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AIR POLLUTION AND ITS ANALYSIS IN TASHKENT AND NAVOIY CITIES DURING 1995–2010

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Abstract: This article analyzes the level of atmospheric air pollution in the cities of Navoiy and Tashkent during the period from 1995 to 2010. The study examines major pollutants including suspended particulate matter, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), nitrogen oxide (NO), phenol, hydrogen fluoride (HF), and ammonia (NH_3). The levels of pollution, trends of change, and main sources are compared between the two cities. Based on the results, recommendations are provided to strengthen environmental control and reduce air pollutants in both cities. The study holds significant scientific value for identifying pollution issues related to industrial activity, transportation, and urbanization in the regions.

Keywords: atmospheric pollution, Navoiy city, Tashkent city, suspended particulate matter, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), phenol, hydrogen fluoride (HF), ammonia (NH_3), environmental monitoring, air quality

Environmental pollution is one of the most critical ecological problems in the modern world. In particular, the quality of atmospheric air directly affects human health and quality of life. Over the past fifteen years, rapid development of industry and transport sectors in the cities of Navoiy and Tashkent, Uzbekistan, has contributed to an increase in air pollution levels. These cities hold significant economic, social, and cultural importance, making the study of their ecological condition and analysis of pollution factors highly important. Pollutants in the atmospheric air—specifically suspended particulate matter, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), phenol, hydrogen fluoride (HF), and ammonia (NH_3)—can harm human health and negatively impact plant and animal life. Therefore, this article analyzes the level and changes in atmospheric air pollution in Navoiy and Tashkent cities over the period from 1995 to 2010.

Based on the study results, the sources of pollution, their dynamics, and their impact on urban ecology in both cities are identified, and recommendations for improving the ecological situation in the future are provided. During 1995–2010, air pollution indicators in Navoiy and Tashkent varied under the influence of various factors. Both cities are economically developing industrial centers, which significantly affect air quality. Tashkent, as the country's capital and largest city, has a high density of industrial enterprises, transport, and population. Navoiy is known primarily as a center for mining and chemical industries.

The main atmospheric pollutants include suspended particulate matter (PM), sulfur dioxide (SO_2),

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carbon monoxide (CO), nitrogen oxides (NO and NO_2), phenol, hydrogen fluoride (HF), and ammonia (NH_3). These substances mainly enter the air as a result of vehicle emissions, industrial waste, construction, and agricultural activities.

Between 1995 and 2010 in Tashkent, levels of suspended particulate matter and carbon monoxide were relatively high, linked to heavy traffic and intensive industrial activity. Although sulfur dioxide levels increased in some years, overall they stabilized due to improvements in filtration systems. Nitrogen oxide concentrations were associated with emissions from transport, showing an increase particularly during the summer months.

In Navoiy, air pollution was predominantly influenced by industrial enterprises, especially harmful gases from chemical and mining sectors. Concentrations of carbon monoxide and phenol occasionally rose, and suspended particulate matter levels were high due to industrial emissions. Ammonia and hydrogen fluoride levels fluctuated in relation to agricultural activities and waste from metallurgical enterprises.

A general trend for both cities showed that air pollution levels were high during 1995–2000 but decreased for some pollutants afterwards due to strengthened monitoring, control measures, and the introduction of environmental standards. However, in areas with intensive transport and industrial activity, pollution levels remained stable or exhibited slight fluctuations.

Below are statistical data and analyses of the main pollutant gases and substances during this period.

Table 1
Air Pollution Levels in the Atmospheric Air of Tashkent and Navoiy Cities (Average Values in mg/m³) for 1995–2010

No	Years	Suspended Particulate Matter (SPM)		Sulfur Dioxide (SO_2)		Carbon Monoxide (CO)		Nitrogen Dioxide (NO_2)		Nitric Oxide (NO)		Ozone (O_3)		Ammoni (NH_3)	
		Tashkent	Navoiy	Tashkent	Navoiy	Tashkent	Navoiy	Tashkent	Navoiy	Tashkent	Navoiy	Tashkent	Navoiy	Tashkent	Navoiy
1	1995	0.4	0.3	0.01	0.006	3	2	0.04	0.05	0.02	0.03	0.039	0.031	0.02	0.0
2	1996	0.3	0.4	0.006	0.004	3	2	0.04	0.05	0.03	0.04	0.074	0.026	0.02	0.0
3	1997	0.3	0.3	0.017	0.005	3	2	0.04	0.05	0.03	0.04	0.038	0.029	0.02	0.0
4	1998	0.3	0.3	0.013	0.003	2	2	0.06	0.06	0.06	0.05	0.037	0.040	0.02	0.0
5	1999	0.2	0.3	0.01	0.003	2	2	0.06	0.05	0.06	0.04	0.039	0.040	0.06	0.0
6	2000	0.2	0.3	0.01	0.003	1	2	0.07	0.06	0.05	0.04	0.076	0.039	0.03	0.0
7	2001	0.3	0.2	0.01	0.003	1	1	0.06	0.05	0.04	0.04	0.02	0.051	0.03	0.0
8	2002	0.3	0.2	0.012	0.003	2	1	0.08	0.05	0.05	0.05	0.032	0.033	0.02	0.0
9	2003	0.2	0.1	0.014	0.003	2	1	0.08	0.05	0.04	0.04	0.064	0.034	0.01	0.0

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10	2004	0.2	0.2	0.015	0.003	2	1	0.06	0.06	0.03	0.04	0.093	0.027	0.01	0.0
11	2005	0.2	0.2	0.023	0.003	2	1	0.07	0.05	0.03	0.04	0.088	0.026	0.01	0.0
12	2006	0.1	0.2	0.018	0.002	2	1	0.05	0.05	0.04	0.04	0.073	0.024	0.01	0.0
13	2007	0.1	0.1	0.004	0.002	2	1	0.04	0.05	0.04	0.03	0.076	0.026	0.01	0.0
14	2008	0.1	0.1	0.003	0.002	2	1	0.08	0.05	0.05	0.03	0.071	0.024	0.01	0.0
15	2009	0.1	0.1	0.003	0.003	2	1	0.07	0.05	0.04	0.04	0.075	0.026	0.01	0.0
16	2010	0.1	0.1	0.004	0.002	2	1	0.07	0.05	0.05	0.03	0.068	0.025	0.01	0.0

Between 1995 and 2010, air pollution indicators in the atmospheric air of Tashkent and Navoiy cities fluctuated. Based on the provided data, significant differences were identified between the two cities for certain pollutants.

Suspended Particulate Matter (PM): In Tashkent, the concentration of suspended particulates was around 0.4 mg/m³ in 1995 and gradually decreased to approximately 0.1 mg/m³ by 2010. In Navoiy, this indicator started at 0.3 mg/m³, dropped to 0.1 mg/m³ by 2003, and remained stable at this level until 2010. The higher particulate matter levels in Tashkent are linked to dense transport and industrial activity, whereas in Navoiy, industrial emissions were the main contributing factor.

Sulfur Dioxide (SO_2): In Tashkent, SO_2 levels started at 0.01 mg/m³ in 1995 and stabilized around 0.003–0.004 mg/m³ during 2007–2010. In Navoiy, SO_2 concentrations remained consistently low, fluctuating between 0.002 and 0.006 mg/m³. This indicates that sulfur dioxide pollution was considerably higher in Tashkent with a declining trend, while in Navoiy it remained relatively low and stable.**Carbon Monoxide (CO):** In Tashkent, carbon monoxide levels were about 3 mg/m³ in 1995, then decreased to a stable range of 1–2 mg/m³ over the following years. In Navoiy, CO levels started at 2 mg/m³ and stabilized around 1 mg/m³. The higher values in Tashkent are associated with heavy traffic and a densely populated urban area.**Nitrogen Dioxide (NO_2) and Nitric Oxide (NO):** In Tashkent, NO_2 fluctuated between 0.03 and 0.05 mg/m³ from 1995 to 2010, while in Navoiy, it remained within 0.03–0.06 mg/m³. Nitric oxide levels in both cities ranged between 0.02 and 0.05 mg/m³ with some variability. These gases primarily originate from vehicle emissions, which explains the similar levels in both cities.**Ozone (O_3):** Ozone levels in Tashkent increased from 0.039 mg/m³ to 0.068 mg/m³ over the years. In Navoiy, ozone concentrations ranged between 0.024 and 0.04 mg/m³. The rise in ozone is linked to chemical reactions in the atmosphere and transport emissions.**Ammonia (NH_3):** In Navoiy, ammonia concentrations ranged from 0.05 to 0.09 mg/m³, while in Tashkent, they were maintained around 0.01 to 0.03 mg/m³. This difference is explained by the influence of agricultural activities and industrial emissions.

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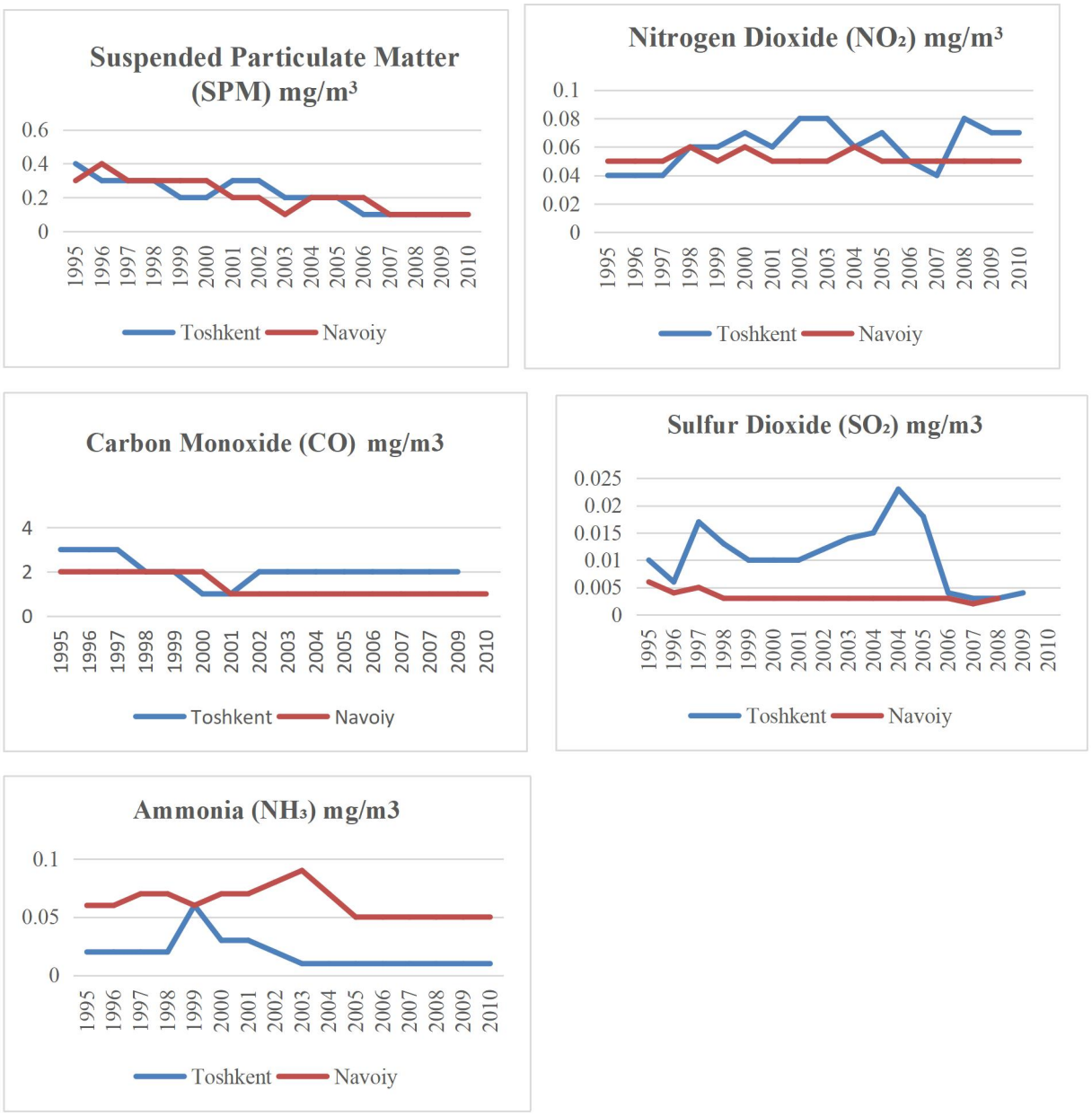

Figure 1. Fluctuation graph of atmospheric pollutant gases in Tashkent and Navoiy cities during 1995–2010.

There are several major reasons for the increase or decrease in the concentration of gases in the atmosphere. Changes in levels of pollutants such as particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, nitrogen oxide, ozone, and ammonia depend on various factors. The increase in particulate matter is linked to industrial waste, construction activities, road dust, and the high number of motor vehicles. In Tashkent, due to intense transport and industrial activities, a high concentration of these particles has been observed. In Navoi, industrial and mining activities are the main contributors to the increase in particulate matter. At the same time, the

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decrease in these particles can be attributed to rainfall, increased wind speeds, and the strengthening of control measures.

Sulfur dioxide is mostly produced as a result of coal and oil combustion. In Tashkent, industrial activity and heat stations have contributed to the increase in sulfur dioxide levels. In recent years, stricter environmental control and improvements in energy sources have led to a decrease in sulfur dioxide levels.

Carbon monoxide mainly originates from motor vehicles and industrial emissions. The large number of vehicles and aging cars in Tashkent have resulted in high concentrations of this gas. Industrial emissions in Navoi have also affected cabon monoxide levels. The reduction in carbon monoxide can be linked to improved vehicle maintenance and enhanced fuel quality.

Nitrogen dioxide and nitrogen oxide are primarily generated through fuel combustion, with main sources being transportation and industrial enterprises. Traffic density, fuel quality, and the effectiveness of filtration systems in vehicles and industries significantly influence the levels of these gases.

Ozone is considered a secondary atmospheric pollutant and is formed as a result of chemical reactions involving NOx and carbon compounds under ultraviolet radiation. Ozone levels rise mostly during the summer due to increased solar radiation accelerating these processes.

Ammonia mainly arises from agricultural activities, fertilizers, and the food industry. Agricultural activities in the areas surrounding Navoi contribute to the increase in ammonia levels.

The increase in gas levels seriously harms human health. Sulfur dioxide, nitrogen dioxide, and particulate matter can lead to respiratory diseases, bronchitis, asthma, and cardiovascular issues. Carbon monoxide reduces the oxygen-carrying capacity of blood, causing dizziness and other health problems. These gases also pollute soil and water, negatively affect plant growth, damage biodiversity, and contribute to climate change.

The main causes of pollution in Tashkent and Navoi include the large number of vehicles that do not meet environmental standards, emissions from industrial enterprises, agricultural activity, insufficient control systems, and issues within urban infrastructure. In Tashkent, the abundance of vehicles and outdated cars are primary sources of pollution, while in Navoi, industrial and mining activities play a dominant role. Therefore, measures such as enhancing environmental controls, implementing modern technologies, reducing transport and industrial emissions, and expanding green zones must be taken.

In conclusion, during the years 1995–2010, the levels of atmospheric pollution in Tashkent and Navoi varied across different pollutants. Overall, in Tashkent, transport and industrial activities were the main pollution sources, whereas in Navoi, the impact of industrial and mining

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operations was more pronounced. The concentrations of harmful gases such as particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxide, and nitrogen dioxide increased in some years and decreased in others. These fluctuations were influenced by urban infrastructure, technological updates, environmental controls, and climate conditions.

Air pollution negatively affects not only the environment but also the health of the population. The increase in pollution levels is linked to respiratory diseases, cardiovascular conditions, and allergic reactions. Therefore, systematic and comprehensive measures are essential for improving the ecological situation.

Recommendations:

1. **Implementing real-time air pollution monitoring systems** – Utilize modern digital sensors and IoT technologies to continuously monitor harmful substances in the air. This will allow for timely and accurate environmental management.
2. **Promoting and developing eco-friendly transportation** – Introduce tax incentives and subsidies to encourage the widespread use of electric and gas-powered vehicles with low fuel consumption and emissions. Additionally, expand urban infrastructure to support cycling and walking.
3. **Installing digital waste monitoring in industrial enterprises** – Equip every industrial facility with automated systems for online emission control and real-time waste analysis, allowing for early detection of problems.
4. **Expanding urban green spaces with vertical gardens and green roofs** – In addition to traditional tree planting, promote the cultivation of special plants on building roofs and walls to enhance natural air purification in urban areas.
5. **Educating the population on ecological innovations and sustainable lifestyles** – Through mobile apps and online platforms, provide continuous interactive information about air pollution, health risks, and eco-friendly living. Also, expand environmental education in schools and universities.
6. **Introducing environmental credits and fines for polluting enterprises** – Encourage industrial entities to reduce environmental damage by offering financial incentives and applying strict penalties for failure to comply with mandatory ecological standards.
7. **Developing and implementing regional environmental programs** – Design tailored environmental development strategies for each city, accounting for local conditions, lifestyle, and industrial potential, to minimize pollution.

By implementing these recommendations, the air quality in Tashkent and Navoi can be significantly improved, leading to better public health and environmental protection outcomes.

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