

ORIGINAL RESEARCH ARTICLE

Impacts of atmospheric air pollution on the cities of the Navoi region

Latipov Normurod Faxriddin o'g'li

Department of Geography, National University of Uzbekistan named after Mirzo Ulugbek, Tashkent 100174, Republic of Uzbekistan; latipovnormurod@gmail.com

ABSTRACT

The president of the Republic of Uzbekistan, Shavkat Mirziyoev, in his address to the Oliy Majlis in 2021, said that, we must pay more attention to environmental protection and improvement of the ecological situation. They emphasized that it is necessary to improve the system of ecological control of the production process and to develop a comprehensive program of measures designed until 2025 to prevent the impact of industrial development on the environment. The rapid growth of cities, the intensification of urbanization processes that lead to all socio-ecological consequences, and the accumulation of large sources of anthropogenic impact on the surrounding area make cities the main object of study. The relevance and social importance of the study of the urban environment contribute to the involvement of many scientific disciplines in the development of their research concepts and directions for the optimization of the living environment of urban residents. The diversity of research calls for the synthesis of ecological knowledge about the city. Economic and social geography is a science capable of realizing the potential of integration in the study of such a complex object. The city should operate in the environment of the area with ecological balance, which ensures the sustainable and harmonious development of the area and the city. The reproduction of the main components of the natural environment and preservation of the diversity of geosystems can be achieved by harmoniously incorporating them into the regional natural ecological system, taking into account the natural and socio-economic characteristics of the city. In general, much work has been done in economic and social geography in the study of the city and its surrounding areas. In the course of the development of agglomerations, the study of the interaction between the city and the region, migration and labour flows is of great practical importance and has helped to solve many important national economic and socio-economic problems. In economic and social geography, many works in the ecological direction are devoted to the impact of cities on the environment, the impact on environmental components, the organization of the territory, etc. However, the reverse chain of the “territory-urban environment-city” relationship has hardly been analyzed in research. The choice of the territory of the Navoi region is symbolic because the region has a large industrial potential and is distinguished by highly intensive agriculture. Various problems in the area can be summarized in 3 blocks: improvement of economic activity, improvement of territorial structure and urban planning structure, protection and optimization of environmental quality. The most important criterion that reflects the range of negative effects of the quality of the environment is the health of the population. However, caution should be exercised when interpreting these indicators and using them in conjunction with other criteria. This article describes some of the results and conclusions of the research conducted on the indicators of atmospheric air pollution in the cities of the Navoi region and their negative consequences.

Keywords: ecological state of cities; nitrogen dioxide; particulate matter; public health; industrialized cities; epidemic

1. Introduction

It is known that atmospheric air pollution is a significant environmental threat to public health. WHO data shows atmospheric air pollution causes 2 million deaths annually. Today, most air pollution deaths are accounted for by developing countries. In most cities, the average annual level of PM10 and PM2.5 (with a diameter of 10 microns or less—PM10 and 2.5 microns (μm) or less—PM2.5 suspended in the air, construction, manufacturing (especially cement, ceramics, bricks, etc.), erosion of the road surface and erosion of brake pads and tires, solid microparticles formed from the burning of solid fuels) exceeded 70 mm/m^3 .

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However, this indicator is 20 mm/m^3 in the WHO recommendations on atmospheric air quality should be lower. By reducing PM10 pollution from 70 mm/m^3 to 20 mm/m^3 , and PM2.5 to 10 mm/m^3 , it is possible to reduce air pollution deaths by 15%.

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2. Literature review

A very wide range of studies have been conducted in the CIS (Commonwealth of Independent States) countries on cities and their territorial complexes. In this regard, first of all, Baransky et al.^[1-5] conducted research.

On the study of cities in Soliev, S.Q. Tashtaeva^[6] and other specialists were involved. Kh. T. Tursunov^[7] on urban ecology, Komilova^[8] on the health of city residents and related issues. In addition, it should be noted that in the 60s of the 20th century, Kovalev et al.^[6,7,9-14] researched the geography of population settlements in the Zarafshan region. The difference between this work from the research of the above scientists is its unique natural environment, that is, the ecological condition of the cities of the industrialized Navoi region, and the development of measures aimed at its improvement.

3. Main body

A high level of industrial potential and an efficient transportation system in the Navoi region have a significant impact, first and foremost, on the administrative centre—Navoi, and on the remaining six urban areas. Observing the ten-year trend of toxic gases released into the atmosphere by enterprises, organizations and institutions within the region, we can observe a slight increase in their amount between years (**Figure 1**).

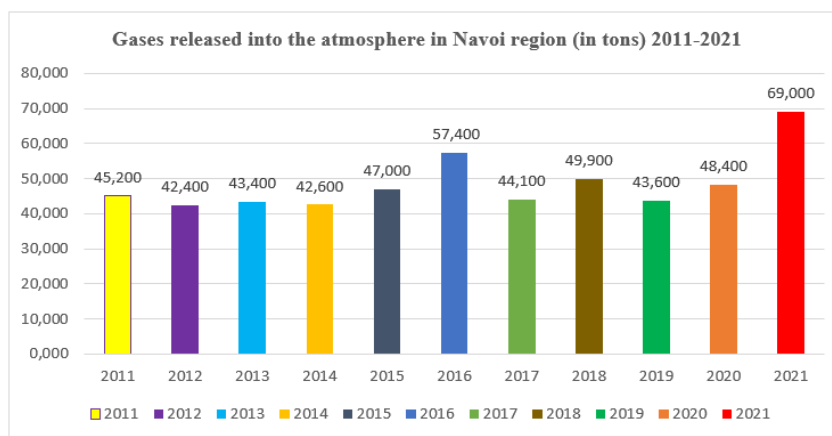


Figure 1. Gases released into the atmosphere in Navoi region (in tona) 2011-2021.

In 2020, 48,400 tons of harmful gases were released into the atmosphere in the region, and according to statistical reports received at the end of 2021, 69,000 tons of harmful gases were released. Compared to last year, 20,600 tons of dust and harmful gases were released. The main part of harmful gases is contributed by industrial enterprises. For example, NKMK (Navoi Mining and Metallurgy Combinat) released 19,700 tons, the Kyzylkum phosphorite plant 26,200 tons, Navoiyazot JSC 4800 tons, Kyzylkumtsement JSC 9500 tons, and Navoi thermal power station 2900 tons of dust and harmful gases into the atmosphere. All large enterprises in the region account for 55.8 thousand tons or 80.8% of total emissions.

The location of industrial enterprises in the cities of the region close to settlements and the fact that the wind direction is not taken into account during their construction has a serious effect on the ecological condition of the areas adjacent to the city, and this situation causes the expansion of the radius of influence of emission sources. Therefore, when it comes to assessing the environmental condition of cities, the quality of atmospheric air should be the first level indicator. It should be emphasized that it is impossible to get a clear result without the observations of the Republic Hydrometeorological Service Center as the main source, as well as the percentage of toxic substances in the air. But it should also be taken into account that the correlation radius of observation posts may not exceed a few km, which will have an impact on the accuracy of the data.

According to the regional statistics office, as of 1 October 2022, the total number of industrial enterprises operating in the region is 3942, of which 826 are in Navoi, 376 are in Zarafshan, 198 are in Gozgon, 442 are in Kyziltepa, 283 are in Nurota, and 180 are in Uchkuduk. 490 of them are located in the territory of Yangirabot cities. Along with the city of Navoi, which is considered the administrative centre according to the indicator of the emission of toxic gases by industrial enterprises, industrialized cities such as Zarafshan, Uchkuduk, Gazgon, and Nurota stand out (**Figure 2**).

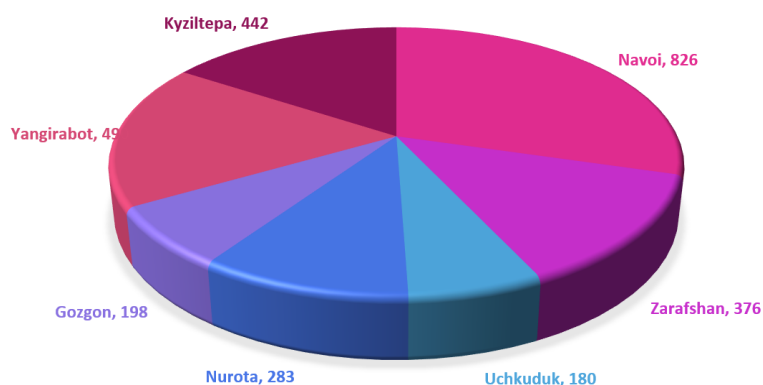


Figure 2. The total number of industrial enterprises in regional cities.

The result of monitoring shows that the average annual indicator of nitrogen oxide pollution in the region in 2022 was 0.04 mg/m³, and in 2021, the indicator of pollution with this substance was 0.03 mg/m³. It can be seen that in 2022, compared to 2021, it increased by 0.01 mg, it is appropriate to associate it with the increase in industrial production in the cities of Navoi, Zarafshan, and Uchkuduq. We can see the average level of air pollution with nitrogen oxides, and in the cities of Nurota and Gozgon, Kyziltepa, and Yangirabot, we can see a low level of pollution. In the same cities, the classification of nitrogen dioxide pollution is also specific to nitrogen oxide. In 2021 and 2022, the average annual indicator of nitrogen dioxide pollution was 0.05 mg, but the allowed average annual norm is 0.04 mg. In the cities of Navoi and Zarafshan, where a high concentration of these substances was observed, mainly electric power and metallurgical industrial enterprises. It is characterized by a large amount of gases released into the atmosphere.

65% of carbon dioxide emissions come from transportation, 21% from small consumers and the household sector, and 14% from industry. Extreme concentrations are often observed in areas with a high anthropogenic load on the environment—traffic jams or inversions leading to smog formation (weak air exchange conditions). The average annual permissible limit of this substance is 3 mg/m³, and the percentage of carbon monoxide in the atmospheric air of the region in 2021 was on average 1 mg, and in 2022 this indicator was 1.5 mg. The 5 existing cities: Qiziltepa, Yangirabot, Nurota, Gozgon, and Uchkuduq have a low level of carbon monoxide pollution, and the cities of Navoi and Zarafshan, they have an average level, and no high level of pollution was observed.

Ammonia (NH₃) is a colourless gas with a characteristic pungent odour. Belongs to the 4th danger class. In nature, nitrogen-containing organic compounds are formed when they decay. Anhydrous gaseous ammonia is lighter than air, so it rises up, as a result, it generally disperses and does not accumulate at the bottom. At high relative humidity, ammonia forms a heavy vapour in the air. This evaporation accumulates over the land or over the lowlands.

80% of industrially produced ammonia is used as fertilizer in agriculture. Ammonia is also used in cooling devices and in the production of plastics, explosives, textiles, pesticides, and dyes. It is found in most household and industrial washing solutions. Ammonia-containing household products are prepared with the addition of 5%—10% ammonia, industrial solutions have a higher concentration of ammonia—25%, so it is sharp.

A high concentration of ammonia in the air causes irritation of the nose, throat and respiratory tract. This can cause respiratory tract damage. Breathing in low concentrations of ammonia causes coughing, and itchy nose and throat. The smell of ammonia gives an early warning of its presence, but at the same time, it weakens the sense of smell, which reduces the possibility of detecting its low concentrations in the air. Ammonia reacts with moisture on the skin, eyes, mouth, and respiratory tract and can cause chemical burns. In 2021, the concentration of this gas in the atmosphere of the region was 0.0333 mg/m³, and by 2022, it will increase slightly to 0.0391 mg/m³, which is almost equal to the average allowed standard (0.04 mg/m³). we can see. In regional cities, a low level of ammonia pollution was observed in the city of Yangirabot, the average level was observed in the cities of Nurota and Gazgon, and a high level of pollution was observed in the cities of Navoi, Zarafshan, Uchkuduq, Kiziltepa.

Sulfur dioxide, sulfur anhydride—colourless, with a specific sharp smell (the smell of a burning match). It includes wastes of ferrous and non-ferrous metallurgical enterprises, ceramic, caprolactam, linoleum, paper, foam production enterprises, food, textile and paper industries, as well as thermal energy enterprises—thermal power plants (WPPs, GRES, boiler houses). Exposure to sulfur dioxide in concentrations higher than the permissible limit can lead to an increase in various respiratory diseases, affect mucous membranes, throat-nose inflammation, bronchitis, cough, throat suffocation and pain. People with asthma are especially sensitive to sulfur dioxide. The average annual MPC indicator for this substance is 0.005 mg per cubic meter, and in the

region in 2021–2022, this indicator was not lower than 0.006 mg. The lowest level of sulfur dioxide pollution is in the relatively clean city of Yangirabot, the cities of Nurota and Ghazgon are average, and the level is particularly high in Navoi, Zarafshan, Uchkuduk, and Kyziltepa (**Table 1**).

Table 1. Key pollutants in regional cities compared to MPC values.

	Nitric oxide (NO)	Carbon monoxide (CO)	Ammonia (NH₃)	Sulfur dioxide (SO₂)	Nitrogen dioxide (NO₂)	Particulate matter (dust)
Low pollution level	Kyzltepa, Yangirabot.	Kyzltepa, Yangirabot, Nurota, Ghazgan, Uchkuduk.	Yangirabot	Kyzltepa, Yangirabot	Kyzltepa, Yangirabot	Nurota, Gazgan.
Moderate pollution level	Nurota, Ghazgan.	Navoi, Zarafshan	Nurota, Gazgan.	Nurota, Gazgan.	Nurota, Gazgan.	Yangirabot.
High pollution level	Navoi, Uchkuduk, Zarafshan.	-	Navoi, Uchkuduk, Zarafshan, Kyzltepa	Navoi, Uchkuduk, Zarafshan.	Navoi, Uchkuduk, Zarafshan.	Navoi, Uchkuduk, Zarafshan, Kyzltepa.

4. Conclusion

Humanity’s progressive development cannot be stopped or reversed like irreversible evolutionary processes. In this regard, it can be said that urbanization is the future of all mankind because the share of the urban population on the planet is growing more and more. In a sense, the process of urbanization gives scientists the opportunity to solve global ecology, human ecology, and modern urban ecological problems. The conclusions made as a result of our research were as follows:

- As the urbanization process develops, not only its regulation and management, but also the problems related to the ecological condition and public health increase, and it is precisely these problems that the science of urban ecology deals with;
- Initially, until the 50s of the last century, attention was focused on the issues of how to organize cities in the process of the acceleration of “nature and society” relations, now the issue of the ecological condition of cities and its optimization is gaining urgent importance;
- Approaches to the study of the urban ecological condition study the urban environment through different parameters and concepts, and in addition to the purpose, positive and negative aspects of each approach, there are also new networks that have emerged on the basis of these approaches;
- When assessing the environmental condition of cities, scientists use different indicators. When choosing indicators, it is necessary to pay attention to such things as relevance to international environmental policy, relevance to national priorities, clarity and clarity for the general public, availability of an acceptable methodology for assessment, availability of a long-term collection of relevant data, and the possibility of forecasting.
- In the near future, if we do not carry out an acceptable environmental policy, especially in cities, cities will continue to appear as the main “centre” of atmospheric air pollution;
- The increase in production in industrialized cities leads to excessive pollution of the atmosphere, and in turn, this process has a negative effect on the ecology of the suburbs and adjacent areas;
- The main thing is that if the ecological situation continues like this analysis, the cities can be interpreted as the centre of public health and related problems, various diseases, and epidemics.

Conflict of interest

The author declares no conflict of interest.

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