British Journal of Global Ecology and Sustainable Development
Volume-16, May, 2023
ISSN (E): 2754-9291

# THE EFFECT OF SOME CLIMATE CHARACTERISTICS ON LAND TRANSPORT ROUTES IN AL-MUTHANNA GOVERNORATE

Dr. Fatima Radi Sajit Al-Jabri
Art College, Al-Muthanna University, Iraq.
Email: Fatima.aljabri@mu.edu.iq

**Abstract:**
The research dealt with the impact of some climate characteristics, including temperature, wind and climatic phenomena such as rain and dust storms on land roads, including railways, and the research contained two sections, the first section dealt with the reality of transport in Muthanna Governorate and the second section included the impact of climatic characteristics on transport routes in Muthanna Governorate and the results showed a clear impact of climate elements on transport routes, The study area is characterized by a high temperature, as it reached (46.2 m 5), which leads to smelting, deformations and pits in the asphalt used in paving the streets. And the occurrence of expansion and contraction of asphalt layers in paved roads when temperatures vary between night and day and during summer and winter, as well as its impact on the expansion of railway rails, and the winds in the study area raise dust and dust due to the lack of natural vegetation, and the lack of rain, which leads to exposure to dust storms as it is located within the areas located south of the 35th parallel north, Dust storms blow over Iraq in the areas that fall within these circles, and the variation in rainfall in the study area leads to damage

**Keywords:** transport methods, temperature, wind, rain.

## Introduction

The climatic characteristics are among the most important factors influencing transportation methods, including land transportation, as land transportation is one of the important means in linking cities together, so it must have easy and accessible transportation methods, and there is a strong correlation between weather conditions and transportation methods since man knew Modes of transportation, and despite the developments that the world has witnessed in this field through weather conditions and knowledge of expected weather conditions, control of these conditions is still an obstacle facing transportation and transportation methods, the most important of which are temperatures, winds, rain, dust storms that obscure vision, etc., so the study of the effect of the characteristics of The climatic elements are among the important studies in revealing the obstacles of land transport routes, which prompted the researcher to delve into the study of these obstacles and ways to treat them or reduce them.

## Research problem :

1- Is there an effect of climate characteristics on road transport in Al-Muthanna Governorate?

2- Is there a variation in the effect of climate characteristics on land transport routes in Al-Muthanna Governorate?

Search Hypothesis:

1- There is an effect of climate characteristics on road transport in Al-Muthanna Governorate.

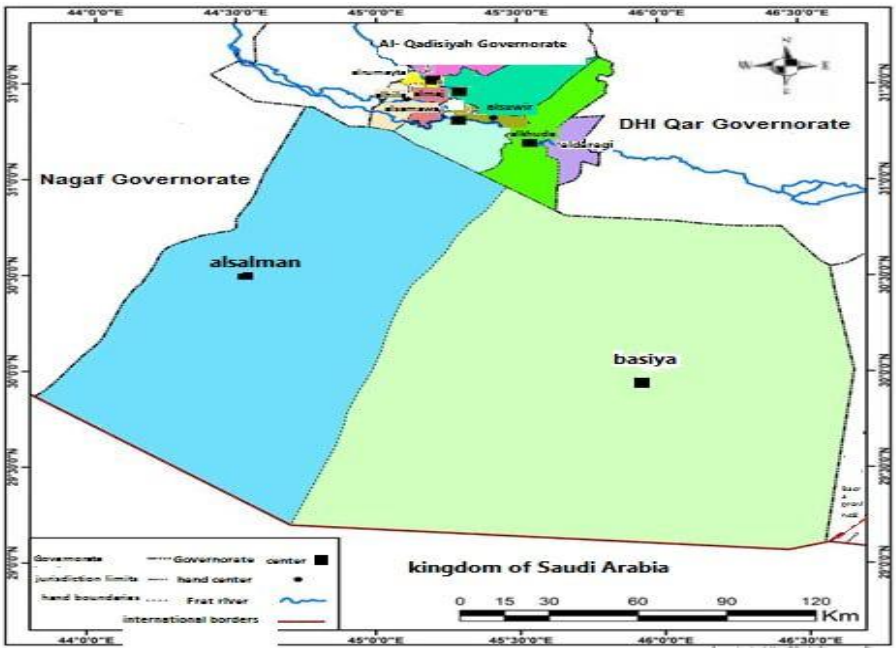
2- There is a discrepancy in the effect of climate characteristics on land transport routes in Al-Muthanna Governorate.

search limits :

Spatial borders: It is represented by Al-Muthanna Governorate, which is located in the southwestern part of Iraq, and is bordered on the east by the two governorates (Basra and Dhi Qar), and on the north is Al-Qadisiyah Governorate, and on the south is the Kingdom of Saudi Arabia, and it is bordered on the west by Al-Najaf Al-Ashraf. Astronomically, it is located within latitudes (29.05 5 - 31.42 5) north and longitudes (43.05 5 - 46.32 5) east.

Administratively, the study area consists of a number of districts (Samawah, Al-Rumaitha, Al-Khader, Al-Salman, and Al-Warka), map (1), with an area of (51,740 km2), and the city of Samawah is the center of the governorate.

Temporal boundaries: It is represented in the year 2022 by a climatic cycle from (2000-2022) depending on the climate data of the Meteorological Authority in Iraq.




**Map (1) The location of Al-Muthanna Governorate and its administrative units**

**Source: 1-Ministry of Water Resources, General Directorate of Survey, Map Production Department, Digital Unit, Administrative Map of Iraq, scale (1:1,000,000) Baghdad, 2007. 2- Program (10:3 GIS ARC).**



Journal Zone Publishing, Ilford, United Kingdom

Qualitative limits: It is represented in studying the impact of climate characteristics (temperature, wind speed and direction, climate phenomena, rain and dust storms) on transportation methods during the period (2000-2022).
Research objective: The research aims to know the effect of some climate elements on land transport methods in Al-Muthanna Governorate, and to highlight the most important effects and treat them.
The importance of research: identifying the extent of the impact of climate characteristics on land transport routes due to the importance of transport in linking the governorate with the rest of the governorates and for its economic development, and taking into account the challenges facing land transport routes in the governorate when planning for the future.
Research methodology: The research adopted the descriptive approach and the analytical approach, in addition to sources and studies related to the subject of the research.

**The first topic: the reality of land transport routes in Al-Muthanna Governorate:**
Transportation is one of the most important structures on which the development of the economy in countries and cities is based. Al-Muthanna Governorate has witnessed a great development in this field due to the increase in the number of residents, in addition to the increase in the number of cars, especially after 2003. As a result of the geographical location of the study area, it facilitated the crossing of cars, and linked the roads leading to the neighboring governorates (1).

Man has known transportation and transportation methods since ancient times due to his need for transportation and transportation of his goods, and the first Iraqis are considered to have built paved transportation roads that were represented by cutting rocks and using bitumen in addition to bricks (2). Transportation methods in the study area witnessed a great development since ancient times, as they knew during the period of the Islamic era a special system for the roads by placing signs in the road as well as building caravanserais and maintaining the security of the road from thieves (3), which are measures that give a clear understanding of the interest in road furniture since ancient times Among these methods: (4)
1- Samawah - Salman. 2- The salmon and branches from it:
A- Salman (Ansab). B- The salmon is her feast. C- D- Al-Salman (Busiya) and a Busayyah (Takbd) branching from it.
3- Ur - Busayyah Road. 4- Basiya - (Al-Wakba).
Land transport roads in the study area are classified into (main, border, highway, secondary, and rural roads), according to their functional classification, table (1) and map (2). Rural roads are the most widely spread, as their numbers reached (79), and their percentage reached (74%) for the governorate, and their length reached (1718 km). These roads are considered among the roads that are clearly affected by weather conditions. Here is an overview of these methods:



Journal Zone Publishing, Ilford, United Kingdom

1- Highway traffic: It is one of the newly designed roads and has two directions, and it is one of the roads that is characterized by a width of three lanes for each direction on the way to and fro, between them is a middle island, and it is planned to avoid traffic congestion and facilitate its movement, as cars can travel through it at a speed more than (120 km / h), and a speed less than (40 km / h) is not allowed (5). In addition to being distinguished by its straightness, low slope, and high speed. (6) These roads are characterized by the provision of road necessities such as gas stations, restaurants, rest houses, and others. Including the Samawah Highway, which is 27 km long and 36 m wide.

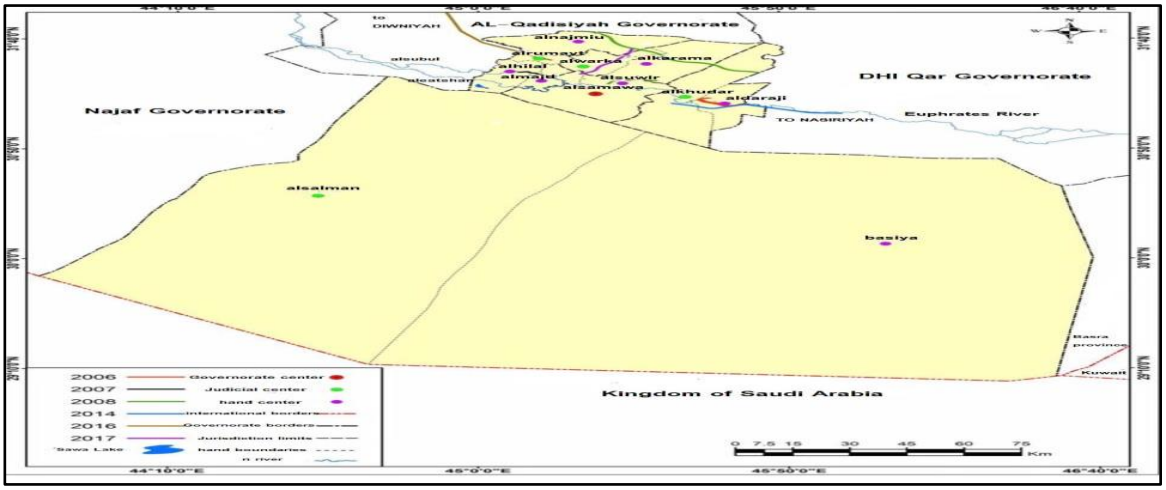
**Table (1) Road lengths in Al-Muthanna Governorate, by type, for the year 2022**

| Sequencing | classify the way | Set it up | percentage | total road length | percentage |
|---|---|---|---|---|---|
| 1 | Highway traffic | 2 | 2 | 172 | 5 |
| 2 | main roads | 7 | 7 | 648 | 21 |
| 3 | border roads | 1 | 1 | 256 | 8 |
| 4 | secondary roads | 18 | 17 | 310 | 10 |
| 5 | rural roads | 79 | 74 | 1718 | 56 |
| total | | 107 | 101 | 3104 | 100 |

**Source: Ministry of Housing and Construction, Directorate of Roads and Bridges of Muthanna Governorate, tables of inventory of roads implemented in Muthanna Governorate, unpublished data, 2022.**

**Map (2)**

**main and secondary roads in Al-Muthanna Governorate 2022**




**Source: Haider Ghali, Azzan Al-Jayashi, The variation in the density of the road transport network by cars on the main roads in Al-Muthanna Governorate for the year 2020 (a study in the geography of transportation), Master's thesis (unpublished), College of Education for Human Sciences, University of Basra, 2021, p. 34.**

**2- The Main Roads:**

These roads link the cities of the study area with each other, as well as linking them to the neighboring governorates, and their construction depends on several variables such as engineering standard specifications, such as the degree of inclination, clarity of vision, road capacity and other visual elements (7), and it is clear from Table (2) that the number of roads is Seven roads and a total length of (407 km) (8).

**Table (2) Main roads in Al-Muthanna Governorate 2022**

| **Sequencing** | route name | Road length (km) in Muthanna Governorate | the offer(M) |
|---|---|---|---|
| **1** | Muthanna - Qadisiyah | **35** | **7·30** |
| **2** | Muthanna - Dhi Qar | **55** | **7,30** |
| **3** | Samawa - Rumaitha | **25** | **8** |
| 4 | Samawa - Al-Khader | **32** | **6.5** |
| **5** | Samawa - Salman - Busayyah | **176** | **8** |
| **6** | Samawa - Al-Rumaitha - Al-Najmi | **42** | **8** |
| 7 | Muthanna - Najaf | **42** | **8** |

**Source: Haider Ghali, Azzan Al-Jayashi, The variation in the density of the road transport network by cars on the main roads in Al-Muthanna Governorate for the year 2020 (a study in the geography of transportation), Master's thesis (unpublished), College of Education for Human Sciences, University of Basra, 2021, p. 11.**

**3- Border roads:**

These roads are on the borders of the road of neighboring countries, and they are considered political roads as they work to protect the common borders between them, and the fact that Al-Muthanna Governorate borders the Kingdom of Saudi Arabia, so it has a border road with it. The length of this line is (256 km) with a width of (8 m).

4- Secondary roads:

They are roads linking the centers of the districts with the sub-districts and connecting the districts with the center of the governorate. The length of these roads has reached approximately (637 km) and there are (20) roads. These roads aim to facilitate the movement of the population and their transfer between the institutions and their areas of residence and between the rest of the settlements of the governorate centers. The roads have two lanes to and fro except for some of it in one lane. Table (3).



Journal Zone Publishing, Ilford, United Kingdom

**Table (3) Secondary roads in Al-Muthanna Governorate 2022**

| Sequencing | route name | The length of the road (km |
|---|---|---|
| 1 | Samawa - Rumaitha | 25 |
| 2 | Samawa - Al-Khader | 32 |
| 3 | Al-Rumaitha - the star | 17 |
| 4 | Salman - Al Busayyah | 200 |
| 5 | Shika - Salman | 120 |
| 6 | Samawa - thirsty / shepherd | 8 |
| 7 | Samawa - Crescent | 13 |
| 8 | Samawah - Warka | 6 |
| 9 | Rumaitha - Old Hamza | 30 |
| 10 | Samawa - Ain Said | 25 |
| 11 | Rumaitha - Glory | 13 |
| 12 | Samawah - Glory - Samawah | 26 |
| 13 | Samawa - Al-Khader - Al-Budiri | 26 |
| 14 | Samawa - Mahdi - salted | 12 |
| 15 | Samawah - As Sawyer - Al Karim | 28 |
| 16 | Al-Samawa - Al-Ma'joun - Al-Khanjar | 10 |
| 17 | Al-Khidr - Al-Daraji (Ayman Al-Furat) | 14 |
| 18 | Al-Khidr - Al-Raji (East of the Euphrates) | 10 |
| 19 | Glory - Crescent | 10 |
| 20 | The main road - As Sawir district | 12 |
| 21 | total | 637 |

**Source: Haider Ghali, Azzan Al-Jayashi, The variation in the density of the road transport network by cars on the main roads in Al-Muthanna Governorate for the year 2020 (a study in the geography of transportation), Master's thesis (unpublished), College of Education for Human Sciences, University of Basra, 2021, pp. 13-14.**

**5- Rural roads:**

They are roads feeding the main roads, where movement is limited and paved with a light layer of asphalt, and most of these roads are characterized by erosion, potholes and distortions, and they work to serve the residents of agricultural areas. They visit their city centers in order to deliver services to them and ease of movement, but this road is one of the most exposed to climatic conditions due to the lack of quality of the paving material, and there are (20) roads, the longest.

It is the road of Hajj Hamzah - Al-Awfi village, as it reaches (30 km), while the least length of it is (1 km). Al-Zawiya (Al-Khazar), Al-Daraji Al-Jazeera, Al-Saja village, Al-Arifat M. Al-Khader village, and Al-Zaher village).

**Bridges:**

Bridges are among the land roads that facilitate the obstacles of natural environments such as rivers and streams (9). Bridges and overpasses also reduce traffic congestion. Building bridges requires engineering techniques and sums of money, and the possibility of floods or torrents is taken into account when building bridges, so the height of the bridge is higher and within high engineering (10).

Reconstruction and maintenance of roads began clearly in the study area since 2005, when financial allocations were made available from the competent authorities, as a number of important bridges were established in the study area, as in Table (4), including the Shuhada Bridge, which allows the passage of vehicles with large loads. The bridge is on the Al-Hawli Governorate Road on Baghdad Road, then it heads to Nasiriyah-Basra Road, and Barbuti Bridge, which reduced traffic congestion in the city of Samawah, in addition to other bridges (11). Work is still underway on the large (Al-Sadrain intersection) project in the center of Samawah, which aims to reduce congestion.

**Table (4) The most important bridges (m) and the year of construction in Al-Muthanna Governorate during the period (2005-2020)**

| Sequencing | Bridge name | his type | length | width | Bridge site | year |
|---|---|---|---|---|---|---|
| 1 | Samawa Suspension Bridge | Armed concrete | 380 | 9 | City center | 2005 |
| 2 | Grochy bridge | Armed concrete | 176 | 9 | Samawah-Rumaitha roads | 2006 |
| 3 | Glory Suspension Bridge | Armed concrete | 55 | 9 | Spend glory | 2007 |
| 4 | Darraji Suspension Bridge | Armed concrete | 800 | 9 | Al-Daraji district | 2008 |
| 5 | Al-Rumaitha Bridge - next to the cables | Armed concrete | 300 | 9 | Rumaitha Centre | 2009 |
| 6 | Suspension Bridge of Martyrs | Armed concrete | 160 | 9 | Samawa Center | 2011 |
| 7 | North Samawa Bridge (Barbotti) | Armed concrete | 160 | 9 | Samawa Center | 2012 |
| 8 | Crescent Bridge | Armed concrete | 100 | 9 | Crescent district | 2013 |
| 9 | Samawa Bridge | Armed concrete | 160 | 9 | Samawa Center | 2017 |
| 10 | Grouchy anesthesia second pass | Armed concrete | 176 | 9 | Samawa Center | 2018 |
| 11 | Darraji Bridge | Armed concrete | 100 | 9 | Al-Daraji district | 2020 |
| Total | | | 2567m | | | |

**Source: Republic of Iraq, Ministry of Housing and Construction, Directorate of Roads and Bridges, Muthanna Governorate, unpublished data, 2022.**

**Railways :**

One of the most important lines entering Al-Muthanna Governorate is the presence of a public line called the Standard Line, as it extends from Baghdad to Basra and its length is (572 km), and it passes through the governorate with a line whose length is (94 km). and Samawah cement), and a third line is Samawah silo. A number of train stations were established in the study area, table (5), and a railway line was established between Baghdad and Hilla in 1999.

**Table (5) Spatial distribution of railway lines in Al-Muthanna Governorate 2022**

| Sequencing | station name | Geographical location | Achievement year |
|---|---|---|---|
| 1 | Rumaitha | Rumaitha | 1948 |
| 2 | cupping | Samawah | 1975 |
| 3 | Sawa Lake | Samawah | 1985 |
| 4 | Samawah | Samawah | 1985 |
| 5 | Khafoora | Samawah | 1975 |
| 6 | Al-Khader | g Al-Khader | 1975 |

**Source: Middle Euphrates Railway Directorate, Samawah Region, Civil Engineering Division, 2022**

**The second topic: (climatic characteristics affecting the reality of transportation methods in Al-Muthanna Governorate):**

The climate has a clear effect on the transportation methods in Al-Muthanna Governorate, and therefore we will discuss some elements of the climate and some phenomena to clarify this effect.

First: the temperature:

The study area is located within the dry desert region, in which the temperature rises, which affects the transportation routes, and the effect is from two sides (high and low temperature), and the temperature varied between the cold months and the hot months. (6) and Figure (1):

1- Minimum temperature:

The minimum temperatures recorded an annual average amounted to (17.8 °C), and the lowest monthly average was recorded in the cold season in January, when it reached (6.0 °C), and the highest was in December, when it reached (8.1 °C). The minimum temperature in the hot season is a temperature characterized by a rise compared to the months of the cold season, as the highest was recorded in July, when it reached (28.6 m 5).



Journal Zone Publishing, Ilford, United Kingdom

2- Normal temperature:

The annual average of the normal temperature was (25.3 Cm 5), as the month of July represented the highest month in the temperature rise, reaching (37.4 Cm 5), while the lowest was recorded in January, when it reached (11.7 Cm 5).

**Table (6): The monthly averages of the normal, minimum and maximum temperatures in the study area. to Samawa station (2000-2022)**

| Months | The average normal temperature m° | average minimum temperature m° | an average grades The maximum temperature m° |
|---|---|---|---|
| January | 11.7 | 6.0 | 17.4 |
| February | 14.2 | 7.8 | 20.7 |
| March | 19.3 | 12.3 | 26.4 |
| April | 25.1 | 17.9 | 32.3 |
| May | 31.2 | 23.6 | 38.9 |
| June | 35.0 | 26.7 | 43.4 |
| July | 37.4 | 28.6 | 46.2 |
| Dad | 36.1 | 27.7 | 44.5 |
| September | 33.3 | 24.1 | 42.6 |
| October | 27.2 | 19.4 | 35.1 |
| November | 19.3 | 12.5 | 26.1 |
| December | 13.8 | 8.1 | 19.6 |
| annual rate | 25.3 | 17.8 | 32.7 |

***Source*: Ministry of Transport and Communications, Iraqi General Authority for Meteorology, Climate Department, unpublished data, 2022.**

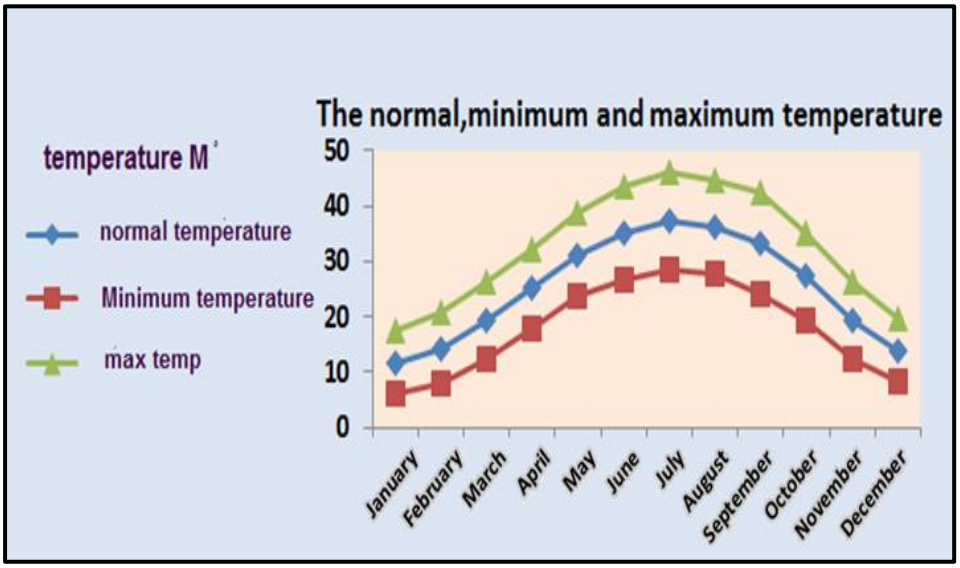



**Figure (1) Monthly averages of the normal, minimum and high temperatures in the study area of Samawa Station (2000 - 2022).**
**Source: Table (6).**



Journal Zone Publishing, Ilford, United Kingdom

**3- Maximum temperature**:

The average annual maximum temperature recorded was (32.7 °C), as temperatures began to rise from the beginning of March, reaching (26.4 °C), reaching its highest in July, when it reached (46.2 °C), while the beginning of the decrease was recorded in December, when it reached (19.6 °C). ) to continue declining to reach its lowest level in January, when it reached (17.4 m 5).

The study area is characterized by a high temperature to (46.2 m 5) as shown in Table (6), and the high temperature affects the paved roads that are covered with asphalt and used for vehicles. The rise in temperature of more than (45 m 5) works to melt the asphalt used in paving the streets, which is reflected in its effects on the means of transportation with its rapid deterioration and consumption (12). Also, the high temperature in the summer in the study area affects the softness of the asphalt layer, which leads to obvious damages on the roads such as bumps and depressions, in addition to the expansion and contraction of the asphalt layers in the paved roads when the temperatures vary between night and day and during summer and winter, which leads to distortions. And digging in the asphalt roads. The high temperature also affects the work of the car's engines, which leads to its stress. (13) The low temperature affects the surfaces of the roads paved with bitumen to shrink, which leads to cracks and bumps in the roads, and thus the entry of water into the holes during rain. (14) It also affects Extreme temperatures on these roads, which reduces their efficiency, and thus high temperatures affect the expansion of the car tires, and exposure to accidents (15). In addition to that, its effect on the railway line, as it leads to the curvature of the railway rails due to their expansion (16), and the human feeling of discomfort when driving a car is also affected by the high temperatures, and this feeling decreases in the winter season (17).

Second: wind speed and direction:

The wind speed recorded an annual average of (3.4 m/s), and it is clear from Table (7), Figure (2), that the rates recorded the beginning of the increase in the month (February), reaching (3.2 m/s), while the months (March and April) were recorded , May, and July) wind speeds amounted to (3.5, 3.7, 3.8, and 4.2 m/s), respectively, and the highest was recorded in June, reaching (4.4 m/s), after which it begins to gradually decrease, starting in August, to reach its lowest speed in November, when it reached (2.5 m / sec).

As for the direction of the winds, we note from Table (8) that the prevailing winds are the northwest winds, and the reason for their blowing is the low pressure that is concentrated in the south and center of Iraq, while the high pressure is concentrated in the northeast of the country (18). The percentage of these winds was (25.1%), and the western wind came in the rank



Journal Zone Publishing, Ilford, United Kingdom

**Table (7): Monthly average wind speed (m/tha)instudy areafor the period (2000-2022)**

| Months | rates monthly to wind speed (m/tha) |
|---|---|
| January | 2.7 |
| February | 3.2 |
| March | 3.5 |
| April | 3.7 |
| May | 3.8 |
| June | 4.4 |
| July | 4.2 |
| Dad | 3.7 |
| September | 3.2 |
| October | 2.8 |
| November | 2.5 |
| December | 2.6 |
| annual rate | 3.4 |

***Source*: Ministry of Transport and Communications, Iraqi General Authority for Meteorology, Climate Department, unpublished data, 2022.**

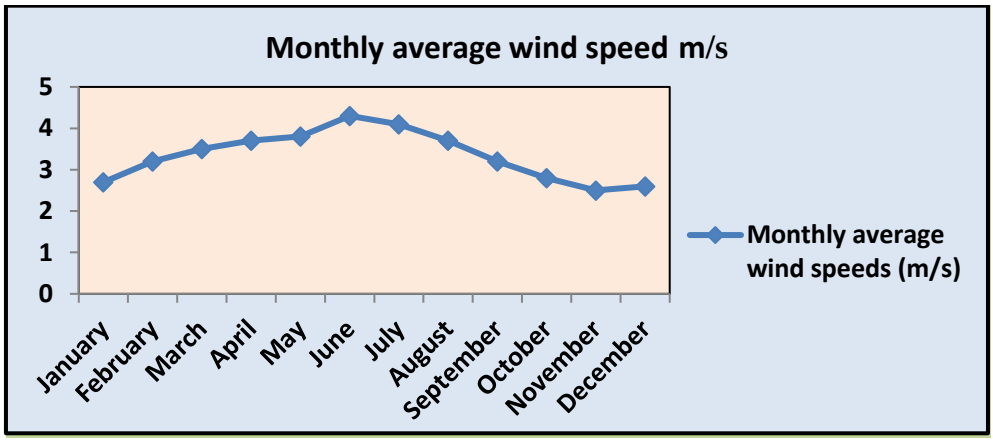



**Figure (2) Monthly average wind speeds (m/s) at Samawa station for the period (2000-2022)**
**Source: Accredited researcher on Schedule(7).**

**The second,** with a rate of (22.4%), while the third rank was represented by the northern wind, with a rate of (12.6%), and the fourth rank with the eastern wind, with a rate of (8.8%).



Journal Zone Publishing, Ilford, United Kingdom

**Table (8) : station Samawah(2000 -2022)**

| Wind direction | Northern | North-west | Western | Southwest | Southern | Southeast | Oriental | Northeast | Stillness | the total |
|---|---|---|---|---|---|---|---|---|---|---|
| the average | 12.6 | 25.1 | 22.4 | 4.6 | 3.5 | 6.5 | 8.8 | 5 | 11.5 | 100% |

**Source:Researcher by adoption on Ministry Transport transportation, Commission the public for the weather weather Iraqi, to divide the climate, data not published,2020.**

The wind stirs dust and dust and the movement of dunes in the study area due to the lack of natural vegetation and the lack of rain, as the rain works to stabilize the sand dunes. (19) As in the Samawah-Salman road and from there to the Saudi border. The study area recorded the highest wind speed in the months of (June and July), reaching (4.4 and 4.2 m/s), which is a northwesterly wind, and is characterized by its speed as it erodes roads and accumulates in other roads, which obstructs traffic and delays its arrival time. An increase in wind speeds above (30 knots per hour) affects the speed of vehicles, especially the large ones, and increases their fuel consumption and the sustainability of the mode of transport (20). In addition, the wind is affected by its transport of sand, especially in the desert areas, by covering the railway lines.

Third: Rain:

It is clear from Table (9) and Figure (3), that the annual rate of rain reached (7.5 mm) in Samawa station, where precipitation begins in October, when it reached (5.7 mm), and the rates increase to record the highest rate in January, as it reaches ( 18.3 mm), and then it begins to decrease with fluctuations in rain after March due to the decrease in the number of depressions and their lack of activity, which leads to a lack of rain in the region.

**Table (9) of the monthly average rainfall (mm) in Al- Muthanna Goverate**

| Months | rates monthly (mm) |
|---|---|
| January | 18.3 |
| February | 11.6 |
| March | 15.2 |
| April | 10.4 |
| May | 1.0 |
| June | 0.0 |
| July | 0.0 |
| Dad | 0.0 |
| September | 0.0 |
| October | 0.0 |
| November | 13.6 |
| December | 14.3 |
| annual rate | 7.5 |

**Source:Researcher by adoption on Ministry Transport transportation, Commission the public for the weather Iraqi, to divide the climate, data not published,2020.**

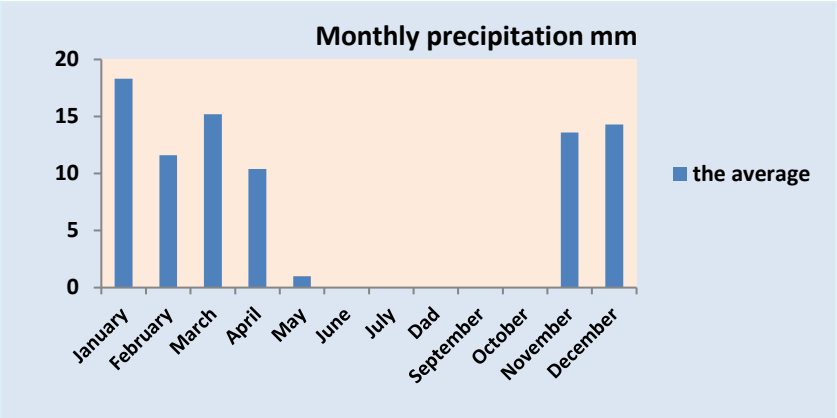



**Figure ( 3) Monthly average rainfall (mm) at Samawa station for the period (2000-2022)**

**Source: Accredited researcher on Schedule(9).**

Rain leads to wetting of the paved transport roads, which affects the wheels of the car by slipping due to the weak friction of the car tires with the asphalt, which leads to traffic accidents (21). In addition to that the rainfall leads to the appearance of cracks and subsidence due to the high level of groundwater, which leads to obstruction of traffic (22). This is what happened in the tunnel leading to the Samawah-Al-Khader road. Rainfall also obscures vision, forcing vehicle owners to stop on the roads, as well as causing accidents by slipping and colliding vehicles, which leads to heavy human and material losses, and the continuous rain falls on the formation of potholes and fractures that cause great damage to asphalt roads (23), The variation in rainfall in the study area affected the occurrence of damage to the road network, forming potholes due to the disintegration and erosion of the components of the asphalt material, especially the roads that were devoid of water drainage channels, as an example of this (Samawah-Salman) road, which caused torrents of running water by removing the layers of the road. Supreme.

And the road stopped serving (24). Rainfall also obstructs rural roads in the study area, and impedes access to cities and school students' access to their schools due to the impact of roads leading to that. Such as through Corporals in the district of Al-Khader.

Fourth: Dust storms:

The lack of rainfall with the high temperatures in the dry summer season works to increase evaporation, which results in the disintegration of the soil, which prepares the soil granules for transportation through the wind. The higher the wind speed, the formation of dust storms, which are particles of small size, the diameter of which does not exceed (100 micrometers), which is characterized by a speed of 7 m / sec or more. Dust storms travel long distances of thousands of kilometers, and they increase in summer, autumn and spring. The study area is exposed to dust storms because it is located within the areas that lie south of latitude 35 degrees north, as dust storms blow over Iraq and their intensity increases in the areas that fall within these circles. (25) It



Journal Zone Publishing, Ilford, United Kingdom

is clear from Table (10) and Figure (4) that the annual rate of recurrence of dust storms was (0.61 days), and it increased in the spring season, starting from March, when it reached (1.4 days), and it continues to increase until the beginning of the summer month, and it decreases with the advent of my seasons. Autumn and winter due to rainfall and low temperatures with low wind speed in these two seasons. The main reason for its formation is due to the passage of a cold air front, which raises the air in a vertical direction, and raises the soil forming dust storms (26). Therefore, the lack of visibility leads to collisions and an increase in accidents, especially to less than (10 m) (27). It also leads to slowing down the movement of vehicles and cars, and thus fuel consumption and damage to car engines (28).

**Table (10) Monthly average frequency of dust storms in Al-Muthanna Governorate (2000-2022)**

| Months | rates monthly (daymonth) |
|---|---|
| January | 0.3 |
| February | 0.2 |
| March | 1.4 |
| April | 1.7 |
| May | 1.2 |
| June | 0.8 |
| July | 0.6 |
| Dad | 0.2 |
| September | 0.4 |
| October | 0.3 |
| November | 0.2 |
| December | 0.1 |
| annual rate | 0.61 |

**Source:Researcher by adoption on Ministry Transport transportation, Commission the public for the weather weather Iraqi, to divide the climate, data not published,2020.**

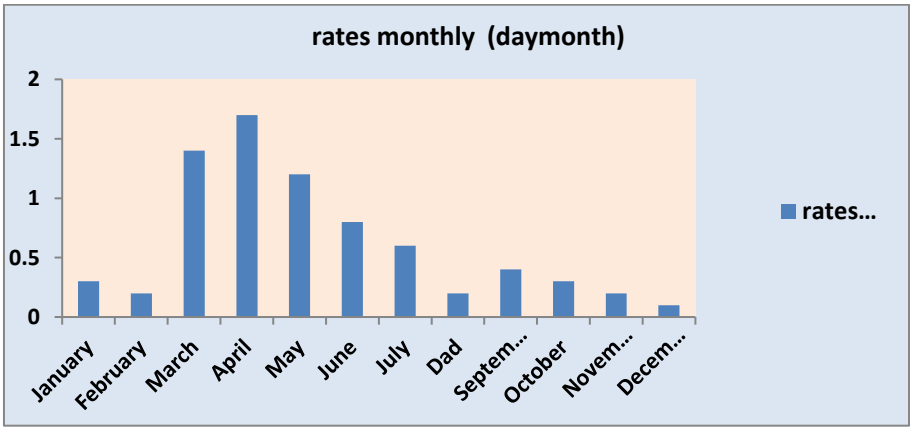



**Figure (4) monthly rates of frequency of dust storms (day \month) at samawa station for the period (2000 /2022)**

**Source: Accredited researcher on Schedule(10).**



Journal Zone Publishing, Ilford, United Kingdom

**Conclusions**

1- The study area is characterized by the existence of all kinds of roads (highways, main, secondary and rural), as well as bridges and railways, and these roads are affected by climatic characteristics.

2- The high temperature in the summer in the study area affects the softness of the asphalt layer, which leads to obvious damages on the roads such as bumps and depressions.

3- The temperature contrast between day and night and during summer and winter leads to distortions and potholes in the asphalt roads, due to the expansion and contraction of the asphalt layers in the paved roads.

4- The wind speed stirs dust and dust and the movement of dunes in the study area due to the lack of natural vegetation and the lack of rain, as on the Samawah-Salman road and from there to the Saudi borders.

5- The study area is exposed to northwesterly winds, which are characterized by their speed, and these winds erode the roads and accumulate them in other roads, which obstructs traffic and delays their arrival time.

6- The wind affects the study area by transporting sand, especially in desert areas, by covering railway lines.

7- The rainfall leads to the emergence of cracks and subsidence due to the high level of groundwater, which leads to impeding traffic movement, as in the tunnel leading to the Samawah-Al-Khader road.

8- The variation in precipitation in the study area affected the occurrence of damages to the road network in it, formed by excavating it due to the disintegration and erosion of the components of the asphalt material, as in the (Samawa - Salman) road, which removed the torrential waters of the upper layers of the road.

9- The study area is exposed to dust storms because it is located within the areas that lie south of latitude 35 degrees north, as dust storms blow over Iraq and their intensity increases in the areas that fall within these circles.

10- Dust storms are produced in the study area due to the lack of rainfall with the high temperatures in the dry summer, which works to increase evaporation and disintegrate soil particles and prepare them for transportation.

11- Dust storms increase in the spring, starting from March, reaching (1.4 days) and continuing to increase until the beginning of the summer month, as they affect the lack of visibility on the roads and the occurrence of collisions.

12- Dust storms decrease in the study area with the advent of the fall and winter seasons due to rainfall and lower temperatures with lower wind speeds in these two seasons.

Recommendations:

1- Paying attention to planning roads before they are built, based on studies and research in this field.

2- Designing roads that adopt special specifications that resist harsh climatic conditions.

3- Reliance on asphalt materials that resist high temperatures.



Journal Zone Publishing, Ilford, United Kingdom

4- The work of water drainage networks in the roads to face the continuous rain that causes damage and accidents.

**Search Margins**

1- Hussein Aliwi Nasser Al-Ziyadi, The Land of Civilizations Geography of Dhi Qar Governorate, 1st Edition, Al-Fayhaa for Printing and Publishing - Lebanon, Beirut, 2017, p. 323.
2- Duha Jawad Kazem, Amir Hadi Jadoua, The Impact of Climate on Land Transportation in Babil Governorate, Babylon University Journal for Human Sciences, Volume 27, Issue 7, 2019, p. 211.
3- Qasim Allam Kazem Al-Owaidi, The Impact of Land Transportation Methods on the Growth of Human Settlements in Al-Muthanna Governorate, Master Thesis, College of Education for Human Sciences, University of Babylon, 2012, p. 83.
4- The same source, p. 83.
5- Haider Ghali, Ajzan Al-Jayashi, The Variation in the Density of the Land Transport Network by Cars on the Main Roads in Al-Muthanna Governorate for the Year 2020 (A Study in the Geography of Transport), Master Thesis (unpublished), College of Education for Human Sciences, University of Basra, 2021, p. 10.
6- Wahab Fahd Al-Yasiri, Charter of Talib Al-Khafaji, Classification of External Land Transport Routes in Dhi Far Governorate Using (GIS), College of Arts, University of Kufa, Volume 1, Issue 32, 2017, p. 55
7- Muhammad Azhar Al-Sammak, The Geography of Transportation between Methodology and Application, Dar Al-Yazurdi Scientific for Publishing and Distribution, Jordan, Amman, 2010, p. 171.
8- Haider Ghali Ajzan Al-Jayashi, previous source, p. 12.
9- Abd al-Rahman Jari Mardan al-Huwaidari, An Analysis of the Geography of Car Transportation in the City of Hilla, PhD thesis (unpublished), College of Education, Basra University, 2011, p. 101.
10- Khalaf Hassan Al-Dulaimi, Applied Geomorphology, Applied Geomorphology, 1st Edition, Al-Ahlia for Publishing and Distribution, Amman, Jordan, 2001, p. 219.
11- Haider Ghali Ajzan Al-Jayashi, previous source, p. 48.
12- Duha Jawad Kazem, Amir Hadi Jadoua, previous source, p. 216.
13- Muhammad Yousef Nemer Khatib, Land Transportation in Jenin Governorate, PhD thesis (unpublished), An-Najah National University, College of Graduate Studies, 2011, p. 77.
14- Ali Sahib Talib Al-Musawi, Abd Al-Hasan Madfoun Abu Rahil, Applied Climate Science, Dar Al-Diyaa for Printing and Design - Al-Najaf Al-Ashraf, 1st edition, 2011, p. 357.
15- Salam Hatif Ahmed Al-Jubouri, Applied Climate Science, University of Baghdad, 1st edition, 2014, p. 196.
16- The same source, p. 197.



Journal Zone Publishing, Ilford, United Kingdom

17- Milad Jassim Mohi Al-Araji, The Effect of Climate on Land Transport Routes in Wasit Governorate, Al-Mustansiriya University - Journal of the College of Education, Issue Two, Part Two, 2022, p. 55.
18- Ali Hussein Al-Shalash, The Climate of Iraq, translated by Abd al-Ilah Karbal, Majid al-Sayyid Wali, Basra University Press, College of Arts, 1988, p. 23.
19- Talib Al-Khafaji Charter, The Effect of Water Resources, Natural Plants, and Climate Factors on the Efficiency of Land Transport Roads in Dhi Qar Governorate, Maysan Journal of Academic Studies, Issue 39, 2020, p. 39.
20- Ali Sahib Talib Al-Musawi, Abd Al-Hassan Buried Abu Rahil, previous source, pp. 357-358
21- Salam Hathef Ahmed Al-Jubouri, previous source, p. 205
22- Qasim Allam Kazem Al-Owaidi, previous source, p. 41.
23- Hamid Ghaleb Al-Sukini, Climate Change and its Repercussions on Land Transport Movement in Iraq, Basra Research Journal, Issue 21, 1999, p.