Reasons for the variation in annual rainfall in the village of Dhahir Al-Fawaris and its relationship to annual temperatures

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Content:

Abstract :

Reasons for the variation in annual rainfall in Dhahir Al-Fawaris and its relationship to annual temperatures

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This research aims to study the reasons for the variation in annual rainfall in the village of Dhahir al-Fawaris during the period 2015-2025, and to analyze the potential relationship between rainfall and annual temperatures.

The research revolves around the following questions:

1. What is the pattern of variation in annual rainfall in the village of Dhahir al-Fawaris during the period 2015–2025?

2. Is there a relationship between the amount of annual rainfall and annual temperatures?

3. What are the possible factors that explain the observed variation in rainfall?

To answer these questions, the study relied on monthly and annual climate data extracted from NASA files (NASA POWER) and from recorded measurements of temperatures and rainfall amounts for GLOBE students, extracted from Visualize Data. This data was then statistically processed, converted into annual averages, and displayed in tables and graphs using Microsoft Excel. The observed variation in rainfall amounts was then interpreted.

The results showed a significant variation in the amount of annual rainfall between years, with some years recording relatively high amounts, while other years were dry. Annual temperatures also recorded a general increase with slight differences between years. A relative inverse relationship was also observed when comparing rainfall data with annual temperature data The high average annual temperature is associated with low rainfall in most years, with limited exceptions due to exceptional weather conditions.

Based on these findings, the researcher recommends raising public awareness about the importance of water conservation during years of low rainfall and encouraging future studies that incorporate other climatic factors such as wind and humidity, and that utilize the research results findings in agricultural and water planning.

Key terminologies:

Temperature: A measure of how hot or cold the air is, measured in degrees Celsius (°C).

- Rainfall: Resulting from the condensation of water vapor falling from clouds due to gravity.

Research questions:

1. What is the pattern of variation in annual rainfall in the village of Dhahir al-Fawaris during the period 2015–2025?

2. Is there a relationship between the amount of annual rainfall and annual temperatures?

3. What are the possible factors that explain the observed variation in rainfall?

Introduction and literature review:

Climate is one of the most important natural factors affecting human life and the environment, especially rainfall, which is a primary source of water. Rainfall varies from place to place and from year to year due to several factors, such as geographical location, temperature, and atmospheric pressure.

The climate in the Sultanate of Oman is characterized by its diversity and variation between coastal, inland, and mountainous regions, due to the country's vast size and varied topography. Generally, the country experiences a hot and dry desert climate, with high temperatures in summer and relatively low temperatures in winter, along with low annual rainfall, except in some mountainous and coastal areas that receive seasonal rainfall. The Sultanate is also occasionally affected by tropical cyclones originating in the Arabian Sea, which bring heavy rains and strong winds, particularly to the southern and eastern governorates.

According to the latest climate data for the Sultanate of Oman, average temperatures vary throughout the year. Winter months are the coldest, with December 2023 recording an average temperature of 23.2°C, January 2024 22.8°C, and February 2024 22.9°C. Summers are significantly hotter, with June 2024 recording an average temperature of 35.5°C, July 2024 34.9°C, and August 2024 32.2°C. These figures reflect the clear seasonal variations in Oman and help residents and visitors understand which months are colder or hotter.

Rainfall amounts in the Sultanate of Oman vary considerably between regions and seasons due to its diverse geography and climatic patterns. Coastal and southern regions, particularly the Dhofar Governorate, receive higher rainfall, influenced by the Khareef (monsoon) season, while most inland governorates remain dry for the majority of the year. Although the average annual rainfall is low, short but intense storms can occur during winter depressions or tropical cyclones.

Tracking rainfall amounts through monitoring stations helps identify seasonal patterns, assess water availability, support flood preparedness, and guide planning in areas such as agriculture, infrastructure, and environmental management. These variations are crucial for understanding the hydrological situation in Oman and developing sustainable resource management strategies.

This research will focus on the village of Dhahir Al-Fawaris and investigate the reasons for the variation in rainfall amounts there, attempting to link this to changes in annual temperatures.

Research methodology:

Research plan:

1. Gather information on the research topic from books available at the Learning Resources Center and from the internet.
2. Develop a research plan.
3. Create a timeline for implementing the research plan.
4. Select appropriate tools for data analysis.
5. Determine the necessary protocols for conducting the research.
6. Extract data from Globe Data Visualization and the NASA Power website.
7. Analyze and graphically represent the data.
8. Draw conclusions and make recommendations.

Timetable of the research plan implementation:

name	task	Date
ALMarwa	Collect information on the research subject from various resources.	25 December 2025
ALMarwa	Data collected from the GLOBE and NASA POWER databases	18 December 2025
ALMarwa	Organizing data and preparing graphs	22 December 2025
ALMarwa	Analysis and discussion of the results	10 January 2026
ALMarwa	Extract conclusions and recommendations	25 January 2026

Survey location

Sultanate of Oman – Al Dhahirah Governorate – Ibri State – Dhahir Al Fawaris Village – (Latitude: 23.37 and Longitude: 56.38) – The atmospheric protocol (temperature and precipitation) was used.

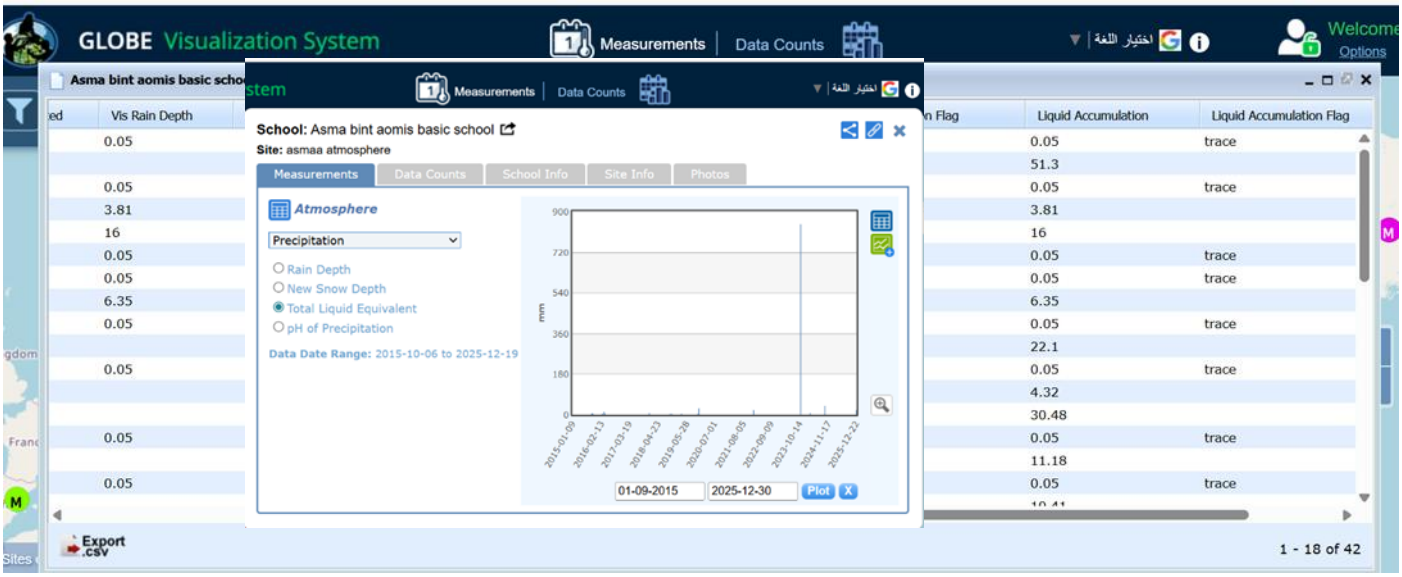
Data collection and analysis:

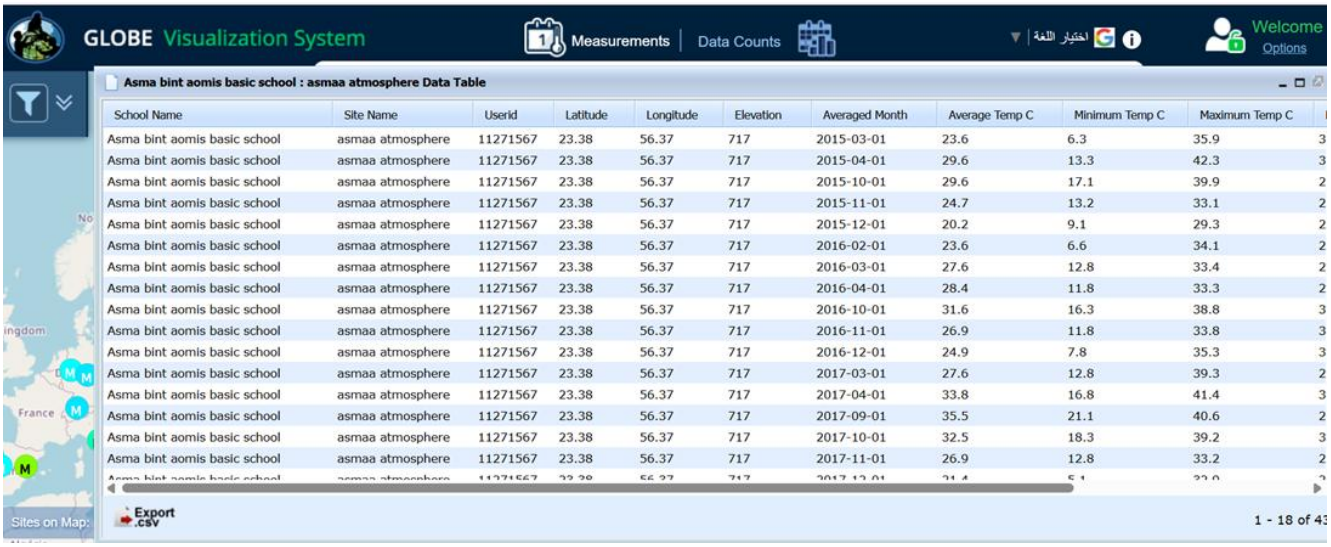
The research question will be answered as follows:

Research question	methods	Application mechanism
1. What is the pattern of variation in annual rainfall in the village of Dhahir al-Fawaris during the period 2015–2025?	Atmospheric Protocol Data (Temperature-Rainfall)	Collect annual rainfall data for the selected period (2015-2025) from the Globe Visualization System website and the NASA Power website, analyze the data, prepare graphs, and observe the prevailing rainfall pattern.
2.Is there a relationship between the amount of annual rainfall and annual temperatures?	Analysis and Comparison	Collecting annual rainfall and annual temperature data for the selected period (2015-2025) from the Globe Visualization System website and the NASA Power website, analyzing the data, preparing graphs, observing the pattern, and determining the relationship between the amount of rainfall and the temperature.
3. What are the possible factors that explain the observed variation in rainfall?	Survey and Interview	Analyzing the data and communicating with the Civil Aviation Authority - Meteorology office to determine the factors affecting rainfall amounts in the village.

Data collection:

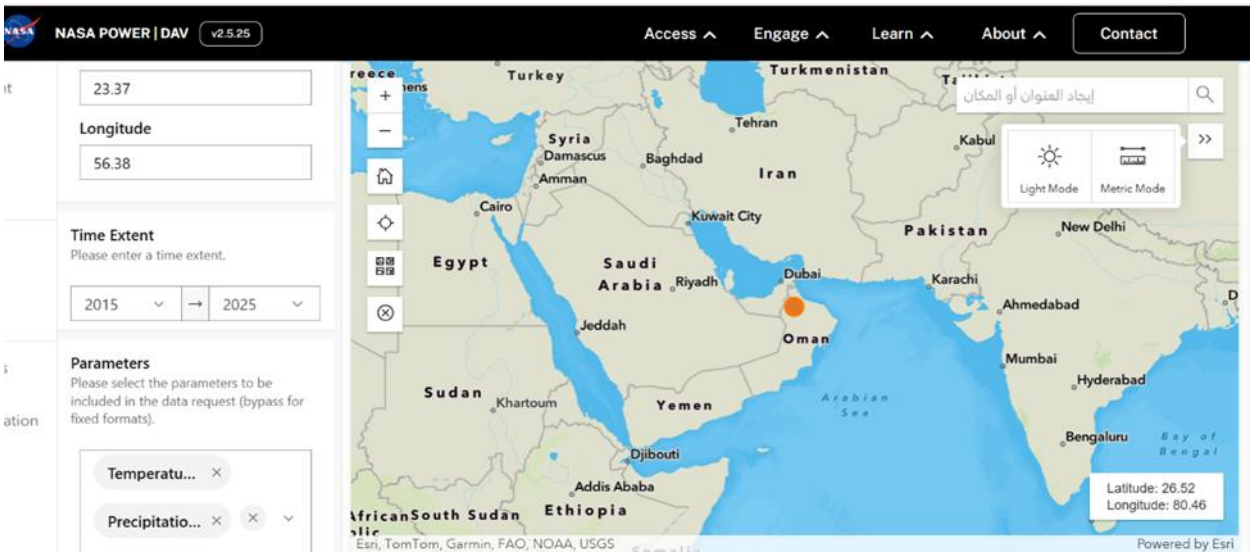
1. Rainfall and temperature data from the program's website (Globe Visualization System)





School Name	Site Name	UserId	Latitude	Longitude	Elevation	Averaged Month	Average Temp C	Minimum Temp C	Maximum Temp C
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2015-03-01	23.6	6.3	35.9
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2015-04-01	29.6	13.3	42.3
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2015-10-01	29.6	17.1	39.9
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2015-11-01	24.7	13.2	33.1
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2015-12-01	20.2	9.1	29.3
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-02-01	23.6	6.6	34.1
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-03-01	27.6	12.8	33.4
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-04-01	28.4	11.8	33.3
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-10-01	31.6	16.3	38.8
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-11-01	26.9	11.8	33.8
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2016-12-01	24.9	7.8	35.3
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2017-03-01	27.6	12.8	39.3
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2017-04-01	33.8	16.8	41.4
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2017-09-01	35.5	21.1	40.6
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2017-10-01	32.5	18.3	39.2
Asma bint aomis basic school	asmaa atmosphere	11271567	23.38	56.37	717	2017-11-01	26.9	12.8	33.2

2. Rainfall and temperature data from the NASA Power website.



NASA/POWER Source Native Resolution Monthly and Annual
Dates (month/day/year): 01/01/2015 through 12/31/2025 in LST
Location: Latitude 23.37 Longitude 56.38
Elevation from MERRA-2: Average for 0.5 x 0.625 degree lat/lon region = 443.18 meters
The value for missing source data that cannot be computed or is outside of the sources availability range: -999
Parameter(s):
PRECTOTCORR MERRA-2 Precipitation Corrected (mm/day)
T2M MERRA-2 Temperature at 2 Meters (C)
-END HEADER-

PARAMETE	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
PRECTOTC	2015	0.23	0.07	0.07	0.01	0.09	0.41	0.29	0.2	0.59	0.28	0.05	0.01	0.19
PRECTOTC	2016	1.35	0.23	1.69	0.55	0.01	0.61	0.17	0.09	0.13	0.13	0.04	0.01	0.42
PRECTOTC	2017	0.57	1.17	2.48	0.44	2.63	0	0.81	0.54	0.03	0	0.03	0.58	0.78
PRECTOTC	2018	0.01	0.09	0.15	0.22	0.09	0.02	0.04	0.06	0.03	0.5	0.1	0	0.11
PRECTOTC	2019	0	0.3	0.12	0.62	0.25	0	0	0.12	0	0.17	0.84	0.9	0.28
PRECTOTC	2020	2.65	0	1.88	0.06	0.06	0.07	0.12	0.69	0.09	0.02	0.04	0.1	0.49
PRECTOTC	2021	0	0	0.03	0.08	0.14	0.03	0.27	0.02	0.12	0.31	0.12	0.37	0.13
PRECTOTC	2022	0.46	0.02	0.02	0.07	0.01	0.02	0.84	0.11	0.02	0.01	0.07	0.17	0.15
PRECTOTC	2023	0.84	0.03	0.08	0.03	0.05	0	0.05	0.11	0.02	0.12	0.2	0.01	0.13
PRECTOTC	2024	0.01	2.06	1.66	2.27	0.36	0.18	0.05	21.05	0.01	0.11	0	0.04	2.34
PRECTOTC	2025	0	0.01	0	0.01	0.01	0.07	0.18	0.37	0.15	0.11	0.01	-999	-999
T2M	2015	18.32	21.34	24.3	30.12	34.26	35.27	37.35	36.51	33.57	30.31	24.43	19.84	28.84
T2M	2016	18.02	19.8	24.16	26.6	33.48	34.17	37.38	37.31	33.85	29.65	24.22	21.82	28.4
T2M	2017	19.41	19.15	24.46	29.47	32.44	37	37.22	36.08	34.17	30.61	24.03	19.13	28.65
T2M	2018	17.88	21.6	25.09	30.49	33.47	36.34	38.29	37.46	34.34	29.71	24.97	20.42	29.21
T2M	2019	19.94	19.45	22.07	28.02	32.51	37.56	37.53	37.1	35.24	30.27	23.04	20.3	28.63

Data Analysis:

Data from NASA Power and the GLOBE Visualization System for rainfall amounts (2015-2025):

Annual rainfall averages (mm) were calculated and graphs were created using Microsoft Excel.

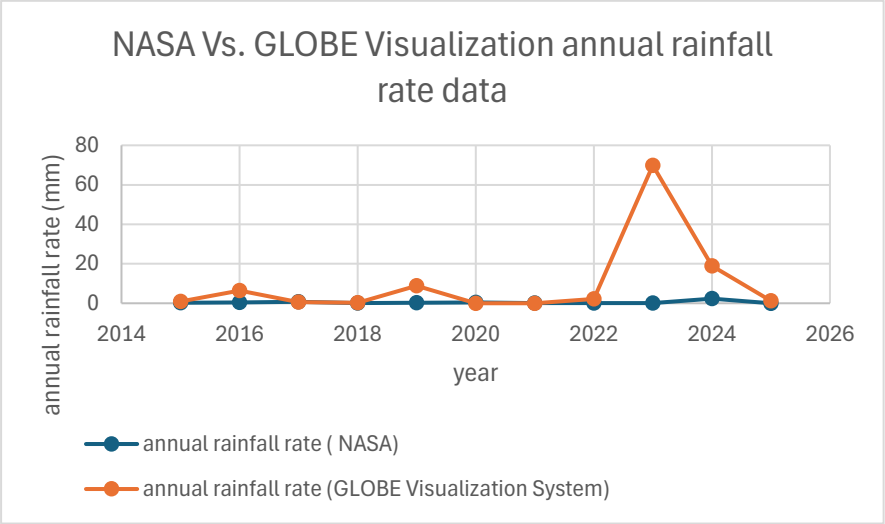


Figure 1

Table 1 :

years	annual rainfall rate (NASA)(mm)	annual rainfall rate (GLOBE Visualization System)(mm)
2015	0.19	0.97
2016	0.42	6.36
2017	0.78	0.53
2018	0.11	0.33
2019	0.28	8.8
2020	0.49	0
2021	0.13	0
2022	0.15	2.2
2023	0.13	69.85
2024	2.34	18.98
2025	0	1.29

NASA Power Rainfall Data(2015-2025):

-Some years are very dry, like 2018.

-Some years are more rainy, like 2017.

-The year 2024 is exceptional with a very high rainfall rate.

GLOBE Rainfall Data (2015-2025):

-Some years are very dry, like 2018.

-Some years are rainier, like 2019 and 2024.

-2023 was an exceptional year with very high rainfall.

-No data was recorded for 2020 and 2021 due to the coronavirus pandemic.

3. Analysis of annual rainfall and annual temperature data (2015-2025)

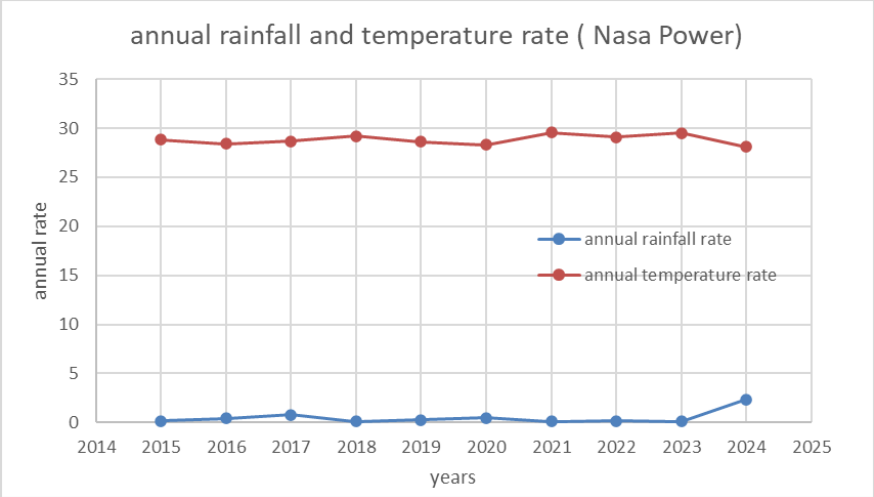


Figure 2

Table 2:

years	annual rainfall rate (mm)	annual temperature rate (c)
2015	0.19	28.84
2016	0.42	28.4
2017	0.78	28.65
2018	0.11	29.21
2019	0.28	28.63
2020	0.49	28.32
2021	0.13	29.57
2022	0.15	29.11
2023	0.13	29.48
2024	2.34	28.12
2025	-	-

In 2018, the lowest rainfall (0.11) was recorded with a relatively high temperature (29,21).

In 2024, the highest rainfall (2.34) was recorded with a relatively low temperature (28,12).

The results show a weak inverse relationship between temperature and rainfall.

4. Analysis of annual rainfall and annual temperature data (2015-2025) GLOBE Visualization System.

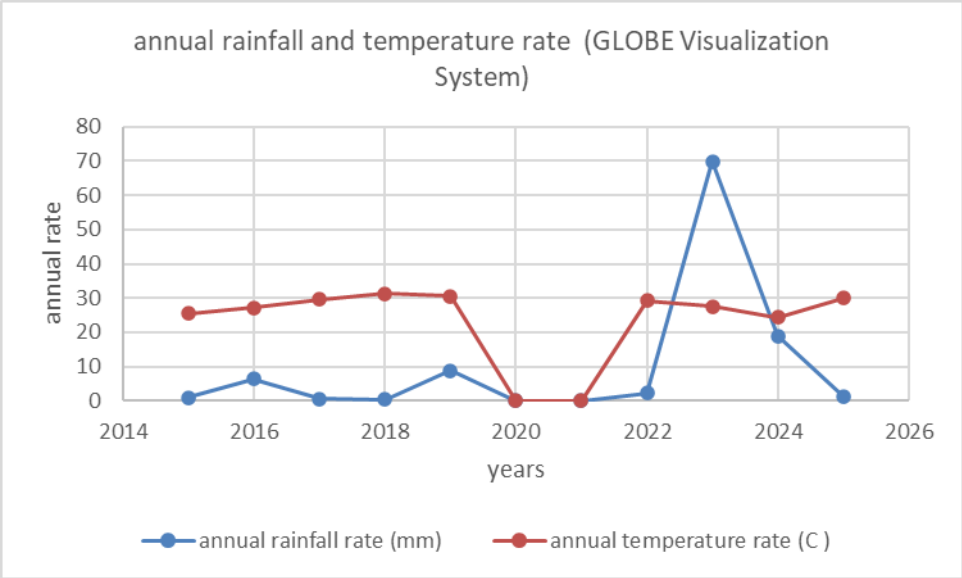


Figure 3

Table 3:

years	annual rainfall rate (mm)	annual temperature rate (C)
2015	0.97	25.5
2016	6.36	27.2
2017	0.53	29.6
2018	0.33	31.3
2019	8.8	30.5
2020	0	0
2021	0	0
2022	2.2	29.3
2023	69.85	27.5
2024	18.98	24.3
2025	1.29	30

In 2018, the lowest rainfall (0.33 mm) was recorded with a relatively high temperature (31.3°C).

In 2023, the highest rainfall (69.85 mm) was recorded with a relatively low temperature (27.5°C).

The results show a weak inverse relationship between temperature and rainfall.

No data was recorded for 2020 and 2021 due to the COVID-19 pandemic.

Results analysis:

Based on the data collected in the period (2015-2025), we find that:

The region is dry most years. The year 2018 had the lowest rainfall according to and the data recorded in the GLOBE NASA Power data (0.11 mm) (Table 1, Figure 1) Visualization System (0.33 mm), with a relatively high temperature. However, the decrease in rainfall cannot be attributed to the high temperature because the change in temperature is slight from year to year.

Some years are exceptional in terms of rainfall(Table 1, Figure 1). According to Nasa Power data, 2024 saw high rainfall (2.34 mm) with a relatively low temperature (28.12 C). Similarly, 2023, according to GLOBE Visualization System data, also saw high rainfall (69.85 mm) with a relatively low temperature (27.5). This is due to the study area being exposed to a low-pressure system during the years mentioned above.

Local measurements show (GLOBE Visualization System) data with slightly higher temperatures than (NAS/POWER) data(Table 1, Figure 2). The difference is attributed to the difference in measurement accuracy and altitude (717 m versus 443 m) and also the difference in observation locations and timing.

The double line graph compares annual rainfall amounts between NASA and GLOBE data(Table 1, Figure 3). A clear difference in values is observed between the two sources, with GLOBE data recording higher amounts in some years. This is because GLOBE data relies on direct ground measurements on specific days, while NASA data is based on estimated averages using satellites and climate models, resulting in different values despite a similar overall trend.

Interpretation of results:

The variation in annual rainfall in the village of Dhahir Al-Fawaris can be explained by several factors, the most important of which are:

Regional climate changes: These affect atmospheric pressure patterns and monsoon wind patterns.

Higher temperatures: These lead to increased evaporation rates, reducing the chances of cloud condensation and rainfall.

Irregularity of low-pressure systems: These do not occur with the same intensity or frequency each year.

Comparing rainfall data with annual temperature data reveals a relatively inverse relationship, Higher average annual temperatures are associated with lower rainfall in most years, with limited exceptions due to unforeseen weather events.

The graphs(Figure 2, Figure 3) show that years with higher temperatures were generally less rainy, while years with lower temperatures recorded higher rainfall.

This is explained by the fact that higher temperatures lead to increased evaporation, which reduces the chances of cloud condensation and rainfall. Global climate change may also be contributing to the irregularity of rainfall patterns.

Conclusion:

This research aims to investigate the reasons for the variation in annual rainfall in the village of Dhahir Al-Fawaris during the period from 2015 to 2025, and to analyze the potential relationship between rainfall and annual temperatures. Analysis of graphs extracted from NASA Power and GLOBE data reveals a clear variation in annual rainfall in Dhahir Al-Fawaris during the study period. Most years were characterized by low and irregular rainfall, with some years experiencing near-complete drought, in contrast to years with exceptionally high rainfall. The data also showed that annual temperatures were more stable than rainfall, fluctuating within a relatively narrow range. Comparing the curves reveals that years with higher temperatures often coincided with lower rainfall, while years with relatively lower temperatures saw a significant increase in rainfall, as is evident in years with high rainfall values. These results indicate a moderate inverse relationship between temperature and rainfall. Higher temperatures increase evaporation rates and reduce the likelihood of rain cloud formation, while lower temperatures create more favorable conditions for precipitation. However, some years show that rainfall can increase unexpectedly due to other climatic factors, such as low-pressure systems, demonstrating that temperature is not the sole factor influencing rainfall, but it is a significant factor in explaining its annual variability.

Therefore, we recommend raising public awareness about the importance of water conservation during years of low rainfall and encouraging future studies that incorporate other climatic factors such as wind and humidity, and utilizing the research findings in agricultural and water management planning.

Thanks and Appreciation:

I extend my sincere thanks and appreciation to the esteemed school principal for her continuous cooperation and constant support for the GLOBE program team. We also thank the esteemed Mr. Bader Al-Maamari, the scientific innovation specialist, for his continuous follow-up and tireless efforts to highlight the program's activities. Thanks are also due to all the members of the school's teaching staff who cooperated with me, and of course, thanks are also due to Ms. Hidaya Al-Farsi for giving me the opportunity to conduct this research and for following up with me during its preparation.

Badges selection :

1. I AM A GLOBE RESEARCHER

2. I WORK WITH SATELLITE DATA.

3. I AM A DATA SCIENTIST .

4. I AM A PROBLEM SOLVER .

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