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The quality of groundwater in the Samawah desert (Iraq) and its impact on increasing the likelihood of severe desertification in the cultivated pasture lands.

Athier A. Hussin and Kariem A. Ghazal
Desert and Sawa Lake Studies Center, Al- Muthanna University,Samawa, Iraq.
Department of Soil Sciences and Water Resources, University of Kufa, El- Najaf 54003, Iraq

Abstract:*This research examined the chemical and physical properties of the ground water in the different parts of the Samawah desert in order to assess its suitability for agricultural purposes'and whether it causes an increase in the salinization of natural pasture lands used for the purpose of agricultural production, and thus exposes them to severe desertification. Several parameters are examined for (16) wells and (3) artesian wells which are located in the different regions of Samawah desert depending on the scientfic methods of sample collection in mid - February (*2019*). The results showed that there are differences in the ground water aspects (chemical and physical aspects) among wells water and most of the wells water was a saline water which causes an increase in the likelihood of pasture lands being exposed to severe desertification as a result of using this water for agricultural production purposes in those lands. However, there are three wells where have a good quality of water therefore, these three wells are suitable for agricultural uses, unlike the rest of the examined wells, where the water was not suitable for agriculture or suitable for agriculture, but taking care of the soil.*

Keywords: *Desertification, Samawah desert, chemical and physical properties, Iraq*

1. Introduction

The study of the physical and chemical properties of water in general is of great importance in determining the quality of water and its degree of freshness and pollution to assess the possibility of its use in industrial and agricultural applications and human drinking. Groundwater varies in its physical and chemical properties according to its location around the world, and that the geological, topographical and climatic conditions play an important role in determining the quality of that water, its possibility of using it for different purposes and its potential for contamination. The type of rocks that passed through them, which have a major role in increasing or decreasing the concentration of dissolved materials, as well as the geological layer in which the water is located, and the type of rocky reservoir containing groundwater, had a great and direct impact on the quality of that water [1]. This study is different from the rest of the studies on groundwater in the southern part of the western desert plateau, where the study aims to conduct physical and chemical examinations of the waters of a group of wells and springs and in different places of the study area (Samawah desert) for the purpose of determining the quality of the groundwater and its impact on the lands of natural pastures. The increase in soil salinity resulting from the use of groundwater with high salinity, along with the accompanying increase of evaporation due to highaverage of temperature, will ultimately lead to severe desertification.According to the United Nations Convention to Combat Desertification (UNCCD), desertification is 'land degradation in the arid, semi -arid and dry subhumid areas resulting from various factors, including climatic variation and human activities' [2].

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2. Study area

The desert occupies most of the area of the Muthanna Governorate, as the desert area is (46928 km²), which includes the Salman district center, which has an area of (22396 km²) and the Busayya district, which has an area of (24532 km²). The desert of Samawah constitutes (90.7%) of the total area of the governorate, which has an area of (51,740 km²), which is the second largest of the governorates of the country. The southern desert is confined between longitude (42.55 º _ 46.5 º) in the east and two circles of latitude (29.10º - 31.55º) in the north [3]. The western plateau has gone through several geological formations that are confined between the third geological time and the fourth geological time, and include sediments ranging in age between the Lower Eocene and the Pliocene and contain rock formations such as the formation of Umm Ardamah where this formation is exposed on small areas of the study area and is considered one of the formations of the third time, and ranges. The thickness of this formation ranges between (30-80) meters. As for the Dammam Formation, this formation is considered one of the oldest and widest formations exposed on the surface as it covers most parts of the study area except for some places covered by modern sediments. It is considered one of the Eocene formations and deposits also and its thickness ranges between (30-62) meters [4]. As for the gas formation, it appears clearly directly above the Dammam formations, and it appears in the form of isolated spots in the northeastern part of the Salman Depression, which is one of the Era formations (the Lower Miocene), and its thickness ranges between (90-130) meters [5]. The Euphrates Formation also appears east of the Dammam Formation, especially in the northeastern parts of the Salman Depression, and it dates back to the third time (the Lower Miocene). Its thickness is about (180 m) and this formation is characterized by the high salinity of its groundwater [6]. The formation of the flower is the most recent as the age of this formation (Pleiocene-Pleistocene), this formation is exposed in the form of small and dispersed areas as it appears in the southeast of the Salman region in both depressions (Shafaliyah and Hadaniyah). The Euphrates Formation in the north and the Dammam Formation to the south, and it consists of a mixture of limestone and alluvial stones with the sediment that contain groundwater. The thickness of this formation is estimated at about (35 m) [4]. And there are the deposits of the modern time, which are the deposits of the Quaternary age, which is the last of the geological times. In the study area, the slope sediments that cannot be separated distinguish them from the slope sediments in the Holocene period. Likewise, the Holocene deposits are other deposits present in the study area and include depressions filling deposits and slope deposits [7].

3. The Climate of Samawah desert

The climate of the study area represents part of the general climate of the Iraqi southern desert, which is characterized by being hot dry in summer and short cold in winter, in addition to the high daily and annual temperature range due to its distance from marine influences and the lack of vegetation cover. In order to know the climatic characteristics of the study area, it is necessary to address each climate element through the recorded data of these elements taken from the two climatic stations (Al-Samawah and Al-Salman) as follows:

3.1 -Solar radiation:

Solar radiation is the main source of energy in the atmosphere, and the intensity and quantity of solar radiation determines the general distribution of temperatures above the earth's surface at different latitude circles, and the intensity and quantity of solar radiation is determined by the apparent movement of the sun between the orbits of Cancer to the north and Capricorn to the south. The length of daylight hours affects the determination of the number of solar rays reaching the surface of the earth. The greater the length of time that the sun is capable of, the greater the number of rays, and vice versa [7].

3-2Temperature:

The thermal characteristics of any region are the result of a set of factors, the foremost of which is the astronomical position that determines the amount of solar radiation reaching the surface of the earth, and as a result of the location of the southern desert within the western desert plateau, west of the Euphrates, that is, it is located within the arid region, which added to its characteristics to be printed with the characteristics of this dry region and that the temperatures start to rise from January to reach their highest levels in the months (June, July, August), and in the winter they fall to their lowest levels (December, January, February). This negatively affected the water supply of the region, especially in the long, arid summer that extends for more than eight months.[8]

3-3 -Rain:

Rain is the most important climatic component after heat. The period of rainfall in the study area is concentrated during the winter months in the period from October to May, which is at low rates, while the summer months are dry. The rates of the amount of rain falling on the study area vary from month to month in both stations, where the highest rate of rain falls during the month (January), which reached in Samawah and Salman stations (23.6, 20.8) mm respectively, then the amount of rain begins by gradually decreasing from the month of March until the rain falls and the drought resolves from the month of June until the end of September, and thus it becomes clear to us that the study area is characterized by a small amount of rain as the annual total of rains in the two climatic stations Al Samawah and Al Salman reached (105, 80.8) mm respectively[8.].

3-4 -wind:

What concerns us from studying the winds is what is considered by some responsible for the drying of the surface of the study area, especially as its surface is characterized by being almost flat despite some terrain that distorts this wide level. As a result of the desert being located within the dry region, as what distinguishes the prevailing winds in this area is that it played a major role outweighs the role of other factors in the desertification of Region [8].

4. Some previous studies of groundwater (well water) tests from the world

4.1 The first study:

It is the study of the physical and chemical properties of groundwater in the Ijan-Ekiti region, located in southwestern Nigeria. Where random samples of water were taken from 9 wells in this region, where the pH value was the highest in the fourth well (A4) while the highest percentage of chloride was in the third well (74.20 mg / L) and the EC rate for wells was (212). The TDS rate for wells was (0.8711 mg / L) and the percentage of Na was (2.75 mg / L) in the sixth well. As for calcium, the highest percentage was in the fourth well (A4), while manganese was the highest in the eighth well (A8) [9].

4.2The second study:

Another example from (Kihara) area in Kia Mbon, Kenya, where a study was conducted to examine the chemical and physical properties of groundwater. Water samples were collected from (10) different wells in the Kihara region for the period from April to July. The chemical and physical examination of the water samples was performed accordingly. For standard procedures of the American World Health Assembly, samples were collected from different depths and were determined from (B1-B10) with significant changes in pH value, electrical conductivity, temperature and turbidity. From the results of the tests, we note that the highest value of TDS was in the well (B1) (795 mg / L) as well as the electrical conductivity the well B7 recorded the lowest value for TDS (48 mg / L) as well as the electrical conductivity. The chloride percentage was the highest in the well B1 (52.3 mg / L) and the lowest percentage was in the well (B7) which is (25.8 mg / L) [10] .

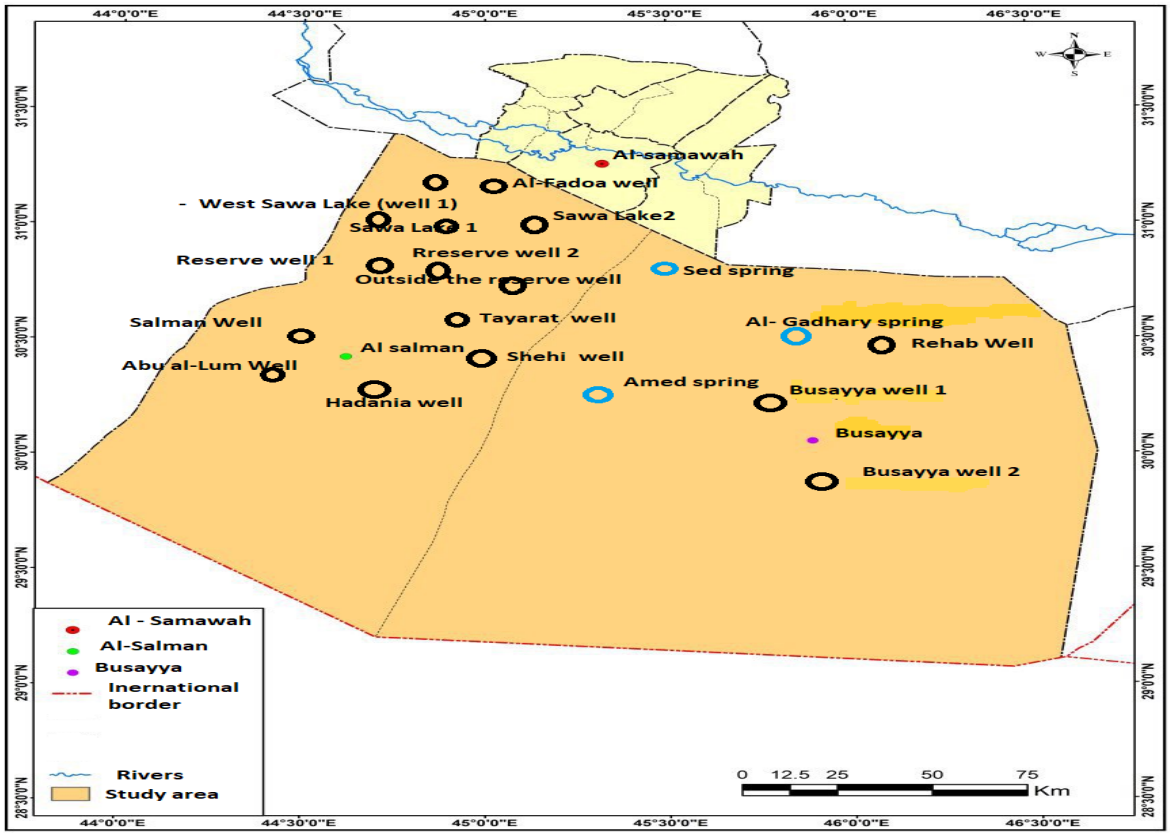
4.3 The third study:

It is an example from the region or village (Tureni) in the district of (Cluj) in Romania. This study is based on the collection of samples for a period of three months (April, May, June in 2011 and on a weekly basis from (10) water wells. Portable devices were used. Also, the laboratory is conducting the tests and the results have been compared according to the Romanian and international specifications of water. Through the results we notice that the highest pH value was in the eighth (9.4), while the highest electrical conductivity was in the tenth well (1679) UMoh, cm. The highest percentage of TDS (1404 mg / L) was in the first well, as well as the ratio of Ca (2.31 mg / L), Mg (17.5 mg / L), sulfate (487 mg / L) and chloride (464.5 mg / L). The lowest PH value was in the second well. The lowest concentration of magnesium is in the seventh well (5 mg L), while the lowest concentration of chloride is in the seventh well. (148 mg / L) [11].

5. Materials and Research methods

Water samples were taken from (16) wells and three springs, and from separate places in the Samawah desert. Chemical and physical tests were conducted for these samples in mid-February (2019) (Map 1). The concentration of hydrogen ion, dissolved solids (TDS) and electrical conductivity (EC) were measured at the well sites, the rest of the elements of wells water were laboratory examined (Table1) as well as the three springs water (Table 2). The laboratory tests included the proportions of calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl), potassium (K) and sulfate (SO4).

Map (1) showing the locations of wells (black circles) and springs (blue circles) examined in this research in the Samawah desert



(Table 1) shows the physical and chemical properties of groundwater (wells water)

Parameters	EC ds.m^{-1}	pH mgL^{-1}	TDS mgL^{-1}	Ca^{+2} mgL^{-1}	Mg^{+2} mgL^{-1}	Na^{+1} mgL^{-1}	K^{+1} mgL^{-1}	Cl^{-1}	$SO4^{-2}$ mgL^{-1}
Sed spring	5.80	7.7	2900	530	165	630	20	1020	1880
Amed spring	6.40	7.6	3210	630	145	740	15	1200	1900
Al- Gadhary spring	6.20	7.8	3098	660	148	148	21	1230	1820

(Table 2) shows the physical and chemical properties of springs water in the Samawah desert

Parameters	EC d.m^{-1}	pH	TDS mgL^{-1}	Ca^{+2} mgL^{-1}	Mg^{+2} mgL^{-1}	Na^{+1} mgL^{-1}	K^{+1} mgL^{-1}	Cl^{-1} mgL^{-1}	$SO4^{-2}$ mgL^{-1}
1- Salman Well	6.25	8.43	3120	520	260	466	45.5	1010	1218
2- Shehi well	4.65	7.02	2340	585	245	389.5	18.5	1025	1175
3- WestSawa Lake (well 1)	5.54	8.00	2773	535	260	160.8	19	1220	1120
4- WestSawa Lake (well 1)	6.92	7.40	3460	580	288	449.5	24	975	980
5- Reserve well 1	4.66	7.90	2560	545	237	545	30.5	924	985
6- Reserve well 2	4.69	7.80	2410	535	239	432.5	28	955	1280
7- Outside the reserve well	4.94	7.60	2520	558	253	564.5	31	940.5	1210
1 8- Sawa Lake	5.96	7.60	2995	640	225	192.5	44	993.5	1490.3
9-Sawa Lake 2	6.60	7.50	3250	590	250	207.5	46	1135.2	1757
10-Tayarat well	3.59	7.28	1790	432	135	215.5	16	339.5	918.9
11-Al-Fadoa well	3.29	7.45	1640	420	128.5	127.5	12	242.5	1176.1
12-Rehab Well	6.01	7.80	3000	535	155	620	22	1190	1860
13-Hadania well	0.98	7.30	657	98	12	146	0.2	163	280
14-Abu al-Lum Well	0.89	7.50	604	26	10	143	0.2	159	220
15- Busayya well 1	1.25	7.80	610	95	48	103	8	185	510
16- Busayya well 2	3.02	7.20	1500	410	198	176	32	242	1182

6. Results and discussion

Table (1) indicates the results of the physical and chemical examinations of water wells in the study area, and it appears that there is a change in the results of the tests according to the places. This may be due to several reasons, including that these wells differ in depths, some of which have a depth of more than 100 m. It does not exceed (50 m) in depth. Therefore, the source of water from wells may be from different geological layers. We also find that the salinity of water wells increases as we go from west to east due to the slope of the earth, as most wells are characterized by the fact that their water has high chloride levels, which gives a taste. These wells are highly saline, and most of the wells that have been studied contain high levels of sulfate and sodium, and this limits their use for agricultural purposes. In order to determine the validity of the water of the selected wells in the Samawah desert for agricultural production, internationally approved classifications were used for the purpose of determining the validity of water for irrigation purposes. Among these classifications are the classification of the American Salinity Laboratory, the classification of the United Nations Scientific Service (UNCCO) and the classification of the American Technical Advisory Committee [11]. When comparing the results of the water tests of springs Sed, Amed

and Al-Ghadhary, and the water of 16 wells from the Al-Samawah desert and their suitability for agricultural purposes, we note the following:

The water of the three springs and the water of many wells that have been studied and according to the international classifications of water suitability for agricultural purposes is very high salinity water according to the classification of the American Salinity Laboratory and represents an acute problem for agricultural production according to the classification (UNCCO). Its time is suitable for growing some crops and on condition that the drainage of the soil or

its water are taken care of. Appropriateness for irrigation of some agricultural crops that tolerate salinity and on the condition of taking care of soil drainage according to the American Advisory Committee (NATC). The results of the water tests also show that the water of the Haddania and Abu Lum wells in Salman and the well in Busayyah are more suitable for agriculture compared to the rest of the wells according to the mentioned classifications (Table 3). Based on Don classification water suitable for irrigation [12] We find that most of the wells that have been studied are not guaranteed results in the case of using their water for agriculture. We also note that the water of the Hadania and Abu al-Lum wells and the well 2 in Busayyah are more suitable for agriculture than the rest of the wells. Therefore, 81.25% of the wells that have been made its studies are of unsuitable water for irrigating crops or suitable for cultivating some crops that tolerate salinity while taking care of soil drainage according to several classifications or not suitable for irrigation or not guaranteed the output if used for agriculture according to the Don classification (Table 3). Therefore, most of the wells water was a saline water which causes an increase in the likelihood of pasture lands being exposed to severe

(Table 3) classifications internationally approved for the purpose of determining the suitability of water for agricultural uses

(Table 3) Water quality suitable for irrigation according to Don classification

Water quality	TDS **mgL^{-1}**	EC Ms/cm	Na **mgL^{-1}**	PH
Excellent Quality	< 175	< 250	< 3	< 6.5
Good quality	175-525	250-750	20-40	6.5-6.8
It can be used	525-1400	750-2000	40-60	6.8-7
Not guaranteed for use	1400-2100	2000-3000	60-80	7-8
Not suitable for irrigation	>2100	>3000	780	

7. Conclusion

Soil salinization is one of the indicators of desertification, and if salts accumulate in the soil, it will lead to severe desertification. Therefore, this paper discusses the issue of the possibility of transforming pasture lands in the Samawah desert in southwestern Iraq into highly desertified lands due to the use of groundwater in agricultural production. Internationally approved classifications were used for the purpose of determining the validity of water for irrigation purposes. Most of the wells water was a saline water which causes an increase in the likelihood of pasture lands being exposed to severe desertification.

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