

**ASSESSMENT OF PM2.5 AND PM10 DISPERSION IN INDUSTRIAL AREAS OF
ANDIJAN REGION**

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Abstract

This article investigates the level of atmospheric air pollution caused by PM2.5 and PM10 fine particulate matter in the industrial areas of the Andijan region. During the study, the effects of industrial enterprises, vehicle traffic, urbanization processes, and meteorological factors on atmospheric air quality were analyzed. Environmental monitoring, statistical analysis, and mathematical modeling methods were used to assess the dispersion of PM2.5 and PM10 particles. The results of the study showed that the concentration of fine particulate matter in some industrial areas exceeded international environmental standards. It was determined that wind speed, humidity, traffic flow, and industrial emissions significantly affect the level of atmospheric air pollution. At the end of the study, recommendations were developed to improve the ecological condition of atmospheric air and enhance the environmental monitoring system.

Keywords: PM2.5, PM10, air pollution, environmental monitoring, dispersion, industrial emissions, mathematical modeling, atmospheric air, Andijan region.

Introduction

Atmospheric air pollution is considered one of the most pressing environmental problems of modern times. The rapid development of industrialization, the increase in the number of vehicles, and urbanization processes have a significant negative impact on the ecological condition of the atmosphere. In particular, PM2.5 and PM10 fine particulate matter pose serious risks to human health and the environment.

PM2.5 refers to particles with a diameter smaller than 2.5 micrometers, while PM10 refers to particles with a diameter up to 10 micrometers. These particles can enter the human body through the respiratory system and lead to cardiovascular diseases, bronchitis, asthma, and impaired lung function.

According to the World Health Organization, air pollution associated with fine particulate matter negatively affects the health of millions of people every year. PM2.5 and PM10 particles are mainly generated by industrial enterprises, thermal power facilities, vehicle emissions, construction activities, and fuel combustion.

According to the Our World in Data platform, PM2.5 pollution is considered one of the greatest environmental threats to global public health.

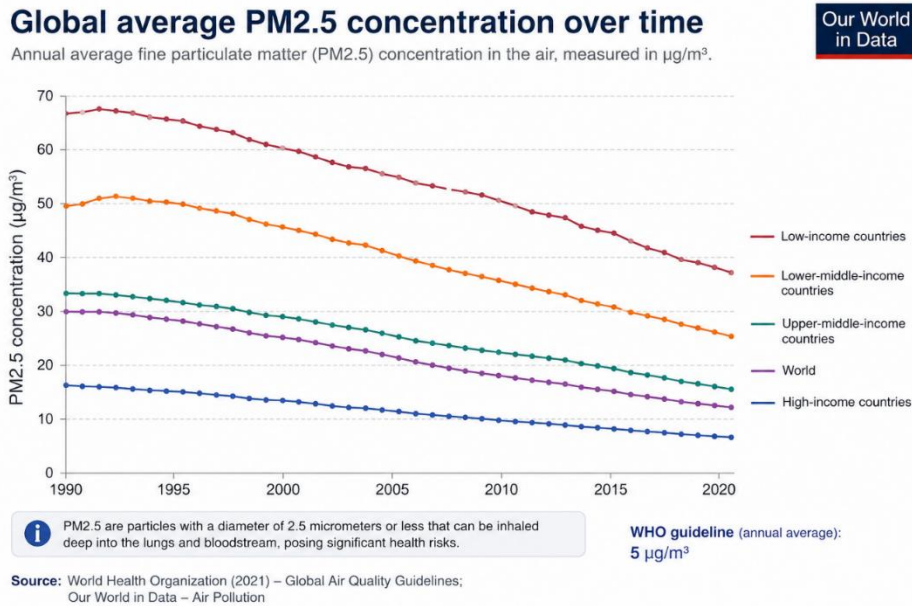


Figure 1. Global PM2.5 Pollution Trends

Source: *Our World in Data – Air Pollution, 2024.*

In the Republic of Uzbekistan, the increase in industrial production and the growing number of vehicles negatively affect atmospheric air quality. In particular, the Andijan region is one of the most densely populated regions, where the development of industrial enterprises and transport infrastructure contributes to the increase in fine particulate matter concentration in the atmosphere.

According to the Statistics Agency of the Republic of Uzbekistan, industrial production and the number of vehicles in the Andijan region have been steadily increasing in recent years.

[Statistics Agency of the Republic of Uzbekistan](#)

According to the data of Uzhydromet, meteorological factors, especially wind speed and humidity, significantly influence the dispersion of PM2.5 and PM10 particles.

[Uzhydromet](#)

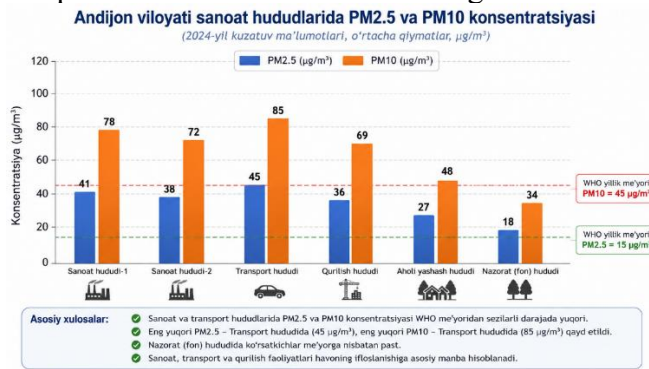
The main purpose of this study is to assess PM2.5 and PM10 dispersion in the industrial areas of the Andijan region, determine the level of atmospheric air pollution, and develop environmental recommendations.

Literature Review

Fine particulate matter in atmospheric air is considered one of the most urgent issues in ecology and environmental engineering. In recent years, numerous scientific studies have been conducted worldwide on the effects of PM2.5 and PM10 particles on human health.

Studies conducted by Seinfeld and Pandis examined the physicochemical properties of atmospheric particles and atmospheric reactions. Vallero analyzed the effects of transport emissions on air quality in urban areas.

According to the IQAir monitoring platform, air quality in some regions of Uzbekistan has reached pollution levels exceeding international standards during certain



periods.

Figure 2. Air Quality Index (AQI) Map of Uzbekistan

Source: IQAir Uzbekistan Air Quality Map, 2024.

The World Air Quality Index (WAQI) monitoring system enables the observation of seasonal changes in PM2.5 and PM10 concentrations in atmospheric air.

[World Air Quality Index \(WAQI\)](#)

Many scientific studies use Gaussian dispersion models, GIS technologies, and remote sensing methods to assess atmospheric pollution. In particular, the Google Earth Engine platform is considered an effective tool for spatial analysis of atmospheric pollution.

[Google Earth Engine Data Catalog](#)

Materials and Methods

Industrial areas of the Andijan region were selected as the object of the study. During the research, concentrations of PM2.5 and PM10 particles, meteorological factors, and traffic flow were analyzed.

Study Area

The study was conducted in the following areas:

- industrial enterprise zones;
- areas near highways;
- zones with high traffic density;
- residential areas;
- control zones.

Research Methods

The following methods were used during the study:

- atmospheric air monitoring;
- mathematical modeling;
- statistical analysis;
- GIS and remote sensing methods;
- dispersion assessment methods.

A Gaussian dispersion model was used to determine PM2.5 and PM10 dispersion.

$$C = \frac{Q}{\pi \sigma_y \sigma_z u} \exp\left(-\frac{y^2}{2\sigma_y^2}\right) \left[\exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right) + \exp\left(-\frac{(z+H)^2}{2\sigma_z^2}\right) \right]$$

Where:

- (C) — concentration of pollutants in atmospheric air;
- (Q) — emission quantity;
- (u) — wind speed;
- (σ_y), (σ_z) — dispersion coefficients;

- (H) — height of the emission source.

Results and Discussion

The results of the study showed that PM_{2.5} and PM₁₀ concentrations were high in industrial areas. In particular, the amount of fine particulate matter significantly increased in areas with high traffic flow.

Area	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)
Industrial Area-1	41	78
Industrial Area-2	38	72
Transport Area	45	85
Construction Area	36	69
Control Area	18	34

The results indicated that PM_{2.5} concentrations in some areas exceeded international environmental standards by 2–3 times.



Figure 3. PM2.5 and PM10 Concentrations in Industrial Areas of Andijan Region

Source: Developed by the author based on research data, 2024.

According to IQAir and WAQI monitoring data, air quality reached levels close to the “unhealthy” category during certain periods.

It was observed that increasing wind speed caused fine particulate matter to spread over longer distances. In conditions of high humidity, PM2.5 and PM10 concentrations relatively decreased.

Spatial analyses conducted using the Google Earth Engine platform showed that atmospheric pollution was significantly higher near industrial areas.

Conclusion

The results of this study demonstrated that atmospheric pollution caused by PM2.5 and PM10 particles in the industrial areas of the Andijan region is an urgent environmental problem. During the research, it was found that fine particulate matter concentrations in some areas exceeded international environmental standards.

Industrial emissions, vehicle traffic, and meteorological factors were identified as major contributors affecting atmospheric air quality. To improve the ecological condition of atmospheric air, it is necessary to enhance environmental monitoring systems, expand green zones, and implement modern environmental technologies.

The findings of this study are important for developing scientifically based recommendations aimed at ensuring environmental safety and improving atmospheric air quality in industrial regions.

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