



# Evaluation Of Environmental Hydrogeological Characteristics And Their Impact On Transportation Routes In The Western Part Of Najaf Governorate

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**Abstract:** This study was carried out in the desert of Al-Najaf province, where water samples were taken from four wells: the first in the Alrohban, the second the Alrihema region, the third in the area separating the Najaf and Karbala governorates (Al-Rijiba), and the last well from the palm production station on the Karbala Road. Some chemical analyzes were conducted of the water taken from these wells that including estimating the electrical conductivity( EC), pH, Total Dissolve Salts (TDS), the concentrations of the elements calcium(Ca), magnesium(Mg) phosphorous(p), Sodium (Na) , chlor (Cl) ,potassium K and sulphates ( SO<sub>4</sub>) of the well water. The highest pH in well water was in the Najaf desert that reach 7.78 and the lowest in alrigiba water of 7.32, while the same wells gave the highest electrical conductivity 7.80 ds.M<sup>-1</sup> and the lowest EC in date palm water of 3.65 ds.M<sup>-1</sup> , the highest percentage of total dissolved salts was at the Alrihema site which reached 4125 mg.L<sup>-1</sup> and the lowest in date palm water water of 2120 mg.L<sup>-1</sup> ,The concentrations of elements showed a significant superiority in the above locations that were ,125 mmole.L<sup>-1</sup>, 78 mmole.L<sup>-1</sup> and 15.2 mg.kg<sup>-1</sup> 420 ppm , 610ppm , 25ppm and 1108 ppm respectively.

The hydrogeological characteristics and quality of groundwater have significantly impacted transportation routes in Najaf Governorate in several ways, including: Erosion: High levels of dissolved salts in the water have caused erosion of roads and infrastructure, leading to a gradual deterioration in the quality of the roads over time. Landslides: Changes in groundwater levels have led to soil instability, causing landslides that have impacted the roads. Thermal Expansion: Fluctuations in groundwater levels can cause roads to undergo thermal expansion and contraction, resulting in cracks and deformations in the roads. Material Quality: Building new roads or maintaining existing ones may require the use of materials that are resistant to saline or alkaline water to prevent deterioration. Agricultural Impact: High-quality water can be used to irrigate agricultural lands adjacent to the roads, contributing to soil stability and preventing sand accumulation on the roads.

**Keywords:** Weel, Electrical conductivity, Total Dissolve Salts, Alnajaf Desert, Transportation methods.

**INTRODUCTION:** Groundwater is distributed differently from one place to another, depending on the geology of the place, the nature of the soil and rocks present in it, and the extent of their permeability to this groundwater, which is originally generated from rainfall or the melting of snow and its transfer from the surface of the earth to its interior in reservoirs known as artesian reservoirs, where groundwater is reserved inside. These reservoirs are made up of hard rocks that are impermeable or semi-permeable to water. The Al-Najaf Governorate is distinguished by the abundance and diversity of its groundwater, but this water varies in its depth and quality [3].

Water has become one of the most precious resources on the surface of the Earth, as the international agricultural community has increased interest in finding irrigation methods that would preserve water wealth and fertile soil [10]. The overuse of water resources is constantly increasing, which requires taking appropriate decisions to use and distribute water, in addition to the necessity of implementing programs that allow... By conserving water, especially by farmers. [4] pointed out that local irrigation technology is compatible with the conditions for preserving water and the environment, and it also ensures a homogeneous distribution of water and nutrients in the root zone in the quantities needed by the crop, which results in an improvement in the yield, both quantitatively and qualitatively, and thus a decline in Quantities of water and fertilizers used.

Water resources are the most determining factor in

agricultural production and one of the main pillars for achieving food security goals, especially since the total use currently reaches approximately 191 billion cubic meters, equivalent to 70% of the amount of available water [3]. The water sector in the Arab countries faces a set of challenges, the most important of which is the growing demand for this important vital resource, especially in countries that suffer from an arid and semi-arid climate and that rely mainly on irrigation to produce food. Studies indicate that, in light of the current rate of water use per capita by the Arab In 2010, the amount used reached about 287 billion cubic meters per year, with a water deficit estimated at about 40 billion cubic meters [5].

Iraqi agriculture is exposed to a major challenge in the face of the shortage of water resources. Surface water, represented by the Tigris and Euphrates rivers and their tributaries, is considered the main source of irrigation agriculture in Iraq, which has been affected by irrigation projects, systems and dams of neighboring countries, as well as the deterioration of quality, which will affect the development of Iraqi agriculture and thus the future of food security [9]. If Iraq wishes to develop its irrigation agriculture, adequate plans must be made to cultivate the arable land, which amounts to 22 million dunums, the net of which is 18.6 million dunums. In this case, an amount of water estimated at approximately 61.7 billion cubic meters must be provided for its irrigation, excluding other needs [7]. Therefore, we expect that in the future the water will not be sufficient to cultivate all the irrigable lands, and that what is available is sufficient to irrigate an area not exceeding 14 million dunams at best [11].:

Locations of groundwater in Iraq. Groundwater is found in Iraq in the following places: The closed and mountainous regions, which are among the richest regions in Iraq with groundwater, especially the mountainous region, due to the abundance of fresh springs there, and the depth of the groundwater there ranges from 5 meters to 50 metres. Plain areas contain less groundwater; This is because it depends for its nutrition on the seepage of water from the Tigris and Euphrates rivers into the ground in that region. Groundwater in the Badia region, which is characterized by its great depth in the ground, reaching a depth of 300 meters, is characterized by the fact that its water is suitable for both drinking and agriculture, especially in the Euphrates Basin region, which is located in Anbar Governorate, western Iraq [2].

Groundwater is distributed differently from one place to another, depending on the geology of the place, the nature of the soil and rocks present in it, and the extent of their permeability to this groundwater, which is originally generated from rain falling or the melting of

snow and its transfer from the surface of the earth to its interior in reservoirs known as artesian reservoirs where groundwater is reserved. Inside these reservoirs are hard rocks that are impermeable or semi-permeable to water.

The water cycle in nature: Najaf Governorate is characterized by the abundance and diversity of its groundwater, but this water varies in depth and quality. The remote sensing devices used by the authors of this article made it possible to study the depths and quality of artesian reservoirs in various places in the city of Najaf and its environs. The depth and quality of groundwater were surveyed for thirty-nine different stations in the city using the Aqua groundwater survey device. This device can survey a circle. Its area exceeds 125,000 square meters for the purpose of determining the optimal location for drilling water wells, and it has the ability to determine the depth and quality of groundwater, whether it is saline, mineral, or natural, suitable for agriculture or human use [1].

The ideal design of wells: The ideal design of wells aims to achieve a balance between two basic elements, which are high production efficiency for the longest possible period of time on the one hand, and reasonable costs on the other hand. In practice, this requires fulfilling two main conditions, which are: 1. Correct determination of the dimensions of the well (depth and diameter). 2. Careful selection of materials involved in construction. This can only be achieved through a thorough study of the well drilling site from the topographic, geological and hydrogeological aspects [12].

The aquifer (aquifer) is a moist layer of permeable rocks loaded with water or of unconsolidated materials (gravel, sand, or silt) present under the surface of the earth, from which groundwater can be extracted using a water well to benefit from it[13]. The study of water flow in the aquifers is called Aquifers are hydrogeologically (hydrogeological), and related terms include the term impermeable aquifer - a thin, low-

permeability ground layer extending along the length of the aquifer, and the term impermeable layer - a solid, impermeable area (impermeable to water) existing under or above the aquifer, and if the area extends The impermeable layer above the aquifer may cause pressure to become a confined aquifer[14].

Saltwater intrusion is the movement of salt water into fresh aquifers, which can lead to contamination of drinking water sources and other consequences. Saltwater intrusion occurs somewhat more naturally in coastal aquifers, due to the hydraulic connection between groundwater and seawater. Because salt water contains a higher percentage of salts and minerals than fresh water, it is denser and heavier, and has a higher water pressure. As a result, salt water can be pushed inland under fresh water.[6]. Some human activities, especially pumping fresh water from underground wells near the coast, have increased saltwater intrusion in very coastal areas. Extracting fresh water from these wells lowered the water level, lowering the pressure and allowing the invasion of salt water coming from the sea. Reducing the pressure on the water and allowing the salt water to flow inward. Other contributors to saltwater intrusion include; Navigation channels or agricultural drainage channels, which provide channels for transporting salty water to inland waters, and sea level rise [8]. Groundwater affects the determination of some land road routes and the establishment of human settlements, as the issue of the availability of groundwater for areas not penetrated by rivers is an important issue as it is the only source for the population. In addition to passing caravans, they need to be supplied with water from wells located in Al-Salman district, and the wells have become a center To gather the population, and the existence of roads was dependent on the presence of this source of water, wells played a major role in drawing the routes of land roads, determining the locations of human settlements, and drawing a map of the movements of Bedouin tribes.[15] Map(1),(2)

**Table (1) Categories and Lengths of Roads in Najaf Governorate for the Year 2020**

1. **Main Roads**
2. **Secondary Roads**
3. **Rural Roads**
4. **Border Roads**

No.	Road Category	Total Length (km)	Width (m)	Number	Lanes	Percentage (%)
1	Main Roads	206	30	3	2	13%
2	Secondary Roads	475.15	6-7	16	1	30%
3	Rural Roads	823.18	3-6	68	1	51%
4	Border Roads	100	4	1	1	6%

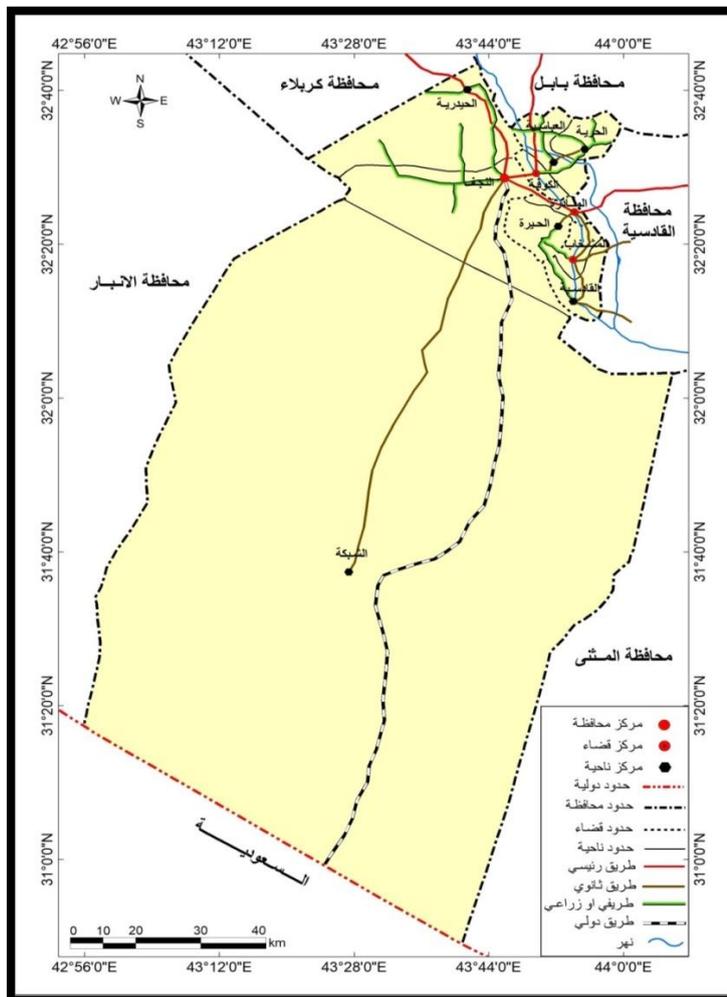
Total	--	1604.33	--	--	--	100%
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Source: Based on:

1. Ministry of Construction and Housing,

Directorate of Roads and Bridges in Najaf Governorate, Technical Division, Unpublished Data, 2020.

**Map (1): Types of Roads in Najaf Al-Ashraf Governorate for the Year 2020**



Source: General Directorate of Surveying, Administrative Map of Najaf Governorate, at a scale of 1:500,000, 2017.

Based on Table No. (1)

**METHODS**

**Experiment sites**

Four wells were chosen in four locations: 1-Alrohban, 2-Alrigiba, 3-Alrihema, 4-and the last well from the date palm production station on the Karbala Road region.

After taking the samples from the wells, they were stored in tightly closed plastic containers and were transported to the laboratory to conduct chemical tests on them.

**Chemical tests**

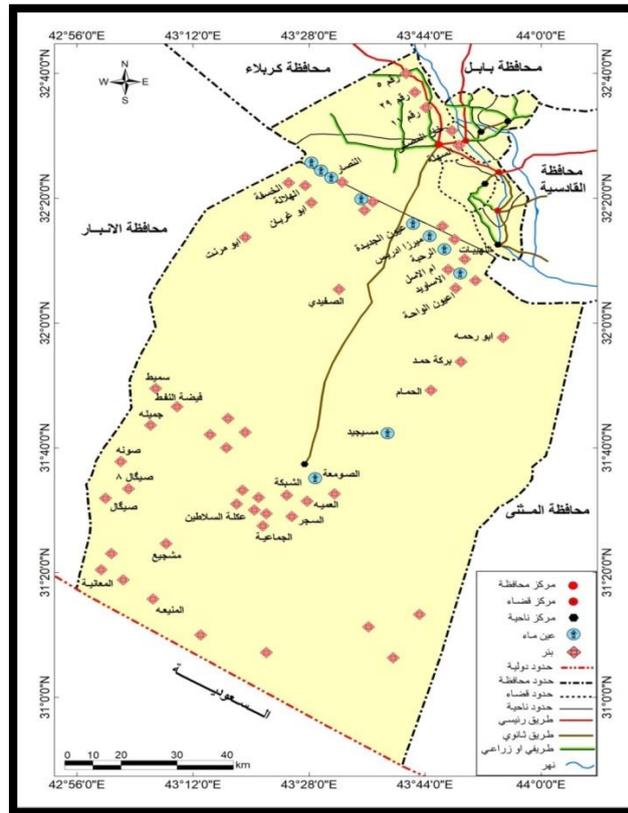
1- Estimation of water salinity: Electrical conductivity (EC): Electrical conductivity (EC) was measured using a conductivity bridge electrical device (Page et al., 1982).

2- Estimation of pH: The degree of reaction (pH) was estimated using a pH-meter (Page et al., 1982).

3- Estimating the total dissolved salts TDS: The amount of dissolved substances is measured in parts per million ppm or milligrams per liter (Page et al., 1982)..

4- Determination of sodium, potassium, calcium, magnesium and chlor : The positive dissolved ions (Ca<sup>2+</sup>, Mg<sup>2+</sup>, P<sup>3+</sup>) were estimated, where Ca<sup>2+</sup> and Mg<sup>2+</sup> were estimated using the denaturation method using Na<sub>2</sub>EDTA Jackson (1958), and P<sup>3+</sup> dissolved was estimated using a flame photometer Flame Richards, (1954).

Map (2) Wells and Springs in Najaf Governorate for the Year 2023



Source: Republic of Iraq, Ministry of Water Resources, General Authority for Survey, Administrative Map of Najaf Governorate, Scale 1:500000, 2020

**RESULTS AND DISCUSSION**

The results appear that the highest pH in well water was in the alrohban which was 7.78 and the lowest in alrigiba water of 7.32 Fig (1), while the same wells gave the highest electrical conductivity that gave 7.80 ds.M-1 and the lowest EC in date palm water that was 3.65 ds.M-1 Fig(2), Also the results appeared that the highest percentage of total dissolved salts was at the alrigiba site which reached 4125 mg.L-1 ,while the lowest in date palm farm water which was 2120 mg.L-1 Fig(3).

The concentrations of elements showed a significant superiority, Ca content appeared a high concentration in alrohban well water which was 125 mmole.L-1 while the lowest concentration in alrigiba well that gave 90 mmole.L-1 , Mg concentration gave a high percentage in Alrohban that was 78 mmole.L-1 and the lowest values in date palm farm which was 42 mmole.L-1 , the available phosphorous indicated a high values in date palm farm that was 15.2 mg.kg-1 ,while alrihema has a lowest contents of phosphorous that was 7.5 mg.kg-1 , Na concentration gave a high percentage in Alrihema that was 420 ppm and the lowest values in alrigiba which was 225 ppm , K concentration gave a high

percentage in Alrohban that was 25 ppm and the lowest values in date palm farm which was 15 ppm , Cl concentration gave a high percentage in date palm farm that was 610 ppm and the lowest values in alrihema which was 412 ppm and So4 concentration gave a high percentage in Alrigiba that was 1108 ppm and the lowest values in alrihema which was 560 ppm respectively.

The hydrogeological characteristics and quality of groundwater have significantly impacted transportation routes in Najaf Governorate in several ways, including: Erosion: High levels of dissolved salts in the water have caused erosion of roads and infrastructure, leading to a gradual deterioration in the quality of the roads over time. Landslides: Changes in groundwater levels have led to soil instability, causing landslides that have impacted the roads. Thermal Expansion: Fluctuations in groundwater levels can cause roads to undergo thermal expansion and contraction, resulting in cracks and deformations in the roads. Material Quality: Building new roads or maintaining existing ones may require the use of materials that are resistant to saline or alkaline water to prevent deterioration. Agricultural Impact: High-quality water can be used to irrigate agricultural lands adjacent to the roads, contributing to soil stability and preventing sand accumulation on the roads.

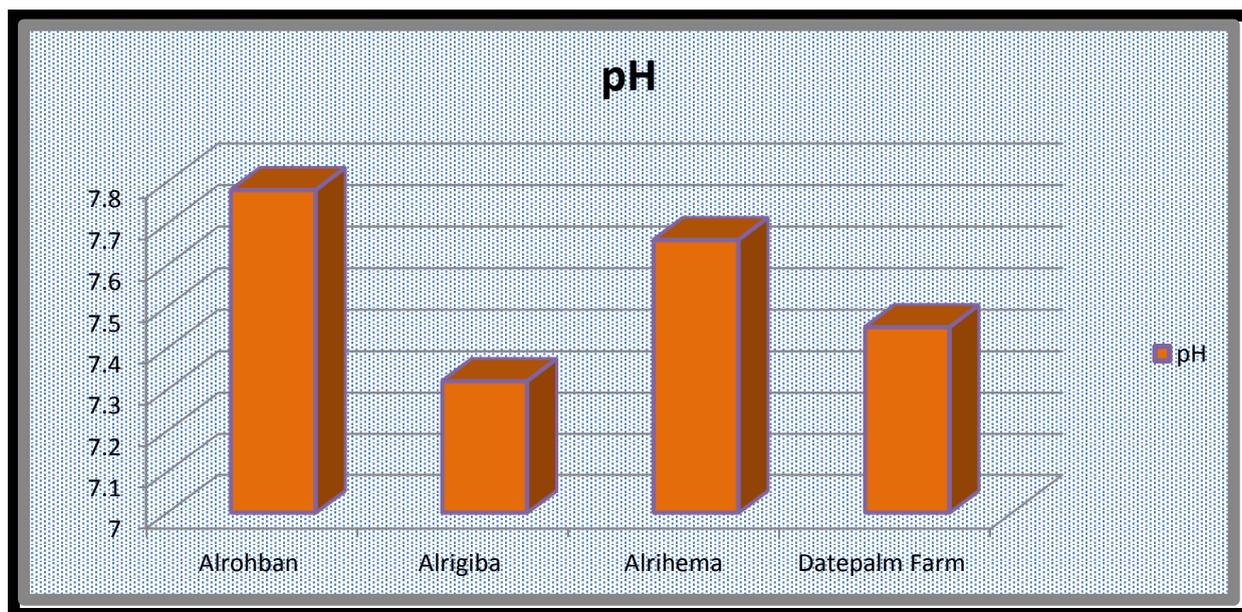


Figure (1) PH Values of the studied well water in four region in AlNajaf desert

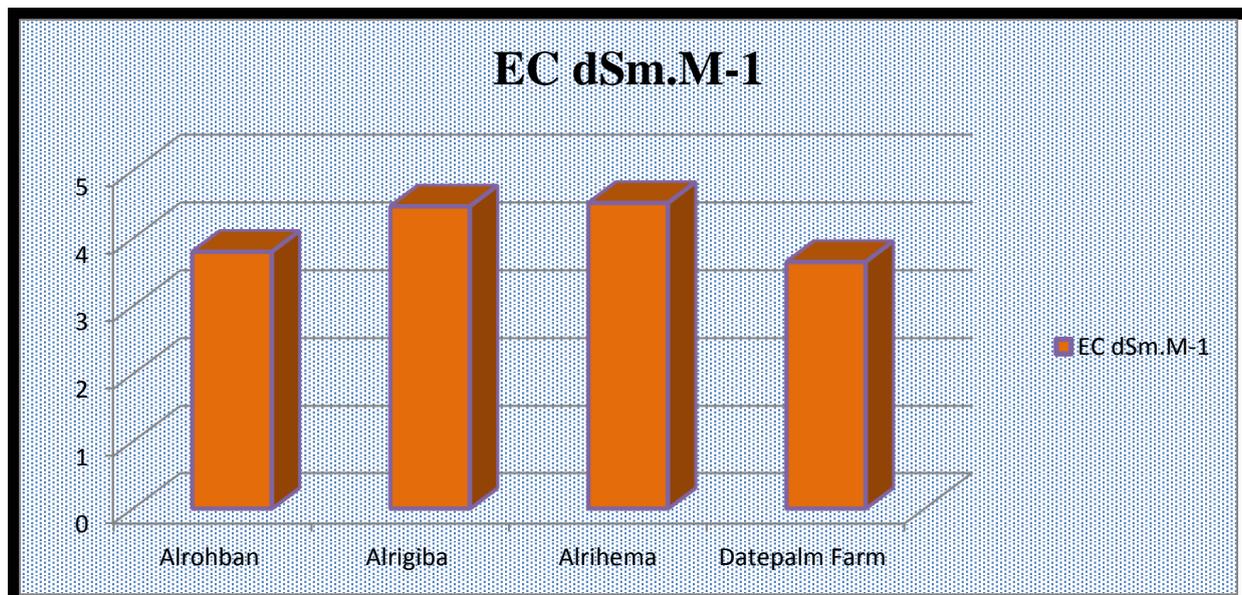


Figure (2) EC .dSm.M<sup>-1</sup> Values of the studied well water in four region in AlNajaf desert

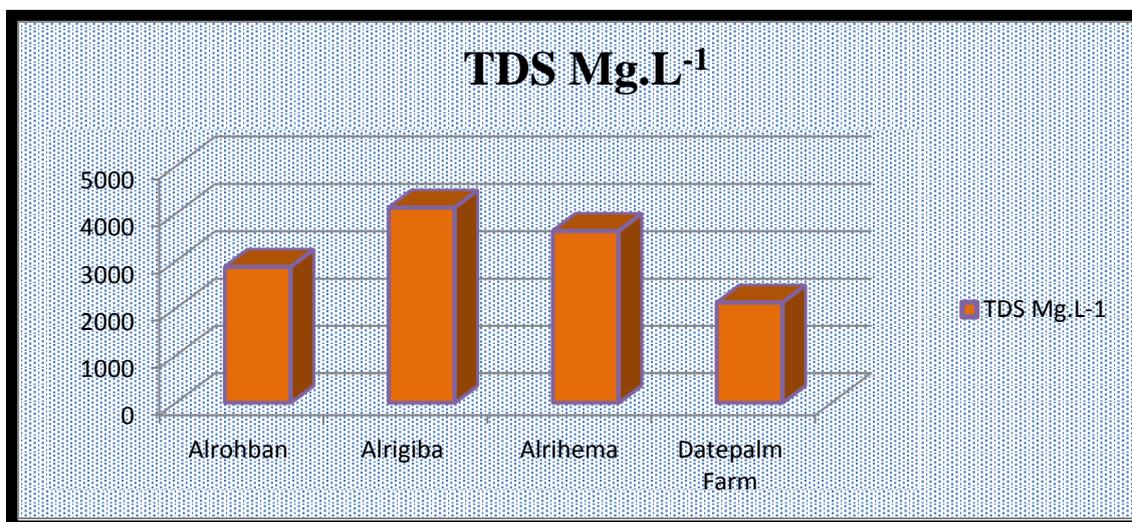


Figure (3) TDS contents mg.L<sup>-1</sup> Values of the studied well water in four region in AlNajaf desert

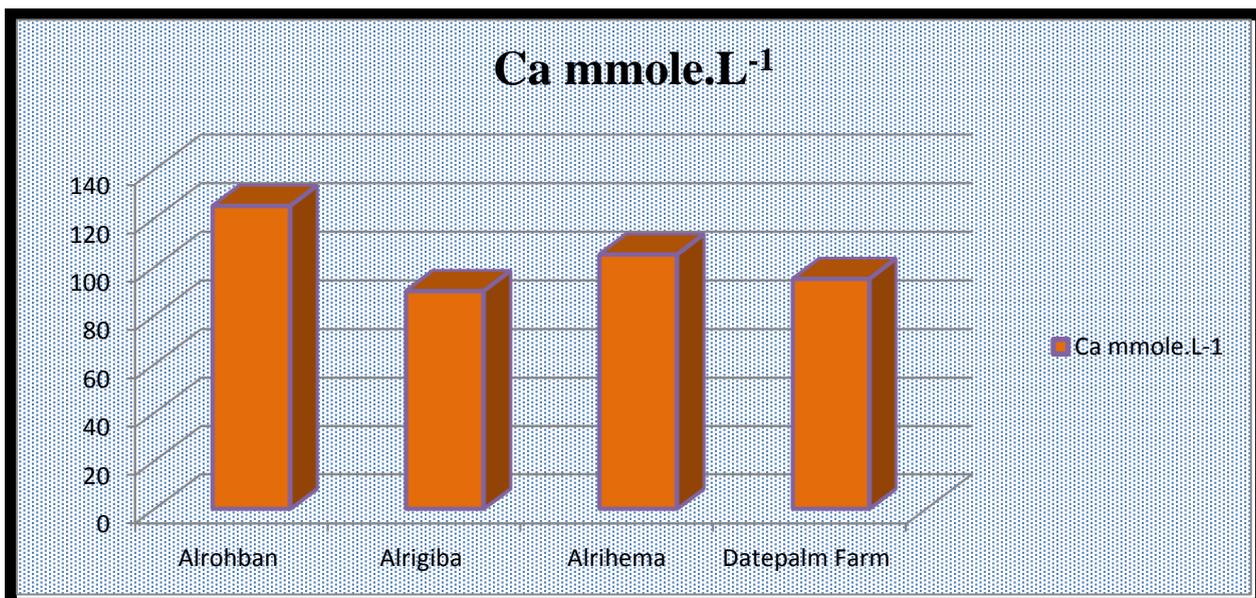


Figure (4) Ca contents mmolel<sup>-1</sup> Values of the studied well water in four region in AlNajaf desert

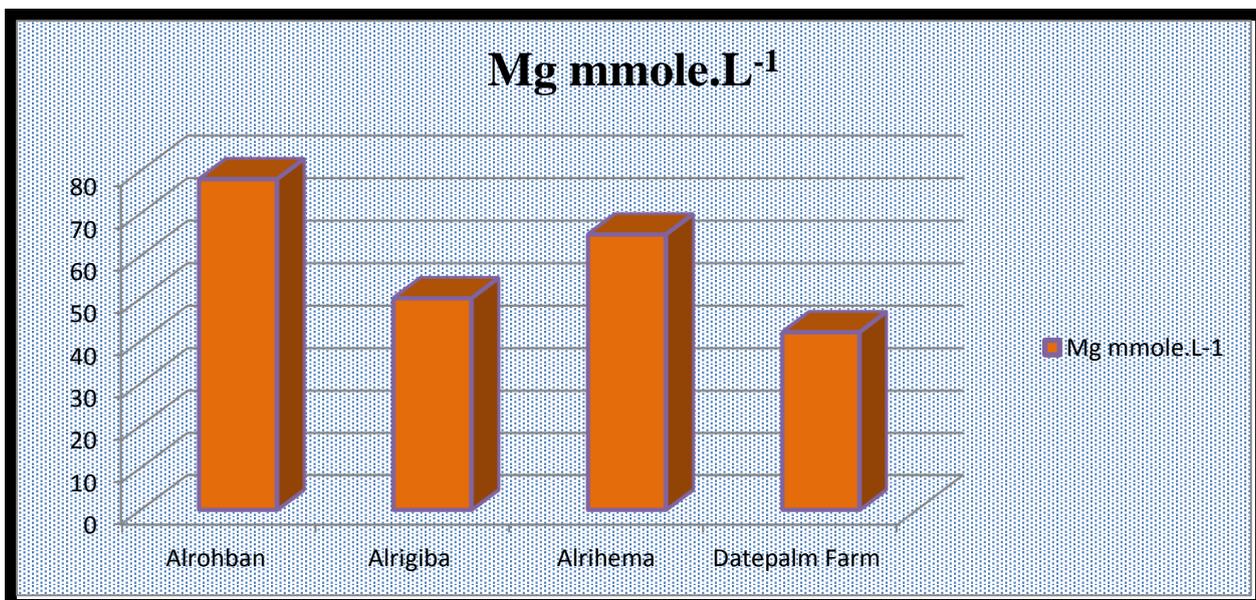


Figure (5) Mg contents mmolel-1 Values of the studied well water in four region in AlNajaf desert

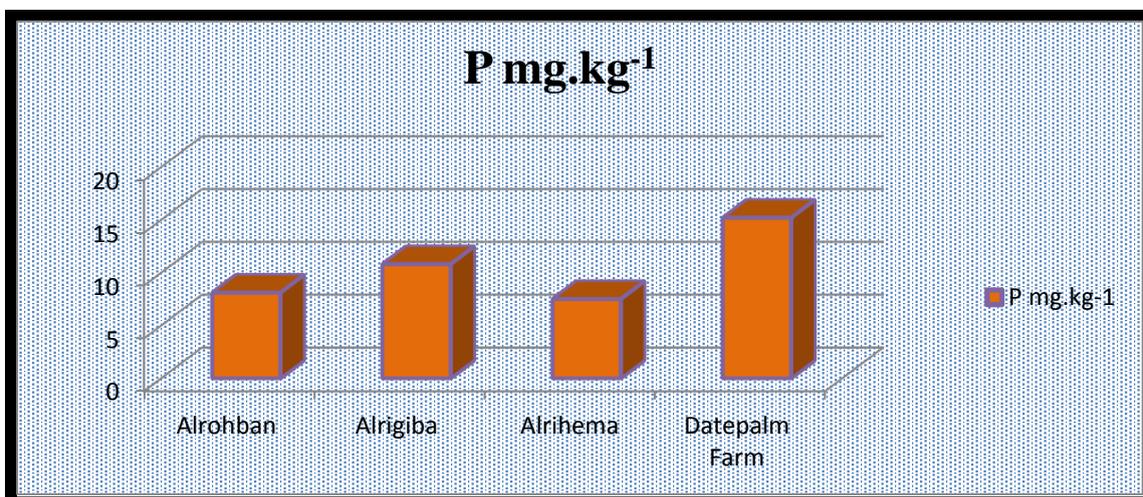


Figure (6) P contents mg.M<sup>-1</sup> Values of the studied well water in four region in AlNajaf desert

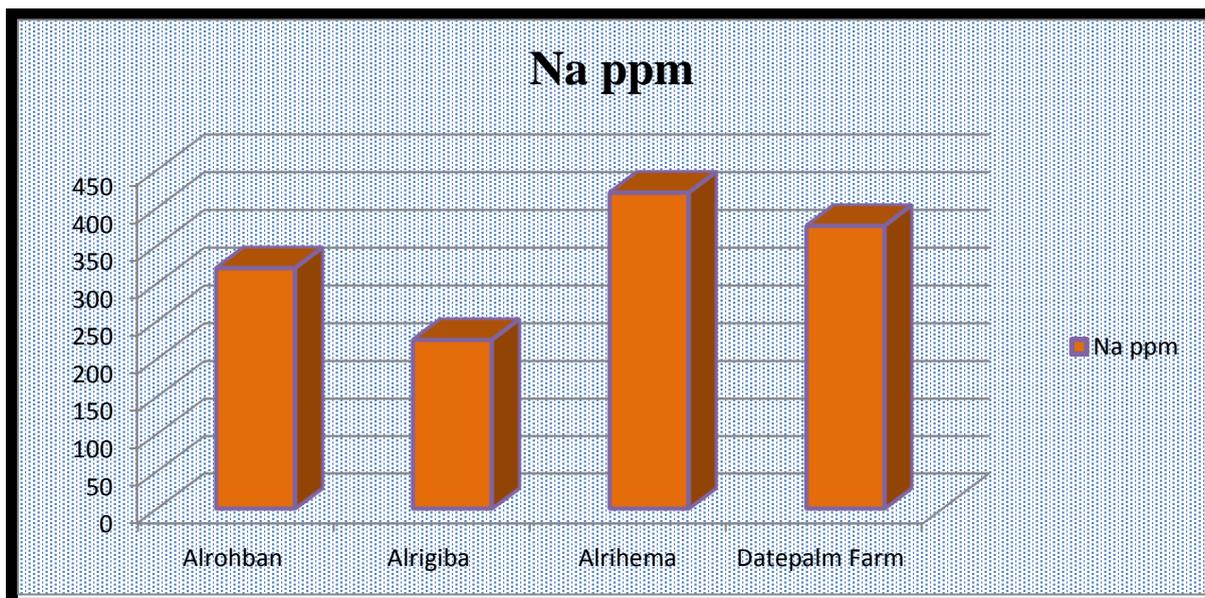


Figure (7) Na contents ppm Values of the studied well water in four region in AlNajaf desert

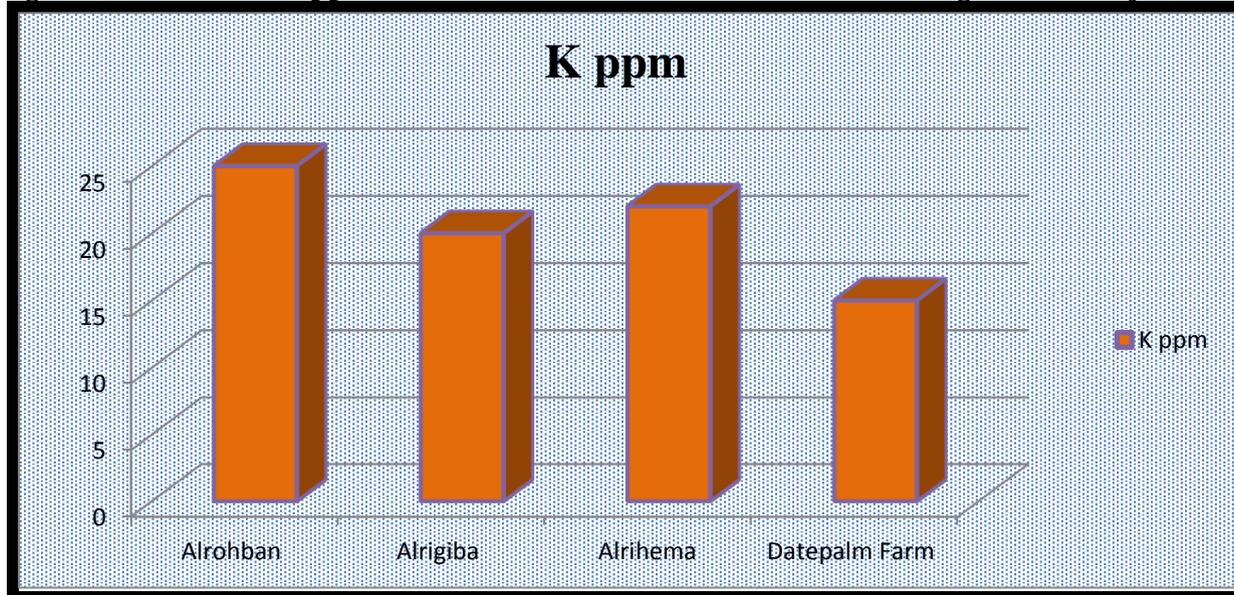


Figure (8) K contents ppm Values of the studied well water in four region in AlNajaf desert

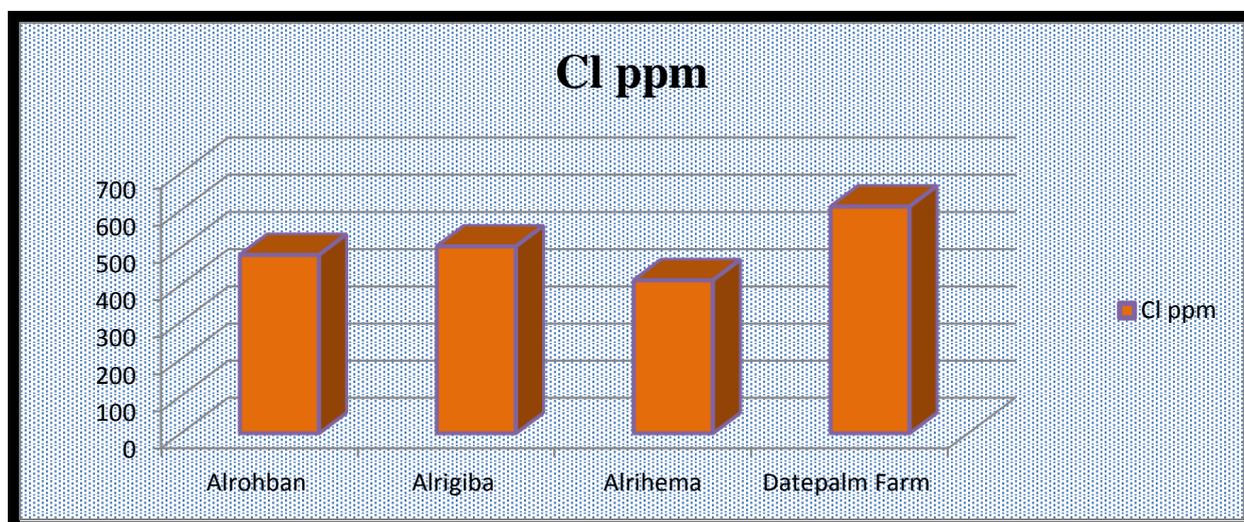


Figure (9) Cl contents ppm Values of the studied well water in four region in AlNajaf desert

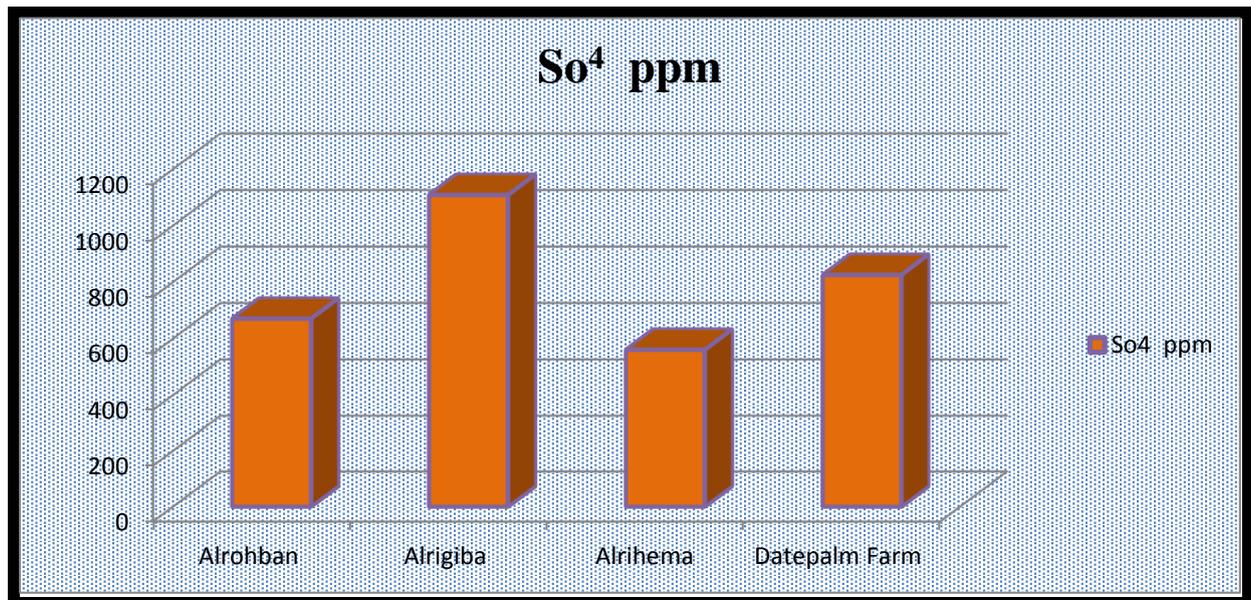


Figure (10) P mg.M<sup>-1</sup> contents Values of the studied well water in four region in AlNajaf desert

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