



Environmental Assessment of Ambient Particulate Matter around Al-Qasim Green University

Ghassan Abukhanafer

Water Resources Management Engineering, Collage of Engineering, AL-Qasim Green University, Babylon 51013, Iraq.

*Corresponding author E-mail: ghassan@wrec.uoqasim.edu.iq
 0009-0005-9543-6097

Abstract

Particulate matter (PM_{2.5} and PM₁₀) have been classified as a hazardous air pollutant because it is inhaled into the respiratory system and can cause chronic health effects. The objectives of this paper are: (i) to evaluate the concentrations of PM in the vicinity of Al-Qasim Green University and (ii) to propose a scientific basis for such studies on sustainability programs within Iraqi universities. Data were obtained between January-June 2025, using a high-volume air sampling instrument at the rate of (a) eight readings per month. Air-quality monitoring results showed that during February and April, the PM_{2.5} (33 µg/m³ and 33 µg/m³, respectively) and PM₁₀ (83 µg/m³ and 81 µg/m³, respectively) levels exceeded the recommended guideline value set by the WHO. This is due to the following reasons: climate change, intensified vehicular movement, ongoing construction works around residential buildings with no verdant spaces to ensure quality air for breathing, and poor city planning, which collectively affect indoor air quality and compromise students' comfort zones in terms of inhalation. The study recommends expanding green spaces (>40%), improving parking design, paving unpaved paths to reduce particulate matter, and implementing continuous air quality monitoring.

Keywords: Particulate matter, PM_{2.5}, PM₁₀, air pollutant, campus

1. Introduction

Air pollution is one of the most significant environmental and health challenges facing countries. Among the most dangerous air pollutants are fine particulate matter (PM₁₀ and PM_{2.5}) due to their direct inhalation into the respiratory system, causing chronic diseases.[1] Consequently, their concentration should be evaluated and compared with the acceptable Iraqi and international limits (Table 1). This is an important question to understand their influence on local environment and public health. Climatic factors such as temperature, humidity, and wind, in addition to traffic, construction activities, and urban and environmental planning, are major influences on particulate matter.[3,2] Iraq is considered more susceptible to fine particulate matter due to its diverse environment and climate, as indicated in reports by the United Nations Environment Programmed (UNEP, 2023), in addition to limited vegetation cover, increasing population, traffic, construction activities, and the prevalence of unpaved secondary roads in most residential areas.[4, 5]

2. Table 1: WHO and Iraqi criteria for PM_{2.5} and PM₁₀[1, 2]

AQI Category	PM2.5 24-hr Average (µg/m ³) - Iraq	PM2.5 24-hr Average (µg/m ³) - WHO	PM10 24-hr Average (µg/m ³) - Iraq	PM10 24-hr Average (µg/m ³) - WHO
Good	0 – 15	0 – 15	0 – 70	0 – 45
Moderate	16 – 35	16 – 25	71 – 150	46 – 75
Unhealthy for Sensitive Groups	36 – 55	26 – 35	151 – 250	76 – 150
Unhealthy	56 – 150	36 – 50	251 – 350	151 – 250
Very Unhealthy	151 – 250	51 – 75	351 – 430	251 – 350
Hazardous	251 – 500	>75	431 – 600	>350

Air quality studies are of particular importance in university environments because they represent an educational and research environment where various human activities, such as students and staff, are mixed with other administrative and



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engineering activities.[3, 4]. The aim of this study is to assess particulate matter levels around Al-Qasim Green University, to promote environmental awareness within the university community, to provide the necessary recommendations to improve air quality around the campus, to maintain the health and safety of students and staff, and minimize as much as possible the risks associated with prolonged exposure to air pollutants, which cause allergies, respiratory diseases, and cardiovascular diseases.

2. Methodology

2.1. Study Area

Al-Qasim Green University is located at latitude 32.7250° North and longitude 44.3333° East in Al-Qasim City, Babylon Governorate, Iraq. [5]. The main campus occupies an area of approximately 40 hectares and has about 7,000 students distributed across nine humanities and science colleges. Green spaces comprise about 25% of the total university area. The university is surrounded by important urban streets: University Street to the north (heavy traffic), Agriculture Street to the west (parking area), Industry Street to the east (less congested traffic), and Service Street to the south (traffic and shops).

2.2. Materials

The High-Volume Air Sampler (HVS) was used to measure $PM_{2.5}$ and PM_{10} with high accuracy, using filters specifically designed for absorbing fine particles.

2.3. Methods

The method of data collection and calculation was as per the table 2. and figure 1.

Table 2: method of data collection

Item	Description
device	High-Volume Air Sampler
Time period	1 January – 1 June, 2025
Number of readings	8 readings per month \times 6 months = 48readings
Locations	Points on the four main streets in all directions (N, S, E, and W) (Fig. 1) C=W / V C: Concentration of suspended particulate matter ($\mu g/m^3$) W: Mass of particles collected on the filter (μg) V : Volume of air passed through the filter (m^3)
	The equation shows that the concentration of particulate matter depends on the amount of particles collected on the filter relative to the volume of air passing through, providing an accurate measurement of the level of air pollution in the area under study.

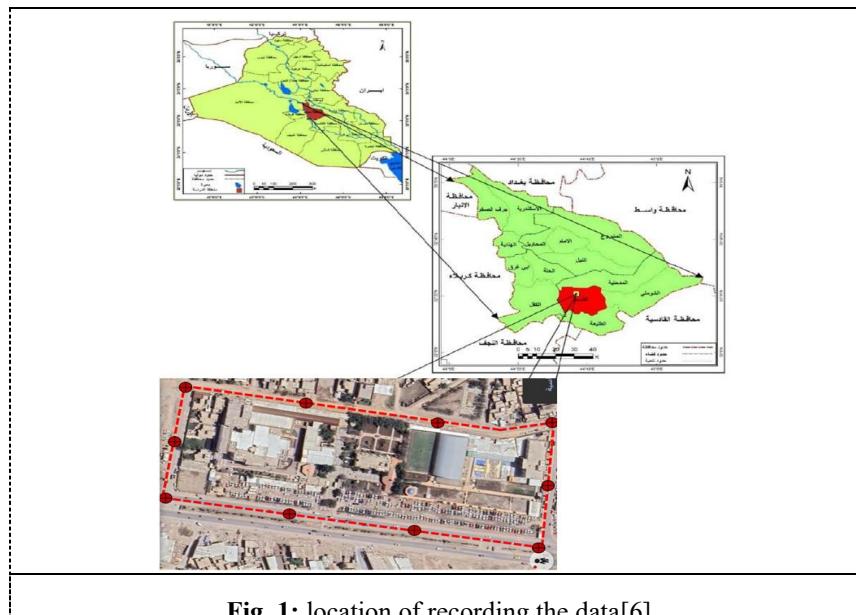
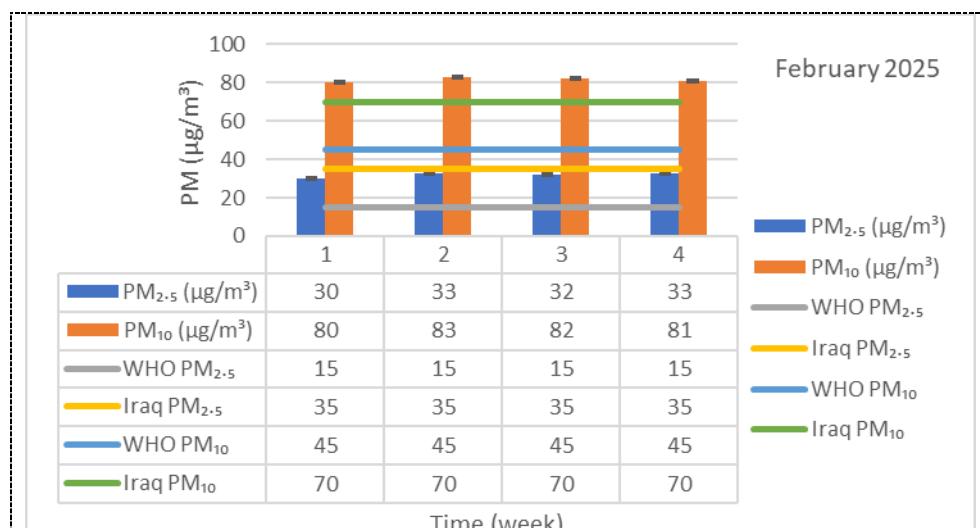
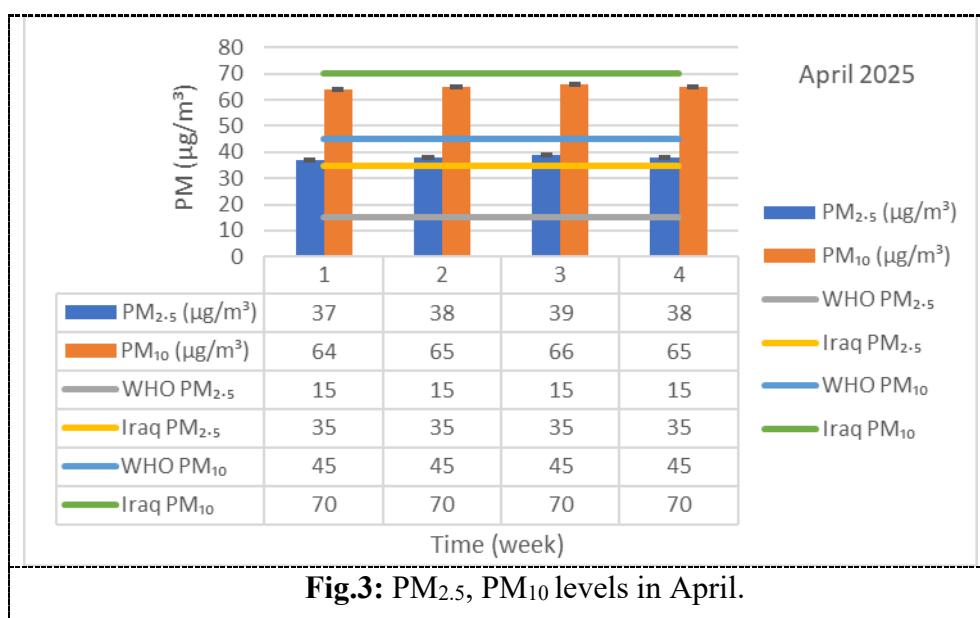


Fig. 1: location of recording the data[6]

3. Results and Dissections

The results showed a temporal variation in the levels of fine particulate matter ($PM_{2.5}$) and coarse particulate matter (PM_{10}) during the study period at Al-Qasim Green University. Figures 2 and 3 illustrate the levels of particulate matter for the months of February and April that exceeded World Health Organization (WHO) standards, while other readings were acceptable within Iraqi standards. This is because WHO standards are based on strict health principles, while national standards take into account local climatic and environmental conditions.

Fig.2: PM_{2.5}, PM₁₀ levels in February.Fig.3: PM_{2.5}, PM₁₀ levels in April.

In Figure 3 the maximum values of both PM₁₀ (38 micrograms/m³) and PM_{2.5} (77 micrograms/m³) occurred in April. This is attributed to environmental and climatic conditions such as high temperatures, dry soil surface and increased winds resulting in more dust movement. Studies have shown that the peak of PM_{2.5} is in the spring due to local dust storms and vehicle emissions, as well as heavy traffic around campus, even walkways are located next to major entrances. Fine (PM_{2.5}) and coarse (PM₁₀) particles are primarily generated from combustion sources, such as vehicles and equipment, and mechanical activities such as soil disturbance and wind-blown dust.

On the other hand, monthly minima of particles were from January to June (Figures 4 and 5). This is interpreted as a result of calm weather condition during these periods, lower wind speeds and high humidity. Green spaces and sound urban planning play a significant role in reducing air pollution by decreasing wind speed, increasing particulate matter deposition, and improving the microclimatic characteristics of the area. Results showed that open areas and walkways near parking lots recorded 25–30% higher concentrations compared to areas covered with vegetation. The results confirm the need to adopt integrated planning and environmental measures inside and outside the university campus, including increasing green spaces, regulating traffic flow, and eliminating all unpaved dirt surfaces (sidewalks and streets), to control the concentrations of suspended particles.

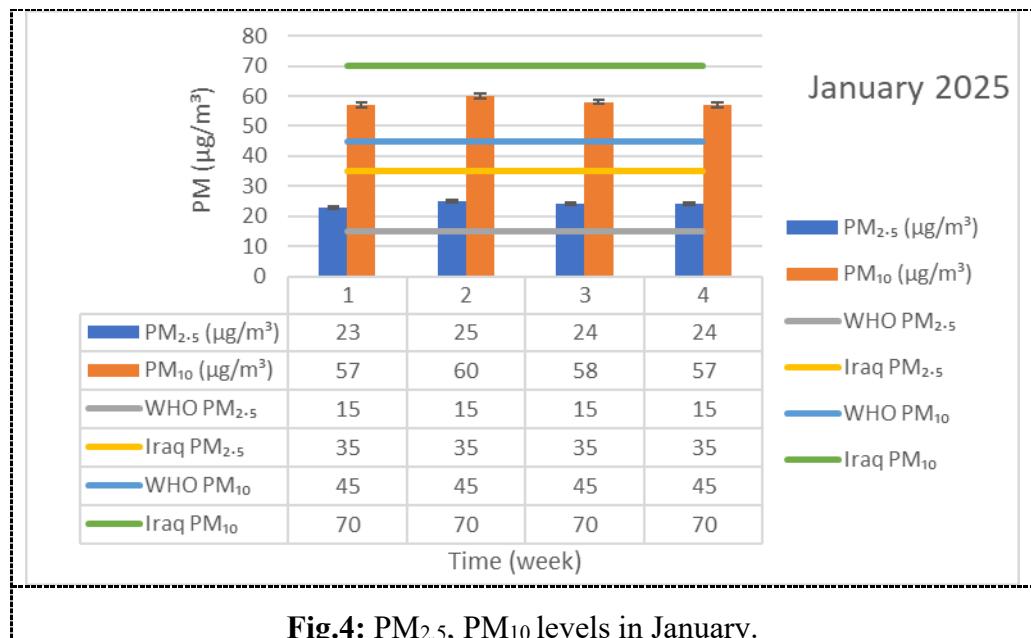


Fig.4: PM_{2.5}, PM₁₀ levels in January.

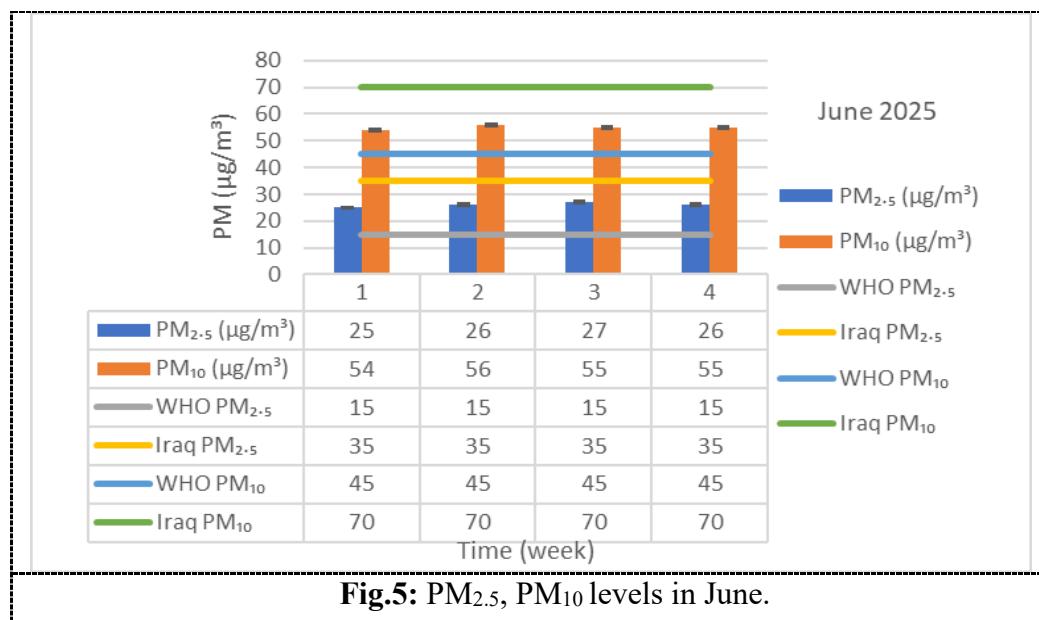
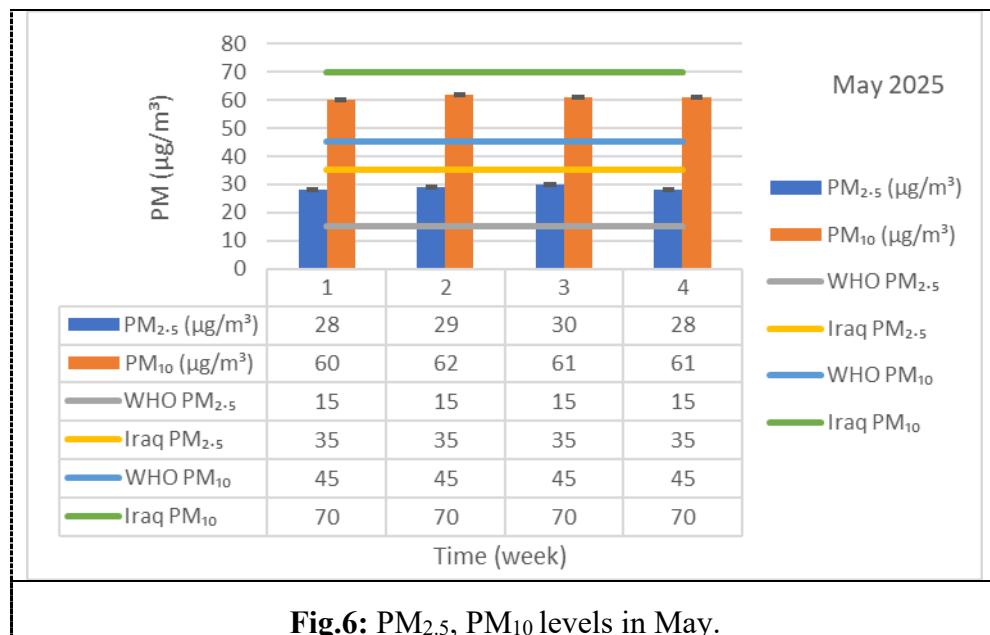
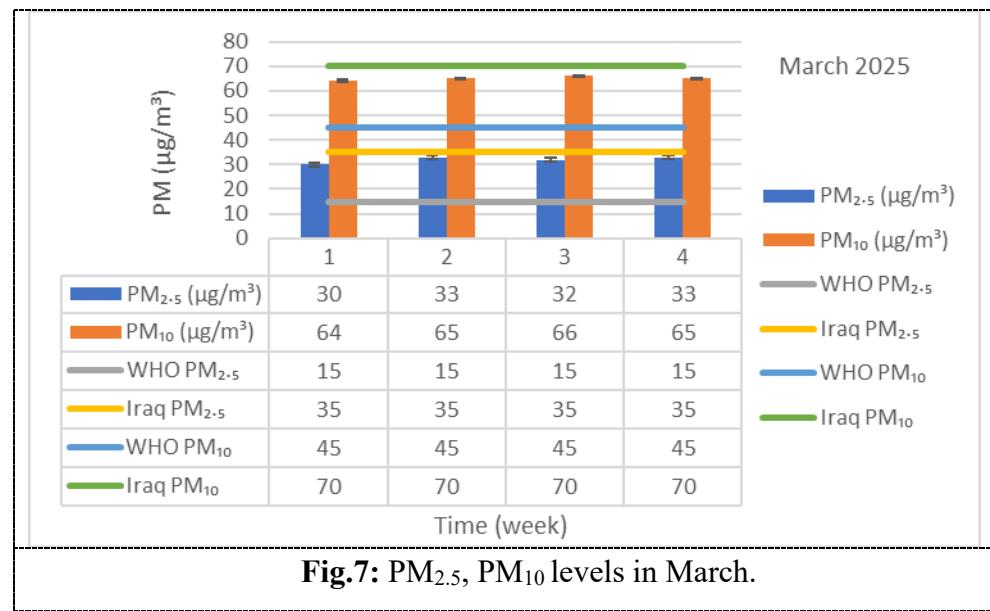


Fig.5: PM_{2.5}, PM₁₀ levels in June.

The relatively mild weather conditions during March and May (Figs. 6 and 7) resulted in particulate matter levels that were fairly acceptable compared to the months of study, not exceeding Iraqi standards but still higher than World Health Organization standards.

Fig.6: PM_{2.5}, PM₁₀ levels in May.Fig.7: PM_{2.5}, PM₁₀ levels in March.

4. Conclusions

The results of this study indicate that:

- PM_{2.5} and PM₁₀ were above WHO limits in February and April.
- Weather, increased traffic, construction activity, and a lack of green spaces are the main factors contributing to exceeding these standards.
- Inadequate urban planning off-campus has directly impacted air quality.

Therefore, it is essential to:

- Increase green spaces and plant hedges (>40%) around walkways, buildings, and surrounding streets.
- Redesign parking areas for urban and modern purposes.
- Fully pave dirt paths to reduce particulate matter emissions.
- Implement a continuous air quality monitoring plan.

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