Ministry of Higher Education and Scientific Research

University of Maysan

College of Science

Department of Physics

Dust-fall Proportions in Maysan Governorate: Environmental Engineering and Physics Approaches

Research submitted to the Department of Physics at the College of Science As part of the requirements for obtaining a Bachelor's degree in Physics by:

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بسم الله الرحمن الرحيم

(وَمِنْ آيَاتِهِ الْجَوَارِ فِي الْبَحْرِ كَالْأَعْلَامِ)

سورة الشورى الآية ٣٢

عَدَوليَّةٌ أَو مِن سَفينِ اِبنِ يامِنٍ

يَجورُ بِها المَلّاحُ طَوراً وَيَهتَدي

طرفة بن العبد

Dedication

The spirit of life to my father, the voice of my mother, the pulse of existence and its scent to my brothers. I am grateful for what they done. Angels of Heaven, pray for the martyrs. This little investigation is dedicated to you.

Acknowledgment

I extend my thanks and appreciation to everyone who contributed to the production of this humble effort, especially mention to the instructor ***Murtadha Mohammad*** for his efforts to enrich this research, and to all the professors in the College of Science / Physics Department.

As a group, we express our heartfelt gratitude and pride to ***the Maysan governorate's Directorate of Environment***, represented by The senior environmental engineer, ***Mr. Hamza Abdul Hussein Abdulridha***, who heads the urban environment division, and the assistant instructor, ***Muhannad Hassan Hamdan***, an environmental engineer and air pollution unit manager, for their efforts, excellence, and work in the transmission of knowledge and learning.

APPROVAL FOR SUBMISSION

I certify that this project report entitle **"Dust-fall Proportions in Maysan Governorate: Environmental Engineering and Physics Approaches"** was prepared by **(*Karar Abdul Hussein Shwil & Fatima Mahdi Saleh*)** has met the required standard for submission in partial fulfillment of the requirements for the award of Bachelor of Physics science at University of Misan

Approved by:

Signature:

Supervisor: **Lecturer. Murtadha Mohammed**

Scientific degree: **M.Sc. Environmental Engineering**

Address: **College of Science / University of Misan**

Date: 2024-2025

CERTIFICATE OF EXAMINERS

We certify, as an examining committee, that we have read this project report entitled **"Dust fall Proportions in Maysan Governorate: Environmental Engineering and Physics Approaches"** examined the students **(Karar Abdul Hussein Shwil & Fatima Mahdi Saleh)** in its contents and found the project meets the standard for degree of B.Sc. in Physics science.

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Abstract:

Air pollution remains a critical environmental challenge with profound impacts on human health, ecosystems, and climate. This study examines air pollution through the lens of physics, focusing on the mechanisms of dustfall pollutants that were measured in Misan province, which is separated into two main regions, over the course of six months (January, February, March, April, June, and July): Both residential and commercial areas. Dustfall proportions were assessed during the investigation using the circular cylinder experiment.

1. Introduction:

Air pollution is not only a chemical and environmental issue but also a profoundly physical one. The physical processes that govern the emission, transport, transformation, and deposition of air pollutants are essential to understanding their environmental and climatic impacts. Physics plays a central role in explaining how pollutants move through the atmosphere, how they interact with radiation, and how they influence weather patterns, cloud formation, and energy balances on both local and global scales. The transport and dispersion of air pollutants are governed by fluid dynamics and turbulence within the Earth's atmospheric boundary layer. Wind speed, direction, temperature gradients, and atmospheric stability determine how pollutants spread from their sources and how long they remain in the atmosphere[1].

Particulate matter and gases are subject to processes such as diffusion, advection, and gravitational settling — all of which are describable by fundamental physical laws,

[1] (Arya, 1999).

including Newton's laws of motion and the Navier-Stokes equations for fluid flow[2].

Another major physical aspect is the interaction between air pollutants and solar radiation. Aerosols and gases like carbon dioxide (CO_2), methane (CH_4), and ozone (O_3) absorb, scatter, and reflect radiation, influencing the Earth's radiative energy balance. These interactions lead to phenomena such as the greenhouse effect and aerosol radiative forcing, both of which alter the planet's climate system[3]. Furthermore, aerosols can modify cloud microphysical properties by acting as cloud condensation nuclei (CCN), thereby affecting cloud albedo, precipitation rates, and cloud lifetimes[4].

Physics-based atmospheric models are vital tools in quantifying the effects of air pollution. These models rely on the conservation of mass, momentum, and energy to simulate how pollutants evolve and disperse over time and space[5]. Numerical simulations using chemical

[2] (Jacobson, 2005).
[3] (Ramanathan et al., 2001; IPCC, 2021).
[4] (Twomey, 1977; Lohmann & Feichter, 2005).
[5] (Seinfeld & Pandis, 2016).

transport models (CTMs) and coupled climate models help predict air quality scenarios and assess the long-term environmental consequences of human emissions[6].

Lastly, deposition processes — both dry and wet — are also physics-driven. Gravitational settling, Brownian diffusion, inertial impaction, and precipitation scavenging determine how pollutants are removed from the atmosphere and deposited on land and water surfaces[7]. The physical characteristics of pollutants, such as particle size, density, and hygroscopicity, influence these processes and ultimately affect ecosystems and human health.

In short, the environmental impact of air pollution cannot be fully understood without a physics-based perspective. By applying principles of thermodynamics, fluid mechanics, and radiative transfer, scientists can better comprehend how air pollution alters atmospheric

[6] (Fiore et al., 2015)
[7] (Fowler et al., 2009)

processes, contributes to climate change, and affects ecosystems worldwide, figure (1)[8].

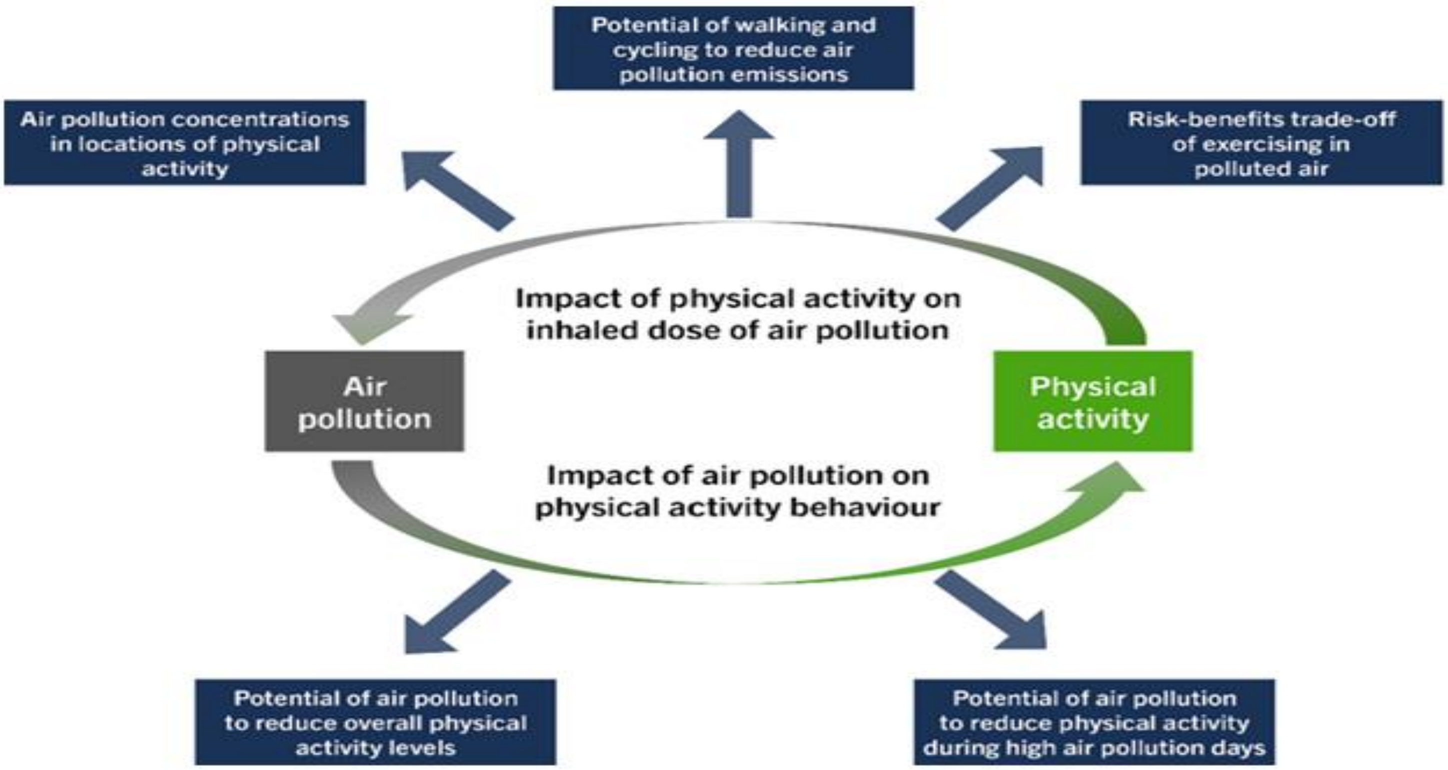


Fig. 1. Schematic overview of the air pollution and physical activity interactions

[8] (Marko et al., 2021).

2. Role of Physics in Understanding Air Pollution

These approaches not only facilitated the accurate measurement of dust-fall but also highlighted the interconnectedness of environmental and climatic factors in pollutant dispersion and deposition:

2.1 Atmospheric Dynamics and Transport:

The movement of air masses—governed by thermodynamics, fluid mechanics, and pressure gradients—directly affects the dispersion of pollutants. Wind velocity, temperature inversions, and boundary layer dynamics influence the concentration and transport of contaminants.

2.2 Radiative Transfer and Heat Balance:

Pollutants like CO_2 , CH_4 , and NO_x affect the Earth's radiation budget by absorbing and emitting infrared radiation. Physics-based models of radiative transfer help assess the contribution of air pollution to climate change and global warming.

2.3 Chemical Kinetics and Reaction Dynamics:

Though rooted in chemistry, the transformation of primary pollutants into secondary pollutants (e.g., ozone, particulate matter) involves reaction kinetics that are mathematically modeled using physical laws. For instance, photochemical smog formation depends on light intensity and reaction cross-sections—both physical parameters.

2.4 Aerosol Physics:

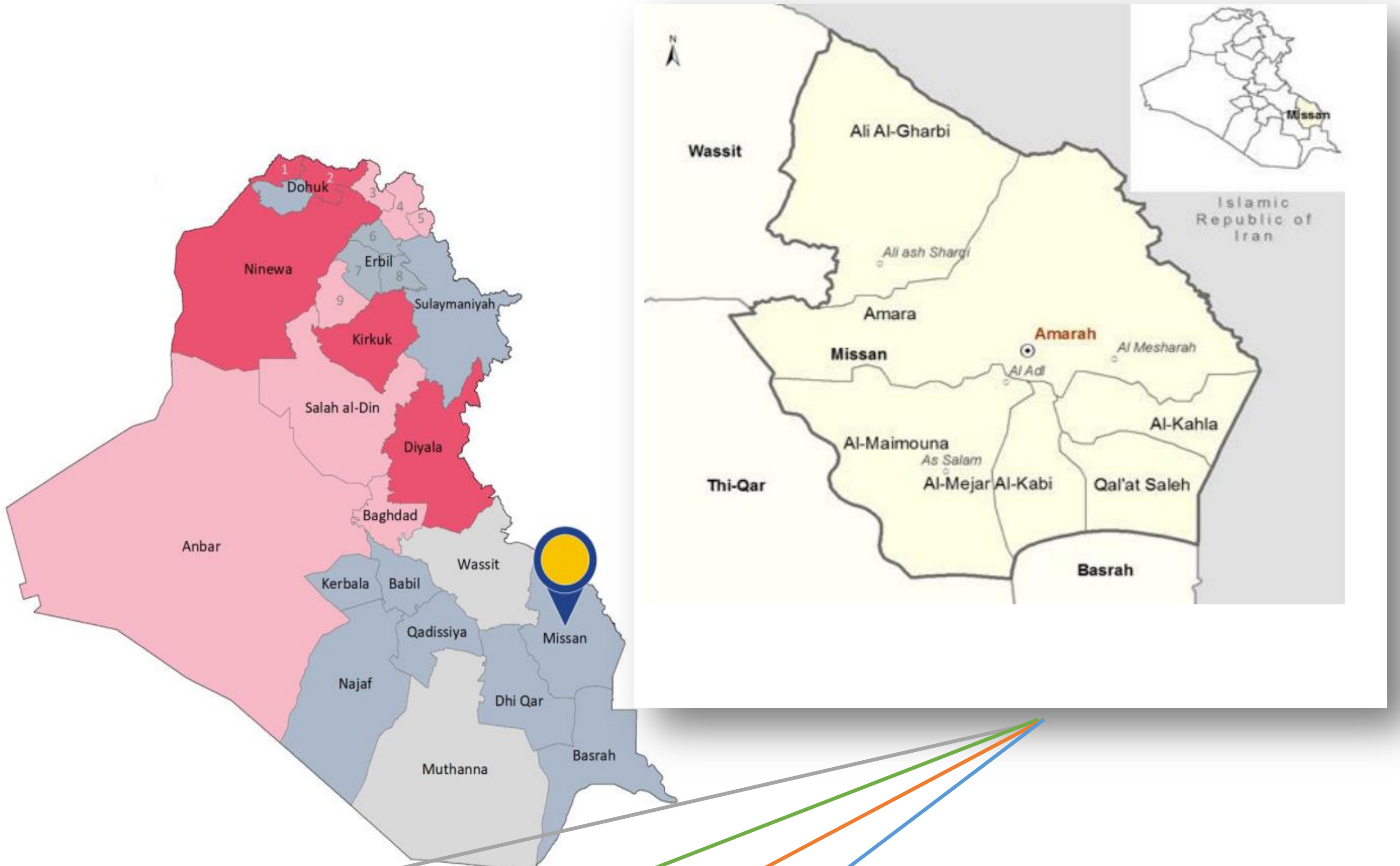
Aerosols influence cloud formation and precipitation processes. Their behavior (e.g., sedimentation, Brownian motion, coagulation) is governed by classical and statistical mechanics. [9] [10] [11] [12] [13] [14] [15]

[9] Arya, S. P. (1999)
[10] Seinfeld, J. H., & Pandis, S. N. (2016)
[11] Turner, D. B. (1994)
[12] Briggs, G. A. (1975)
[13] WHO (World Health Organization). (2006)
[14] Jacobson, M. Z. (2005)
[15] Hanna, S. R., Briggs, G. A., & Hosker Jr, R. P. (1982)

3. Misan province/ A work location:

It is located in southeast Iraq, bordering Iran. And borders Wassit, Basrah, and Dhi Qar governorates. Moreover, the population consists of (1,112,673) million Table 1. It consists of fifteen administrative units, six districts, and nine sub-districts, while the area of those districts is varied, as the Amara district is the largest area (6287.07 km^2) and (39.1%) of the total area of the governorate, followed by the district of Ali Al-Gharbi, Al-Maymoonah, Al-Majar Al-Kabir, Qal'at Salih and Al-Kahla, with a percentage of (22.4%), (13%), (8.9%), (8.5%) and (8%) respectively, Fig. 2[16]-[17]-[18]-[19]-[20]

[16] https://euaa.europa.eu/country-guidance-iraq 2021/Misan
[17] www.citypopulation.de.
[18] Hayder Oleiwi Shami Al Saidi, Naji Radees Abd. Analysis Indicators in Governorate Hayder of Human Development the Maysan. International Journal of Innovation, Creativity and Change; 2020; 14: 1296-1039
[19] Governorate Profile Misan. NGO Coordination Committee
[20] The impact of service, industrial and agricultural activities on some physical and chemical qualities of water The Tigris River at the city of Baghdad. Firas Hashim Qamar Al-Hamdani (Arabic Munscript)



Area: **16,072 km^2**

Average High Temperatures:
16,5°C (January) to 45,5°C (July)

Capital City: **Amara**

Population: **(1,106,208)**

Average Low Temperatures: **6,2°C (January) to 28,5°C (July**

Fig.1: Misan province

Source: http://www.jauiraq.org/gp/print/GP-Missan.asp

4. Material and method:

4.1 Dustfall Rate Assessment (DRA)

1. Establishment the stations of DRA in the governorate's two separate regions (residential and commercial).
2. Equipment is placed in the middle of a building's roof, away from walls, trees, and other obstructions, and ranges in height (**1 m**). Fig (3)
3. On the first day of the month, the form is implemented, and on the last day, it is uploaded.
4. By repeatedly cleaning the container's contents, the model is gathered for DRA.
5. Following each wash, the solution is drained into a glass Baker Volume (**500 ml**), dried to the smallest volume (up to **50 ml**) (**W1**), and then moved to a dry water bath. Fig (4)
6. Drying at (**105 c°**), fig (5) in an oven before being allowed to cool inside DISCATER, fig (6-a).
7. Moreover, the weight following drying = **W2**. Fig (6-b)

Fig. 3: The stations of DRA. Maysan Environment Directorate building rooftop (residential area)

Fig 4. Water path type (Non-circulating water baths)

Fig 5. The Oven type (Hotbox Oven)

Fig 6-a. DISCATER

Fig 6-b. glass Baker Volume 50ml

4.2 The calculations:

The following formulas are used to determine the quantities of the falling dust:

$$C = W / A \text{ --- } 1$$

Where:

C = Concentration

W = Weight

A = Area

$$D = W / A \text{ --- } 2$$

Where:

D = Dust fall amount

W = Dust weight

A = Container base area

$$A = \pi \times r^2 \text{ --- } 3$$

Where:

A = Area of the circle

π (pi) ≈ 3.1416 (a constant)

r = Radius of the circle

$$d^2/4 * 22/7 \text{ --- } 4$$

Where:

A = Area of the circle

π (pi) ≈ 22/7 (a constant)

d = diameter of the circle and

Thus, the container's Area is $\mathbf{0.7855 \times r^2}$ **.**

$$\mathbf{D = (W_2 - W_1) \times 1000 / 0.7855 \times d^2} \text{ --------------- } 5$$

Where:

W_2 = Weight of the Baker after collecting dust (usually in grams)

W_1 = Weight of the empty container (before exposure)

$W_2 - W_1$ = Net dust weight (only the dust collected)

$0.7855 \times d^2$ = Base area of the container (in square meters). This value assumes the container is circular with a diameter of 1 meter:

$$\text{Area} = \pi \times (\text{radius})^2 = \frac{22}{7} \times \left(\frac{d}{2}\right)^2 = 0.7854 \times d^2 \approx 0.7855 \times d^2 \text{ m}^2$$

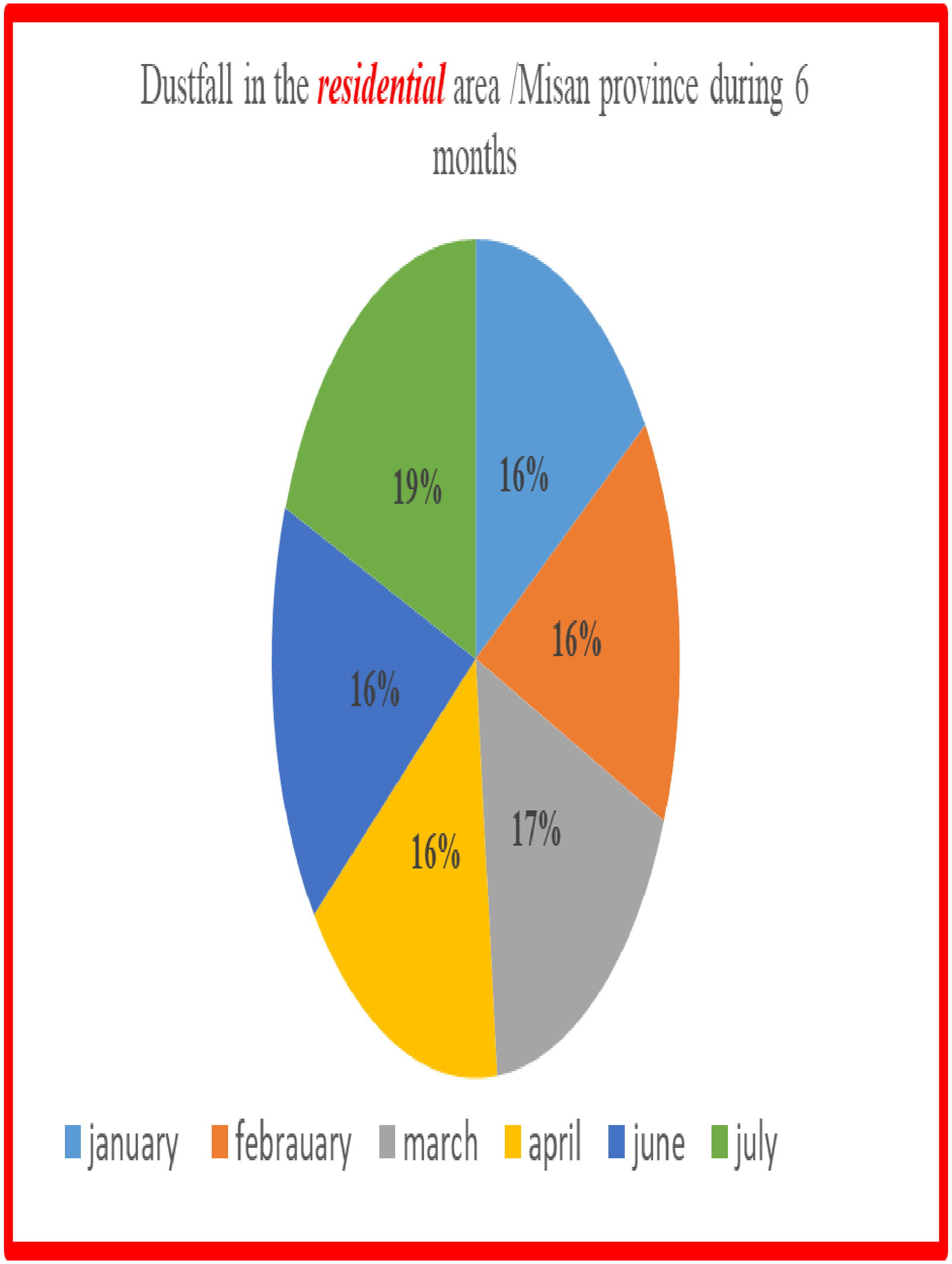
5. Results and discussion

5.1 Residential area

The percentage distribution of dustfall during a six-month period is shown in (Figure 7-a.) July: 19% highest April: 17% March: 16%; January, February, and June: 16% each. Most months see around the same amount of dustfall (16–17%). The largest contribution occurs in July, indicating a peak in dust activity, most likely brought on by drier weather or more summertime wind activity.

Line Graph Analysis (Figure 7-b) the quantitative trend of dustfall during the same six months (1–6) is displayed in this chart: About 12.5 units of dust fall per month. 1 A little rise each month 2 Month 3 Peak (about 14.3 units) Month-to-month stability with a slight decline 5 Month 6 saw a sharp increase of about 15.5 units.

Dustfall has been generally increasing over time. Month 6, which corresponds to the pie chart (July), has the highest point. Implies that the summer months—especially July—may be particularly important for air quality.



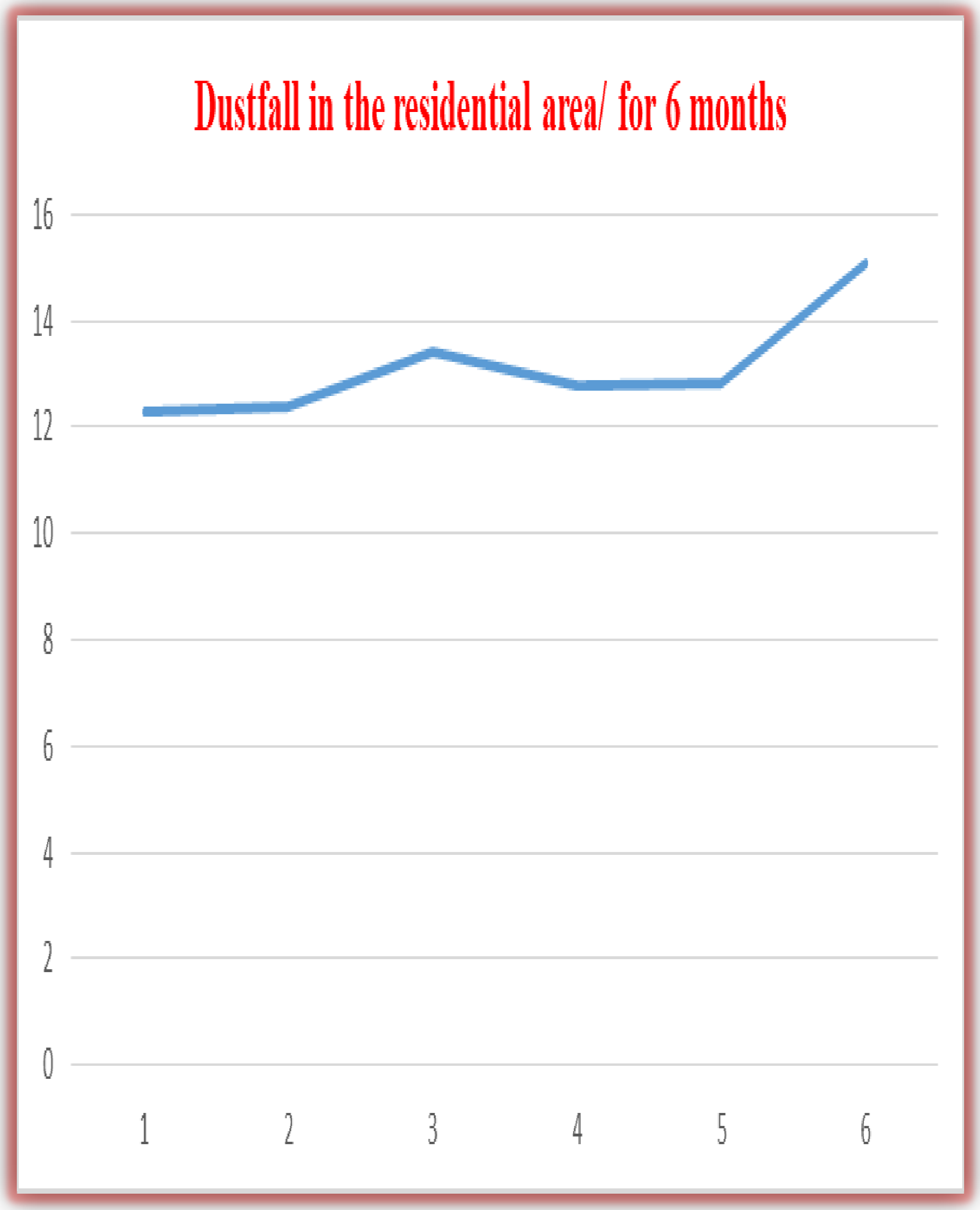


Fig 7-a: The percentage distribution of dustfall during a six-month period in Misan province

Fig 7-b: the dustfall quantitative trend during the same six months

5.2 Commercial area:

The percentage distribution of dustfall over a six-month period is shown in the pie chart (figure 8-a), which is most likely based on monthly measurements made in the province of Misan. The percentages are as follows: January 15%, February 15%, March 18%, April 16%, June 16%, and July 20%. The months covered are January, February, March, April, June, and July.

The amount of dustfall fluctuates, increasing gradually from January (15%) to July (20%). Dustfall percentages are higher in March, April, June, and July, which may be related to seasonal climate changes such summertime temperature increases and decreased humidity.

It is theoretically conceivable that there would be more dustfall in June and July because of increased dryness and wind activity, which can move dust particles. Particulate matter in the atmosphere may be caused by urbanization or agricultural practices.

Lower readings in January and February could be related to cold or rainy weather, which lowers airborne particulate matter through wet deposition (dust particles captured by rain or dew).

Interpretation of the Graph (figure 8-b) X-axis: Represents the time period in months (1 to 6). Y-axis: Represents the dustfall values, likely in grams per square meter per month (g/m^2/month) or a similar unit (though the unit is not explicitly stated). Data Points: The graph shows a declining trend in dustfall over the six months, with values decreasing from 18 to 0.

If the monitoring period spans from a dry season to a wet season, increased rainfall could suppress dust. Example: Months 1–3 (dry, high dust) → Months 4–6 (rainy, low dust). Mitigation Measures Implementation of dust control strategies (e.g., water spraying, green barriers, reduced construction activity). Regulatory enforcement (e.g., stricter emission standards for vehicles/industries). Temporary Pollution Events Month 1 may have had unusual pollution (e.g., construction, wildfires), which subsided later.

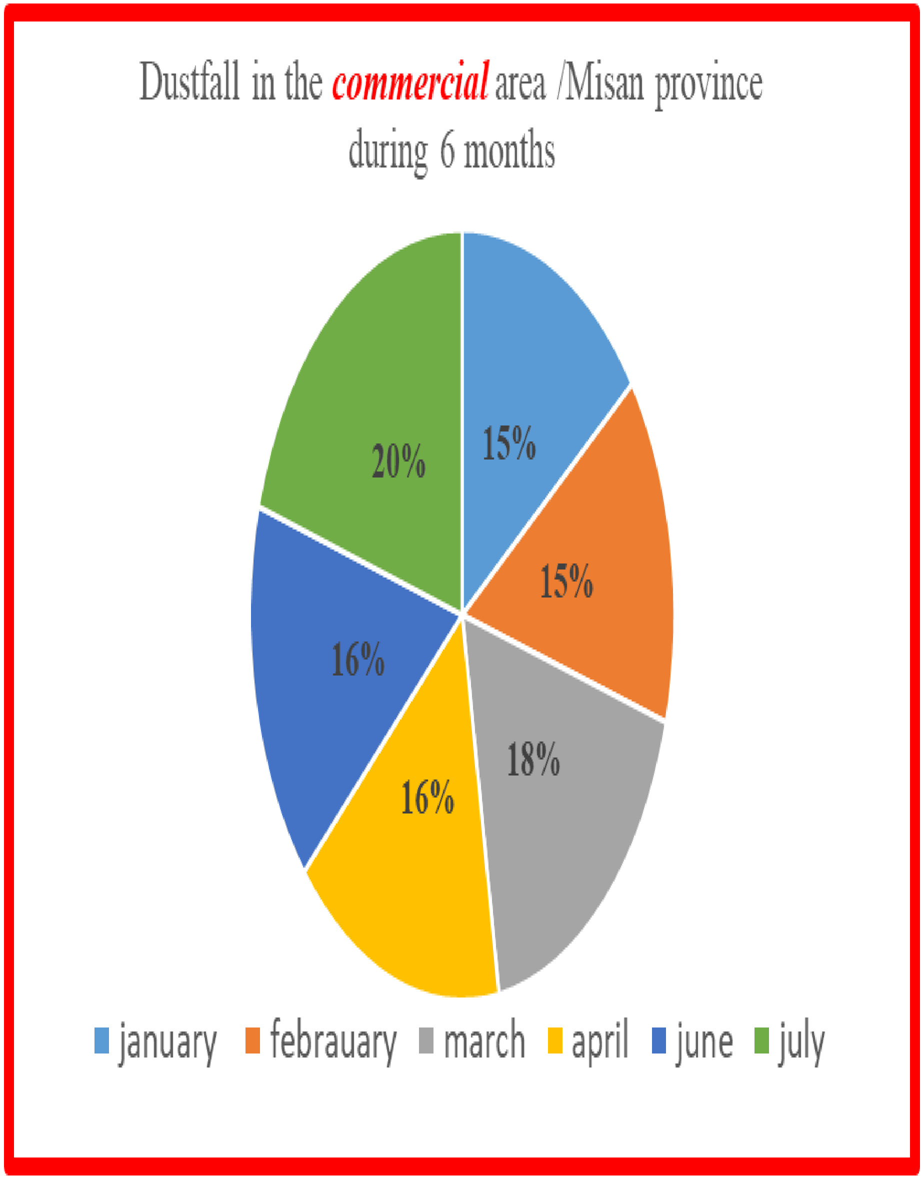


Fig. 8-a: The percentage distribution of dustfall over a six-month over commercial area in Misan province

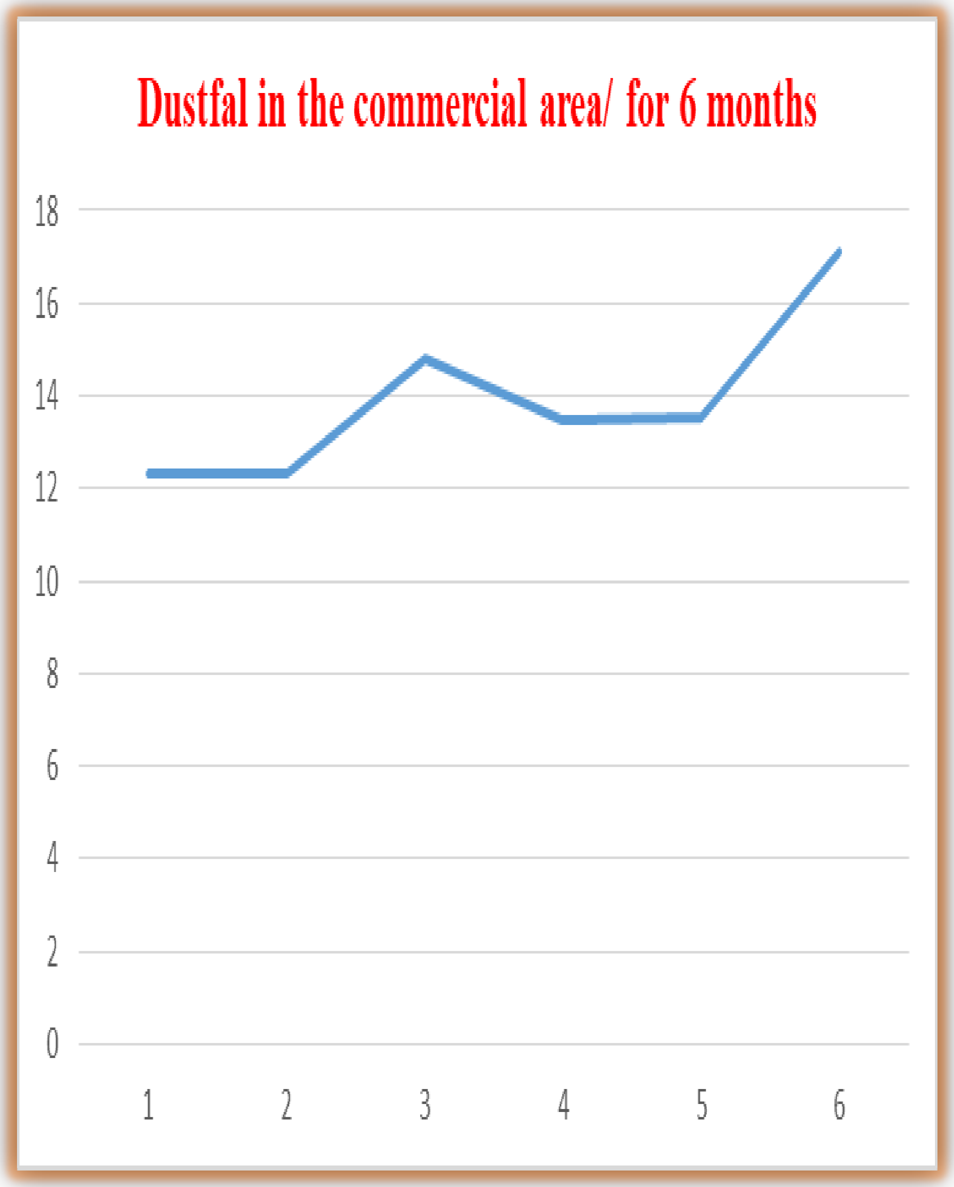


Fig. 8-b: Interpretation of the Graph of the percentage distribution of dustfall over a six-month over commercial area in Misan province

6. Conclusion

Over the six-month monitoring period, distinct seasonal variations in dust-fall were observed, with peak levels occurring in July, likely due to drier conditions and increased wind activity.

The residential area exhibited relatively stable dust-fall rates, while the commercial area showed fluctuations, possibly influenced by urbanization, agricultural practices, and seasonal climatic changes.

The application of physics-based methodologies, such as the circular cylinder experiment and the analysis of atmospheric dynamics, radiative transfer, and aerosol behavior, underscored the critical role of physics in understanding and addressing air pollution.

Due to these approaches not only facilitated the accurate measurement of dust-fall but also highlighted the interconnectedness of environmental and climatic factors in pollutant dispersion and deposition

The findings emphasize the need for targeted mitigation strategies, such as dust control measures, regulatory enforcement, and public awareness campaigns, to improve air quality in Maysan Governorate.

In conclusion, this study contributes to the growing body of knowledge on air pollution in Iraq and demonstrates the importance of interdisciplinary collaboration in tackling environmental challenges. By integrating physics and environmental engineering, sustainable solutions can be developed to safeguard public health and ecosystems for future generations.

7. References:

The footnote approach was utilized to typeset the references used in this investigation.