significantly affect air quality. Therefore, identifying pollution sources, conducting quantitative and qualitative analyses, assessing negative impacts, and establishing effective monitoring systems are urgent environmental tasks. This article examines the causes of atmospheric pollution in cities of Uzbekistan, its effects on humans and the environment, and offers practical recommendations to mitigate the problem.

Numerous scientific studies on atmospheric pollution have been conducted worldwide. Internationally, the World Health Organization (WHO) and United Nations Environment Programs are key sources of data on air pollution and its impact on human health (WHO, 2021). In Uzbekistan, local researchers have produced various scientific articles, reports, and monitoring results related to air pollution. For example, analytical data on the concentrations and sources of harmful substances in the atmosphere of Tashkent and other major cities have

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been presented (Islamov, 2018; Karimova, 2020). The main pollutants in Uzbek city atmospheres include nitrogen oxides, sulfur dioxide, carbon monoxide, ammonia, phenol, and dust particles (Toshmetov, 2019). Many studies focus on the impact of transport, industry, and construction activities on air quality and pollution levels (Rakhimov et al., 2021). Additionally, the country is developing environmental monitoring and air quality assessment systems, although their effectiveness and coverage are still limited (Mirzaev, 2022).

These studies indicate that meteorological factors such as air temperature, wind speed, and precipitation influence urban air pollution, causing seasonal variations in pollution levels (Abdullaev, 2017). Based on these studies, further in-depth research is needed on the dynamics of air pollution and its health impacts.

This research focuses primarily on recent monitoring data from major cities such as Tashkent, Samarkand, Namangan, Bukhara, and Navoi. Key air pollution indicators analyzed include average annual and seasonal concentrations of nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), ammonia (NH3), phenol, and particulate matter (PM10 and PM2.5). The data were gathered from official reports of the Uzbekistan State Environmental Monitoring Service, data from city ecological control stations, and scientific literature.

The study examined pollution sources such as traffic flow, industrial enterprises, construction activities, and anthropogenic factors. Also, the correlation between meteorological factors (temperature, wind speed, precipitation) and pollution levels was evaluated. Based on the results, recommendations to reduce air pollution in Uzbekistan's cities are proposed.

The findings indicate that the level of atmospheric pollution in major Uzbek cities is significant. The highest pollution levels were recorded near industrial centers and areas with heavy traffic. Main pollutants and their concentrations include:

- **Nitrogen oxides (NOx):** Average annual concentrations in Tashkent and Navoi sometimes exceed national regulatory limits, mainly due to vehicle emissions and industrial discharges.
- **Sulfur dioxide (SO2):** Elevated levels are observed near industrial zones, especially in Navoi and Bukhara, mainly due to greenhouse gas emissions from industrial plants.
- **Carbon monoxide (CO):** Concentrations are high along city centers and transportation routes, with pollution intensifying during winter.
- **Particulate matter (PM10 and PM2.5):** Dust particles are particularly abundant in arid areas and active construction zones. PM2.5 is especially harmful to human health, highlighting the importance of ongoing monitoring.
- **Ammonia and phenol:** Present due to industrial and agricultural activities; although within permissible limits, continuous monitoring is essential.

Meteorological conditions, including wind speed and direction, temperature, and precipitation, influence the dispersion of pollutants. Changes in wind direction can transport or concentrate pollutants in different areas. Reduced precipitation contributes to increased dust particle concentrations.

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Primary sources of pollution identified are:

- Emissions from passenger and freight transport vehicles
- Industrial enterprises, particularly in chemical and metallurgical sectors
- Construction and road works
- Harmful gases released from agricultural activities

In summary, air pollution in Uzbekistan's cities poses a serious threat to human health and ecological conditions. Particularly in densely populated areas, strict measures are required to reduce pollution levels.This study demonstrates that air pollution in urban areas of Uzbekistan presents serious risks to public health and the environment. Major pollutants include nitrogen oxides, sulfur dioxide, carbon monoxide, particulate matter, and industrial and transport emissions. Pollution is highest near industrial centers and transportation corridors, with meteorological factors significantly influencing pollution levels.Atmospheric pollution leads not only to health problems but also disrupts ecological balance, accelerates climate change, and causes economic losses. Therefore, it is essential to identify pollution sources, conduct regular monitoring, and establish effective control systems.

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