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ASSESSING AIR POLLUTION DYNAMICS ACROSS UZBEKISTAN'S REGIONS

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Abstract

In this scientific research, an analysis of the long-term dynamics of atmospheric air pollution in the Bukhara and Surkhandarya regions was carried out, considering the contribution of stationary sources of pollution. A study of the dynamics of gross emissions into the atmosphere in the Bukhara and Surkhandarya regions showed a significant decrease in the volume of pollutant emissions over the period under review. In the Bukhara region, the rate of decline turned out to be more significant, amounting to 34.5%, in the Surkhandarya region this indicator was 17.6%. However, the national average values also indicate a general trend of reducing emissions by 9.9%.

Analysis of the dynamics of the contribution of stationary sources to the total volume of emissions into the atmosphere made it possible to establish that there is a significant decrease in the contribution of stationary sources by 26.9% in the Bukhara region, while in the Surkhandarya region, there is a significant increase of 44.1%. The general trend throughout the republic shows an increase in the contribution of stationary sources to the total volume of emissions into the atmosphere by 9.2%.

Keywords: air pollution, the contribution of stationary sources of pollution, volume of emissions, dynamics of emissions.

Polluted air is one of the most significant environmental factors that harm public health and one of the priority pollutants in the air is dust [3].

The World Health Organization (WHO) pays important attention to the hygienic importance of fine particles. In 2005, the World Health Organization issued global guidelines on maximum levels of fine dust (PM_{10} and $PM_{2.5}$), ozone, and nitrogen dioxide to protect public

health. Recommended levels are regularly exceeded in many foreign countries [13]. Since the early 1990s, PM_{10} concentrations have been measured in the United States, which made it possible to estimate the share of this fraction in the total volume of suspended solids, which averaged 57% [4].

Administrative cities with a small number of large stationary sources of air pollution are characterized by a high traffic load and the presence of a huge number of medium and small production facilities, which can also be sources of air pollution. The results of many studies allow us to conclude that in all cities the atmospheric air is polluted and is the most important risk factor for diseases among city residents, but the methodological foundations for conducting relevant studies require systematic refinement and unification [2, 5].

In the CIS republics, the formation of a management system for the hygienic safety of the human environment is also based on an assessment of the health risks of environmental factors in research [6, 7, 8]. However, unlike European standards, it takes into account not only reference exposure levels and calculated risk values, but also an assessment of cause-and-effect relationships in the "environmental pollution – public health" system, obtained based on epidemiological studies [1, 7]. Much attention is paid to ranking the territory according to the level of pollution [2,5].

One of the significant sources of air pollution in cities are industrial facilities, which make a significant contribution to air pollution with fine particles. Particles with a diameter of less than 10 microns, due to their slow natural removal from the atmosphere, have a long life in suspension. Microparticles have increased toxicity and exhibit pro-inflammatory, carcinogenic, teratogenic, and cytotoxic effects, contributing to the development of allergy pathology [10, 11, 12].

According to studies conducted in Russian cities with developed industries, it was found that the incidence of respiratory diseases correlates with the quantitative and qualitative composition of microparticles in atmospheric suspensions [7].

Studies conducted in Germany have shown that fine particulate dust (PM_{10} and $PM_{2.5}$) affects the cardiovascular and respiratory systems [9, 14]. In addition to lung and heart diseases, the carcinogenic effect of fine dust is now well known. High exposure to fine dust is also associated with metabolic diseases, with the incidence of type 2 diabetes mellitus found to be associated with increased concentrations of fine dust, with the relative risk increasing by 25% for every 10 μg/m3 of PM2.5 [9,13,14].

The purpose of the study was to determine the long-term dynamics of atmospheric air pollution in the Bukhara and Surkhandarya regions, taking into account the contribution of stationary sources of pollution.

Materials and methods: This study used official statistical data from 2018 to 2022. To analyze the dynamics of atmospheric emissions, units of measurement were used - thousands of tons per year, taking into account the division into stationary sources of pollution. To assess the level of pollution, calculations of dynamics indicators were carried out, such as the average annual growth rate, maximum and minimum values, arithmetic means, and standard deviations. Data analysis and visualization of results were performed using the Microsoft program Excel, ensuring high accuracy and reliability of research results.

Results and discussion

Earlier, we carried out a comparative analysis of the dynamics of the general morbidity rate of the population of the Bukhara and Surkhandarya regions relative to the republican indicators for the period from 2017 to 2021, which allowed us to establish that in 2017 both regions demonstrated an morbidity rate above the republican average (83,808.5 cases per 100 thousand

population). In subsequent years (2018-2021), there were more significant decreases in overall morbidity, both in Surkhandarya (up to 49,394.4 cases) and Bukhara regions (up to 42,495.2 cases) than in the republic as a whole (67,666.6 cases per 100 thousand population).

In the structure of morbidity in the Surkhandarya region, there was a predominance of diseases of the respiratory system, blood and hematopoietic organs, digestive organs, genitourinary system and circulatory system, which in total amounted to 64.5%.

The structure of the general morbidity rate of the population of the Bukhara region was determined mainly by diseases of the respiratory organs, blood and hematopoietic organs, the circulatory system, trauma and poisoning, as well as diseases of the digestive organs, the incidence of which in total amounted to 67.1%.

Taking into account the fact that in the structure of the leading diseases among the population of the two studied regions of the republic, diseases of the respiratory organs, blood and hematopoietic organs, and circulatory system, which relate to diseases of dust etiology, prevailed, we analyzed the dynamics of air pollution in these same regions.

Atmospheric air pollution in the studied regions of the republic is caused by two types of sources: stationary sources and mobile ones. We analyzed stationary sources of pollution, which are mainly represented by industrial enterprises. The results of the study are presented in Figure 1.

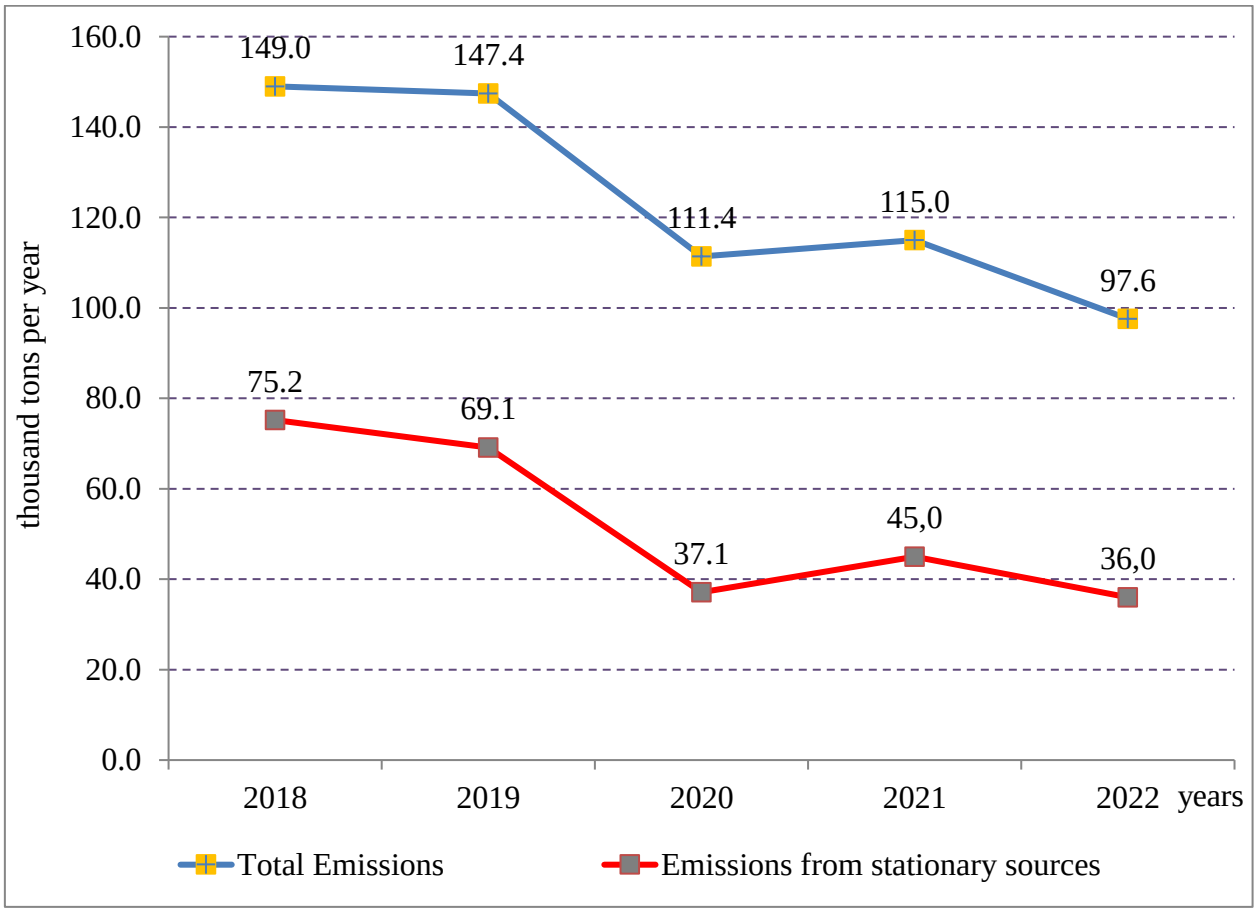

Figure 1. Dynamics of atmospheric emissions from stationary sources in comparison with the total volume of emissions into the atmospheric air of the Bukhara region.

Analysis of the dynamics of gross emissions into the atmosphere of the studied regions made it possible to establish that in the Bukhara region, there was a significant decrease in the

volume of emissions of air pollutants for the period from 2018 to 2022. Emissions decreased by 34.5%, from 149 thousand tons /year in 2018 to 97.6 thousand tons /year in 2022. The average emission value for this period was 124.1±2.1 thousand tons /year.

In the Surkhandarya region, there is also a decrease in the volume of emissions of air pollutants during the period under review, but the rate of decrease is not so significant, amounting to -17.6 %. The volume of emissions decreased from 83.9 thousand tons /year in 2018 to 69.1 thousand tons /year in 2022 (Fig. 2).

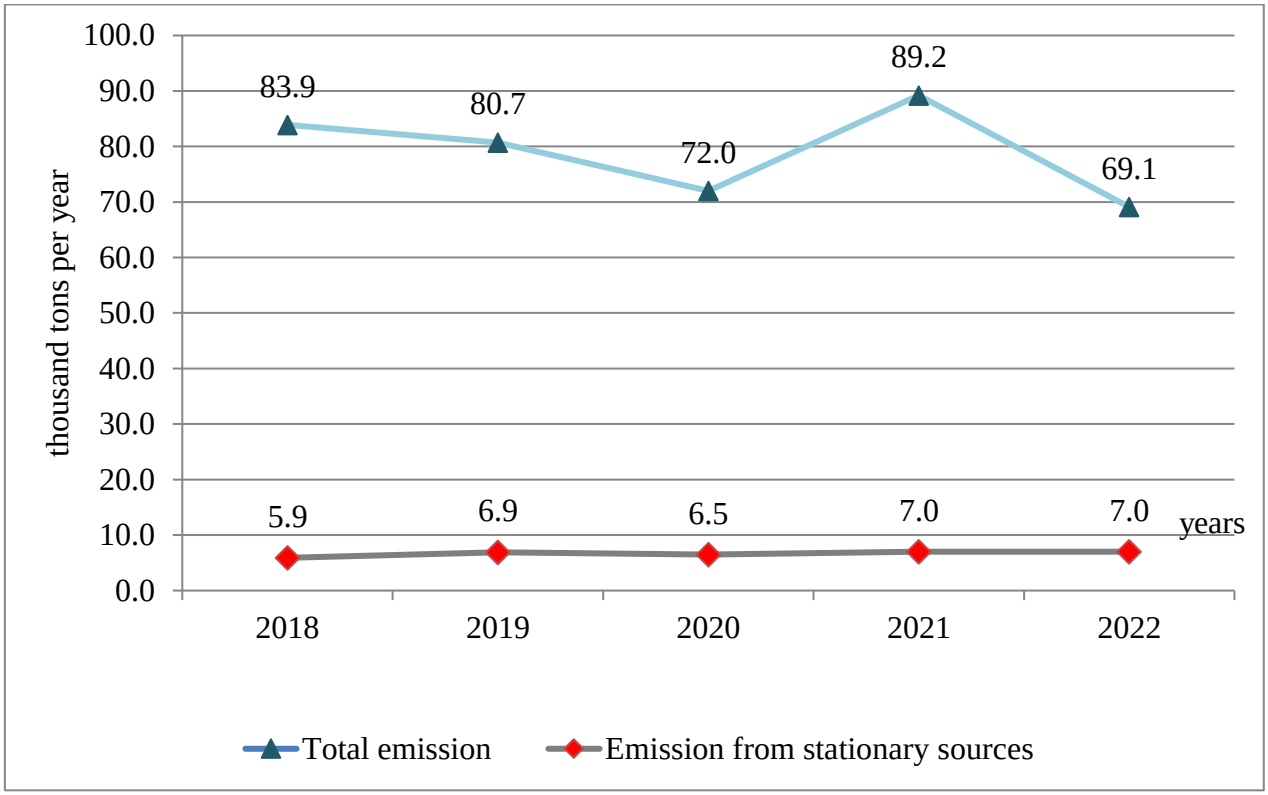

Figure 2. Dynamics of atmospheric emissions from stationary sources in comparison with the total volume of emissions into the atmospheric air of the Surkhandarya region.

The average value of emissions in the Surkhandarya region for five years was 79.0±0.9 thousand tons /year.

The national average values for the volume of emissions of air pollutants for the five years studied amounted to 2292.4 ± 2.7, with a decrease rate (by -9.9%).

In general, an analysis of the dynamics of gross emissions into the atmosphere allows us to draw a conclusion about the positive dynamics of reducing air pollution in both regions considered and at the level of the entire republic.

We also analyzed the contribution of stationary sources to the total volume of emissions of air pollutants. The results of the analysis allowed us to conclude that the contribution of industrial enterprises to the total emissions for the studied period amounted to an average of 41.3 ± 1.1% in the Bukhara region, in the Surkhandarya region - 8.5 ± 0.4%, while the republican the values were equal to - 39.8 ± 0.3%. During the study period, the dynamics of changes in the contribution of enterprises to total air pollution were observed, presented in Table 1.

Table 1.

Share of emissions of air pollutants from stationary sources, % of the total volume of pollution

Regions of the republic	2018	2019	2020	2021	2022	M ±m	growth rate %
Bukhara region	50.5	46.9	33.3	39.1	36.9	41.3 ± 1.1	-26.9
Surkhandarya region	7.0	8.6	9.0	7.8	10.1	8.5 ± 0.4	44.1
By republic	36.9	38.9	41.0	41.7	40.3	39.8 ± 0.3	9.2

In the Bukhara region, a significant decrease in the contribution of enterprises was recorded, which amounted to -26.9%. This may be the result of several factors, such as the introduction of stricter environmental standards or the modernization of production processes to reduce emissions. In the Surkhandarya region, there is a significant increase in the contribution of enterprises to total air pollution, amounting to 44.1%. This may indicate increased industrial activity in the region or ineffective emission control measures. Comparing the dynamics throughout the republic, it can be noted that the growth rate of the contribution of enterprises to total air pollution was 9.2%. This indicates a general trend towards an increase in the impact of industrial enterprises on the environment, which requires attention and the adoption of appropriate measures to reduce negative environmental consequences.

Conclusion:

1. A study of the dynamics of gross emissions into the atmosphere in the Bukhara and Surkhandarya regions showed a significant decrease in the volume of pollutant emissions over the period under review. In the Bukhara region, the rate of decline in the Bukhara region turned out to be more significant and amounted to 34.5%, and in the Surkhandarya region - 17.6%. However, the national average values also indicate a general trend of reducing emissions by 9.9%.

2. Analysis of the dynamics of the contribution of stationary sources to the total volume of emissions into the atmosphere made it possible to establish that in the Bukhara region, there is a significant decrease in the contribution of stationary sources by 26.9%, while in the Surkhandarya region, there is a significant increase of 44.1%. The general trend throughout the republic shows an increase in the contribution of stationary sources to the total volume of emissions into the atmosphere by 9.2%.

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