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Research Article

The Effect of High-Water Salinity Concentrations on the Agricultural Reality in Samarra District

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Abstract
The research (the effect of high concentrations of water salinity on the agricultural reality in Samarra district) aims to clarify the effect of salts and water quality on the diversity of agricultural investment In the region, whether it is Superficial or Subterranean water, as well as clarifying the role of the Tigris river stream in financing irrigation projects in the region with the necessary water to cover its need, The modern technology (GIS) has mainly been relied upon to clarify the reality of the region to benefit from the results of the laboratory analyzes and various maps in the analysis and building samples. The study reached several results, the most important ones are: The importance of using modern technologies in hydrological studies in analyzing and converting raw spatial data into a digital database in the process of analysis and building various models. The variation in the distribution of Subterranean water from one region to another in terms of numerical distribution affected by climate on the one hand and natural and human factors on the other hand. The distribution of the variation in the salinity of Subterranean and Superficial water and its effect on the diversity in the quality of agricultural crops, which is the main economic axis for the region's population. Classifying agricultural crops and determining their areas and the possibility of expanding them through concern for determining the quality of the crop and the appropriateness rate of salts in the water used for irrigation, whether superficial or Subterranean water.

Keywords
Samarra, Soil, Water Salinity, River, Well, Agricultural, Groundwater, Grains, Vegetables

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Introduction

Water is consider a major factor in the use of lands for agricultural purposes, and the process of exploiting them for these purposes is still not parallel with its importance in this aspect, its use for agriculture faces many problems, and there is no doubt the salinity is consider one of the serious problems facing agriculture at the current time, And the salinity tolerance by plants is an important matter that has occupied the interest of most researchers and workers in agricultural fields. Water salinity is one of the most important problems of irrigated lands, as large areas of land have turned into unproductive lands due to the accumulation of salts in them, and salinity in general is the presence of many chemical compounds in the soil of some mineral salts such as calcium and magnesium sulfate chlorides, and thus it is called saline soil. The research problem represents the first step of conducting the research, which is: Does the high concentrations of water salinity have an effect on the agricultural reality in Samarra district? The research assumes: The high concentrations of water salinity have an impact on the agricultural situation in Samarra district. Determining the study area: The coordinates location: The study area (Samarra district) is located between latitude (80, 33) and (34, 36) north, and longitude (43, 3) and (44, 5) east. Geographical location: The study area is located to the south of Tikrit at a distance of 60 km from Salah al-Din Governorate, as it is expanding in the direction to the west, as its borders with Anbar Governorate, Tharthar Lake and is bordered on the north by Tikrit District and the district of al-Dur is bordered on the east and by the district of al-Dur as well, on the south it is bounded by the district of Balad. As for the space of the study area, it is (4577) km2, or the equivalent of (831152) Acres, and this area includes three administrative areas: Samarra district, Tigris sub-district, and Al-Mu'tasim sub-district, as shown in Map No. (1).

The Natural Factors Are Affecting on The Water Salinity.

The importance of natural factors in any area includes in understanding geographical phenomena through determining the natural characteristics that effect on the quantity of subterranean water and superficial water, as well as the geological structure, which is influence through the nature and properties of rocks affecting the quality and movement of subterranean water.

First: Geological Structure:

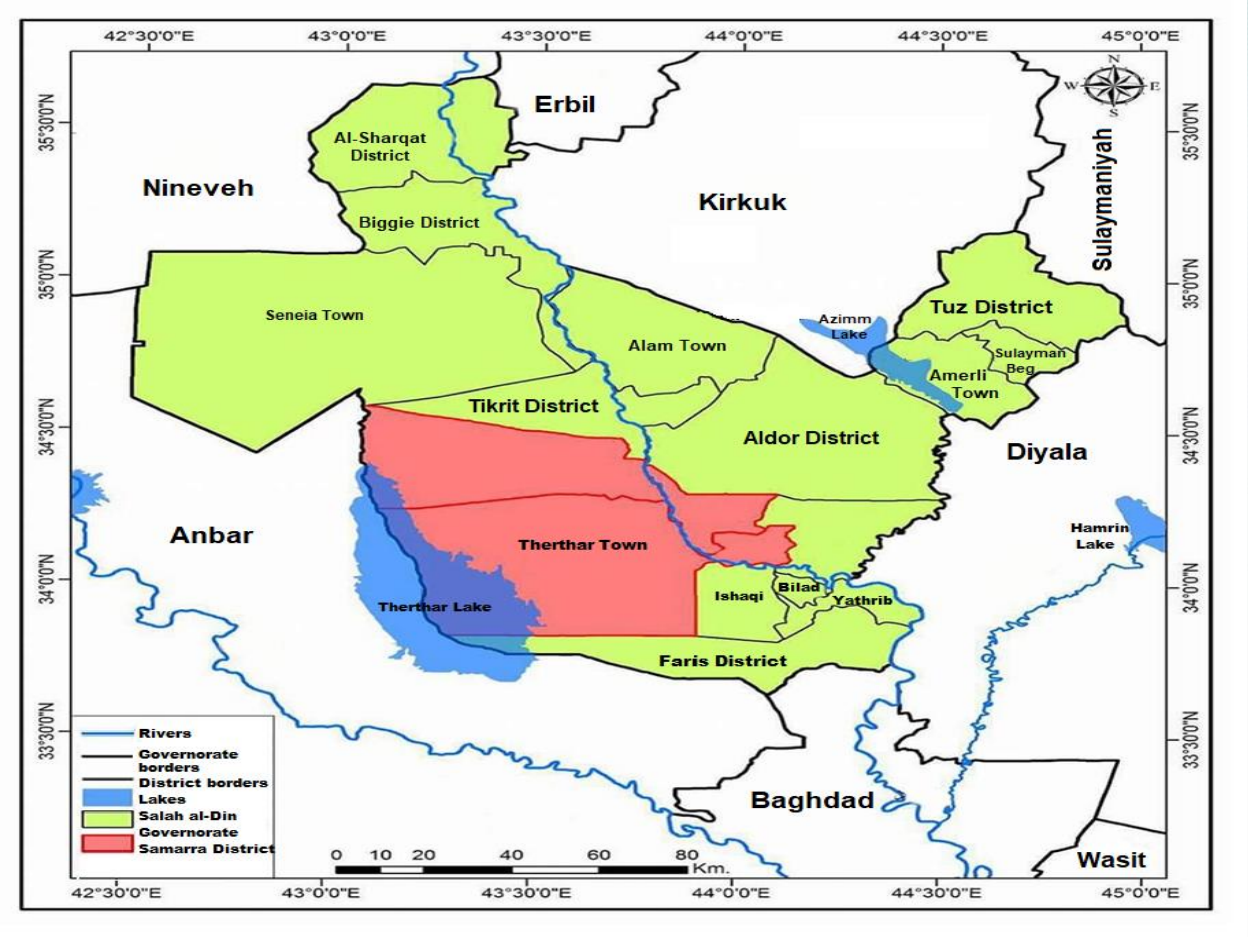
Is concerned with the study of rock formations, the type and system of rocks, any study of the stratigraphic system (Abu-Gullal et al., 2021). The geological structure affects the distribution of water and determining its characteristics, as it determines the locations of water and the characteristics of its underground reservoirs and its movement.

Geological Formations:

The study area consists of quaternary deposits and covers very large space of the area, and it is included the Pleistocene or modern age deposits, as shown in Map (2).

Valley Sediments:

they are the sediments that fill the salty depressions, and it is formed from gravel, sand, silt and mud deposits, its source is the surrounding high areas brought by water torrents and wind movement to the lowlands, the spread of these sediments in the form of a strip that extends from the far northwest of the region to the extreme southwest as it spreads in Scattered areas in the east and southeast of the region.



Map (1): Location of the Study Area
Source: Researcher based on (Arc Gis).

Flood Plain Deposits:

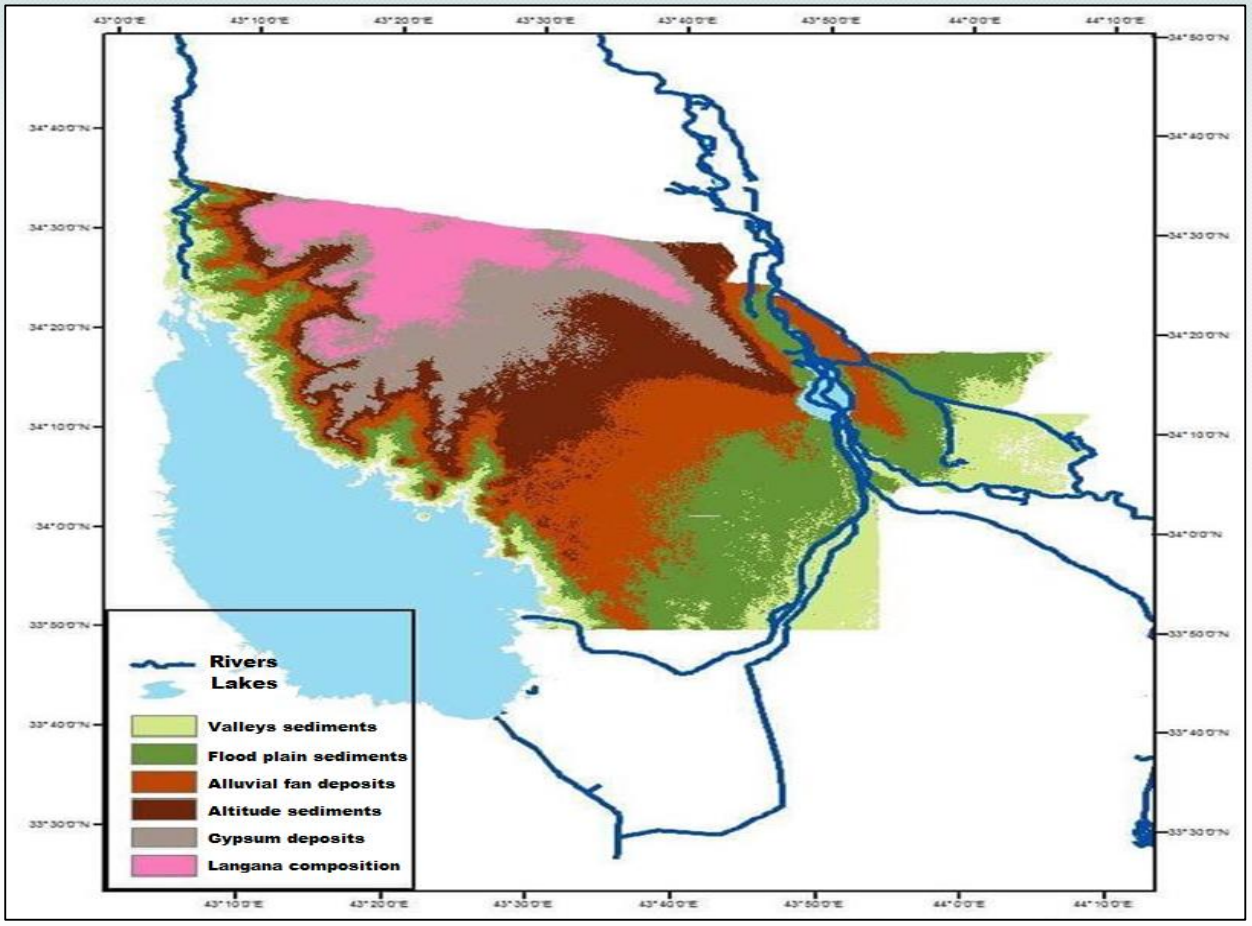
In narrow strips, the proportions of the main streams and valleys straightening, the Tigris River deposits materials near its banks, a line of mud, silt and sand with gravel, the highest thickness of the sediments is about 20 m in width and 5 m in width, spread on the side Eastern and Southeastern border in the northwestern region. (Al Shalash, 1966)

Alluvial Fan Deposits:

They are found in two locations, the first along both sides of the Tigris River and the second on the southwestern end of the southern Hamrin structure. It is spread in the eastern regions in the center of the study area and its northwest and northeastern borders.

Highland Sediments:

It is consisting of valleys sediments of various materials such as sticks, sand, silt, and gypsum from the surrounding of highland areas, and it is spread clearly in the center of the region and extend in a strip in the far northwest of the region.



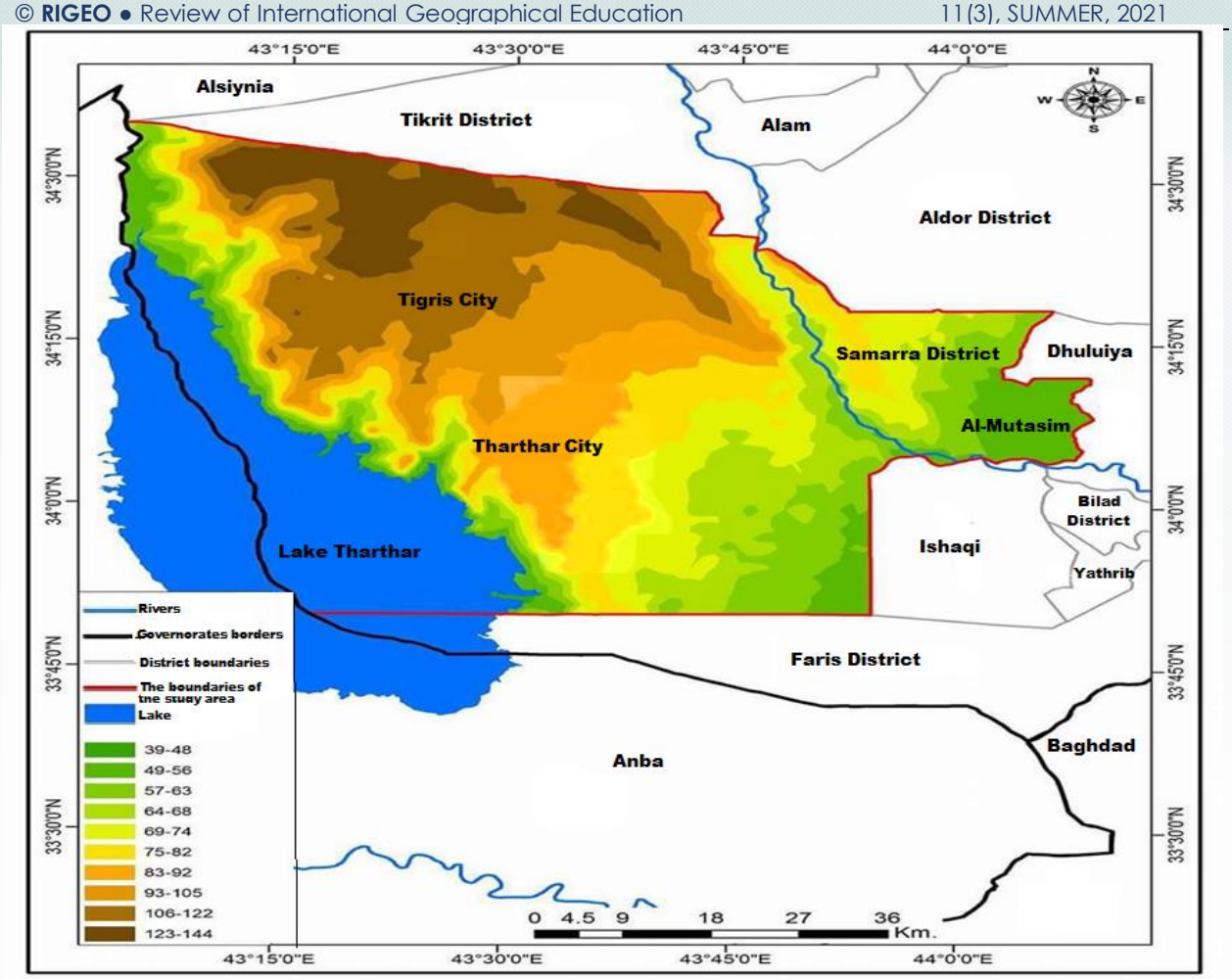
Map (2): Geology of the study area
Source: Researcher based on (ArcGIS v10 3).

Gypsum Sediments:

This soil is one of the oldest types of soils in the plain area and it is consisting of a mixture of clay materials, gravel sediments and aggregates. This type of soils is poor in agricultural production due to the high rate of gypsum and gypsum is the second type that is soluble, it can be observed in separate places in the middle of the study area.

The Anjana Formation:

The Anjana formation is revealed in several locations in the region under the modern sediments, as it is discovered on the eastern bank of Tharthar Lake, with a thickness of about 12 m. Its lower part is in a transitional environment with salt water to continental. Second. The effect of ground movements: The study area is located geologically within the unstable zone, and this division is characterized by its modernity, comprehensiveness and the large thickness of sedimentary rocks is only evidence of the instability of the region. And that the continuation of the land movements led to the emergence of their effects on the river terraces, the difference in height above sea level, ranging of between (39 - 144). The geological structure of the study area in general is a sub-surface building in the north and northeast direction. The folds in Samarra are Flat and easy to slope, wide and low, and continues to extend in the parallel direction to build synthetics northwest-southeast, about 35 km.



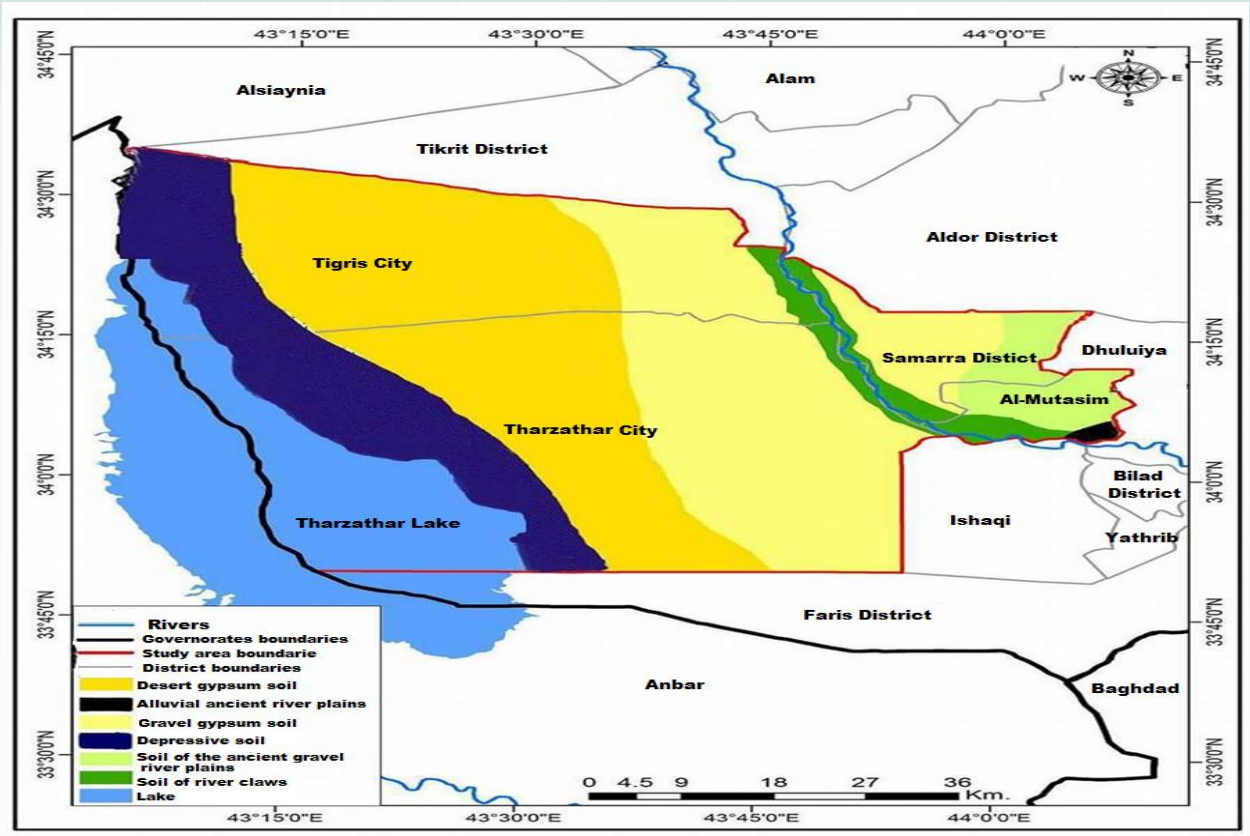
Map 3: Topography of the study area
Source: Researcher based on (Arc Gis)

Third. The Soil:

Soil is the fragile or crumbling surface layer that covers the surface of the earth, according to the study of the Dutch scientist (Björnk) for soil in Iraq in his book, (Soil conditions in Iraq), The study area was among them. Björnk found that there are three terraces of the Tigris River near the city of Samarra and it was named after the Abbasiyeen caliphs, dating back to the Pleistocene era (the second era) from the fourth time. The soil in the region is classified into several types because of the different natural conditions such as weathering processes and all kinds of erosion and sedimentation. Over time, many types of soils have been formed (Al-Kayiem & Mohammad, 2019). As shown in the map (4).

Riparian Soils (Mixtures):

This soil was formed as a result of the accumulation of recent sediments transported by annual floods. This type is one of the best kinds of soils in the study area, and the movement of water and plant roots is good, free of harmful salts and the ground water in it is deep, its height ranges from (2-6) meters from the stream of the river and is characterized by the intensity of agricultural production. It extends in the form of a strip along the Tigris River in the far northeast of the region.



Map (4): Classification of soils in the study area
Source: Researcher based on (Arc Gis).

Gypsum Gravel Soil:

This soil is one of the oldest types of soils in the plain area and it consists of a mixture of clay materials, gravel sediments and aggregates. This type of soil is poor in agricultural production due to the high rate of gypsum and this gypsum is the second type that is soluble (Alrawi & Mohammed, 2021). Gypsum soil is characterized with low nitrogen and phosphorous content, which is spread in the far northeast of the region to the far southeast of the region.

The Soils of The Ancient River Plains:

This soil is characterized by its good depth and medium texture, with the presence of some pebbles, and it consists of a mixture of clay, sand, and silt, also characterized by a high rate of clay in it and the drainage in these soils is poor due to its clay texture and the absence of natural drainage, and it is represented by a small area at the far end Northeast region.

Soil Of the River Plains Submerged with Silts:

this soil was formed from sediments of the Tigris River during the severe flood and its thickness reaches (2-3 m) and the rate of gypsum is low, and this soil is used in the cultivation of summer and winter crops, and it forms a very small area on the eastern side of the region.

Lowland Soil:

This soil is characterized by high contents of salts due to the high level of Subterranean water in it and its lack of organic and nutritional materials needed by the plant, and it became decertified lands due to salinity and swamps in which reed and sedge plants grow, and the higher lands were used by cultivating field crops and orchards, especially grapes (Changeux, 2012), and this region extends in the form of a strip extending from the far northwest to the southwest.

Third: Climate Evolution and Climatic Elements Analysis:

Climate is defined as the average weather condition for a long period of time that reaches more than thirty years. The climatic elements collectively participate in shaping the climate of any region. From here the importance of studying climatic conditions have been appeared as they are the basis for clarifying the prevailing naturalness in the area to be studied, and to clarify Climatic elements have been relying on (Samarra) station data for the period between 2000 and 2019, and the following are the most important elements:

A-Temperature:

It is mean the heat temperature of the substance and the state of the energy rate depends in one part of the body, the temperature is one of the climatic elements as it directly effects on activity of humans, plants and animals (Deikran, 2008), in addition to clear effect on rain precipitation, with its height increasing evaporation and lower The opposite happens, which works to increase the amount of water that can reach superficial and Subterranean water, from Table No. (1) It is noticed that temperatures rise to reach their maximum rate in July at a rate of (35.9), while its decrease to its lowest levels in the month of January at a rate (9.7).

B-The Rain:

is one of the basic climatic elements that have a role in feeding Subterranean and superficial water, and rain is an important aspect of the condensation of water vapor and the water cycle in nature and reaching the ground, as it feeds the Subterranean water reservoirs (Dunnington, 1958) and from Table (1) the total amount of rain fall is (45.171) As it increases to reach its highest levels In the month of January, it reaches (29, 2) mm, while in the months of June, July and August it decreases to (0, 0) mm.

C-Evaporation:

Evaporation is the process of converting water from a liquid state to a gaseous state (water vapor) when the air is not saturated with water vapor. The temperature is influencing factor in the evaporation process, as it increases directly with the temperature (Gabriel & Sokal, 1969), and it is clear that the rates of evaporation increase in summer and the highest rates of evaporation were recorded in the month of July by (486, 2) mm, and that the rates of evaporation decreased in the winter and the lowest rates were recorded in a month January by (7, 70) mm.

Table No. (1):
Annual averages of climatic elements for Samarra Station for (2000-2019).

The months	Heat	Rains	Evaporation	Relative humidity	Wind
January	9.7	29.2	70.7	78	1.8
February	11.9	28.9	96.9	66	2.4
March	16.3	25.7	155.4	60	2.6
Forget	22.7	18.2	231.8	49	2.9
Mays	28.5	8.1	341.1	36	2.9
June	32.6	0.0	426.5	30	3.4
July	35.9	0,0	486.2	27	3.4
Father	35.4	0.0	464.2	30	3.1
September	31.5	0.75	337.8	33	2.5
October	25	8.4	256.7	45	2.3
November	16.7	23.9	140.3	60	1.9
December	11.6	28.3	78	77	1.6
Total		171 .45			
the average	23 .15		254 .88	49 .25	2 .56

Source: Ministry of Transport and Communications. (2019). General Meteorological Authority,

Climate Section, unpublished data, Baghdad.

D-Relative Humidity:

It is the quantity of water vapor present in the air at a certain temperature, relative to the maximum amount that the air can carry at the same temperature. The quantity of humidity in the air is the basis on the rain, and it rises with lower temperatures and decreases with its height, meaning that it has an inverse relationship. About the study area, the highest rates were recorded in the month of (January) at a rate of (78), while the lowest rate was (27) per month. July

E-The Wind:

wind is the movement of air parallel to specific surface, it may be part of land or water, and wind occurs due to the difference in atmospheric pressure between two points on the same level of the earth's surface due to the difference in temperature and humidity. The northwest winds prevail in the study area, and the rates of speed for winds increase during the summer months, reaching their peak in (June and July) at a rate of (3, 4) and decrease in the month of (December) at their lowest rates, reaching (1, 6).

Analysis The Hydrological Properties of Water

The Superficial Water:

superficial water is considered one of the most prominent natural elements determining the uses of agricultural land in the area of agriculture, as it plays a major role in determining the areas of agricultural land.

The Most Important Narrative Projects In The Study Area Are:

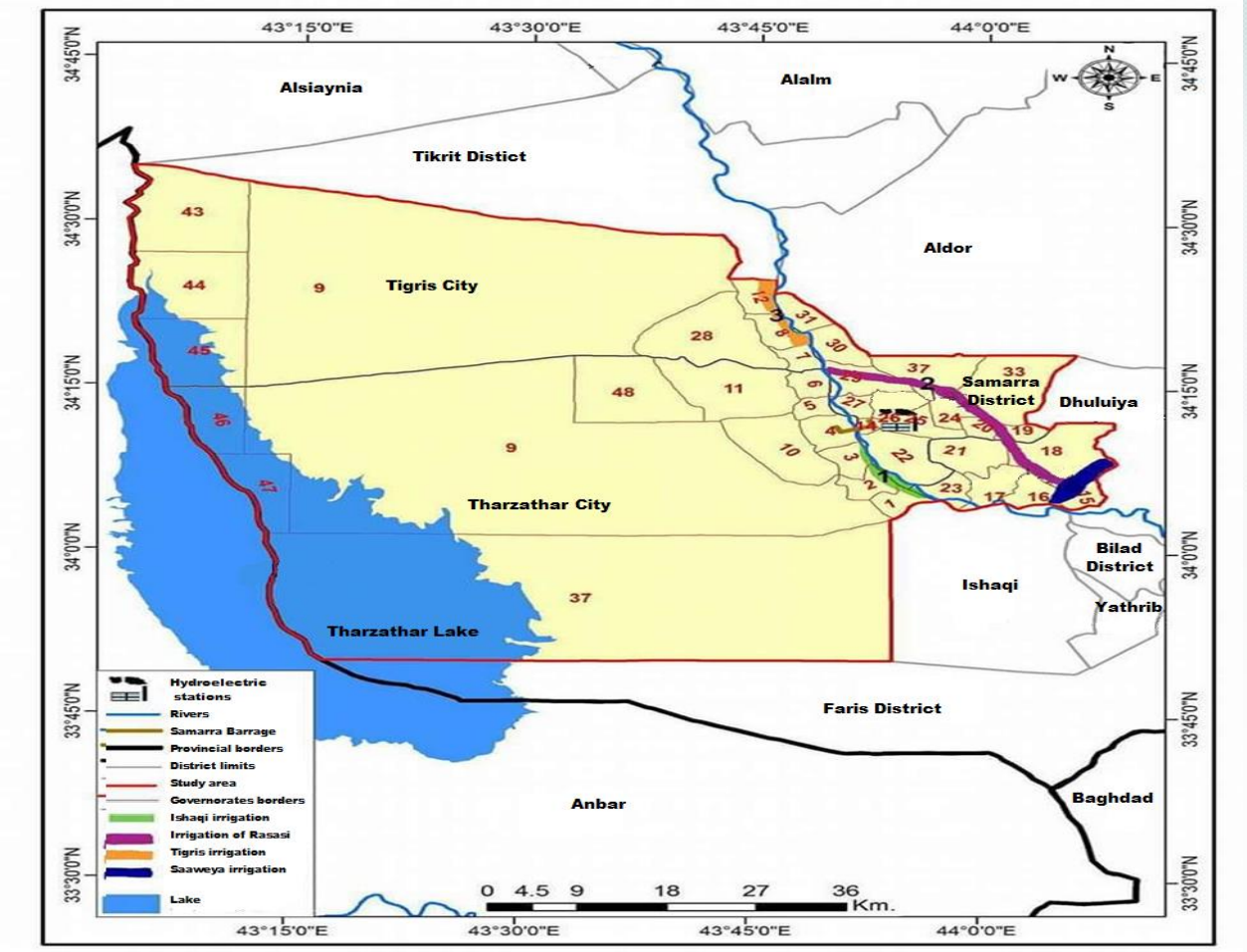
Tigris irrigation project: the lands of this project are located on the right side of the Tigris River between the cities of Samarra and Tikrit, and the project serves the lands located within the geographical area of the Tigris sub-district Conjugation of 1, 15 m (s).

Rasasi Irrigation Project:

This project is in the eastern region of the Samarra district on the left bank, one of the most prominent old irrigation projects in the study area. This project adopts the method of tourist irrigation, especially in the parts where the water level in the district and the irrigation streams are higher than the level of the lands. And the naming of this project is due to the use of lead in building one of the arches was established on it, called the bridge of lead (Hussein, 2008).

Sa`Awiyah Irrigation Project:

The lands of this project are located on the left side of the Tigris River between the cities of Samarra and Dhuluiya, this project is located in the district of Saawiyah, and it takes its water from the Tigris River by pumps, as shown in Map (5).



Map 5: Surface water and irrigation projects
Source: Researcher based on (Arc Gis)

Chemical Analysis of Superficial Water

It is clear from Table No. (2) For laboratory analyzes of superficial water that the rate of dissolved salts in the superficial water in the study area is (390) moderate salinity suitable for irrigation of agricultural crops with good salt tolerance, and there was a slight variation as its concentration in the Tigris water reached (360), As for the Tigris irrigation project, it reached (390 ppm), and in the Rasasi irrigation project, it reached (410), and the water of the Sa`iwiya irrigation project was (401) (ppm / million, that its use in the field of irrigation does not pose a danger to the soil and plants.

The Spatial Distribution Model of Surface Water Quality:

since the model is a means for a comprehensive understanding of what is happening on the surface of the earth and is an important way to clarify that it does not provide solutions to all the problems of the studied phenomenon, but rather it is a simplified fabric of composition (Jursa, 2020). The spatial distribution of surface water quality is noticed the variation in the quality of this water in terms of salt ratios, as its average salinity reached (390 mg / liter), which is suitable for crops that are well tolerated for this percentage of salts. Average salinity in the south and center of the study area, fresh water in the north eastern study area, map (6).

Table No. (2)
Results of the laboratory analyze of surface water in the study area in 2019.

Positive ions				Negative ions ppm						
Place	**Acidity ph**	**Dissolved salts ppm**	**Suspended material ppm**	**Calcium ca**	**Magnesium mg**	**Sodium na**	**SO4 Chlorides**	**NO3 Sodium**	**Nitrate Mutual SAR**	
Tigris River	8.1	360	60	86	70	12	21	32	2	2.7
Tigris Irrigation	8.2	390	10	90	74	13	23	34	1	2.9
Rasasi Irrigation	9.1	410	13	85	74	13	25	35	2	3.1
Sa`Awiyah Irrigation	9.3	401	15	82	69	14	22	36	3	2.6
Average	8.7	390	24.5	85.8	8 ،71	13	22.8	34.3	8	2.8

Source: The researcher based on the results of laboratory analyzes of surface water, State Company for Medicines and Medical Appliances in Samarra, Samarra, 2019.

Subterranean Water:

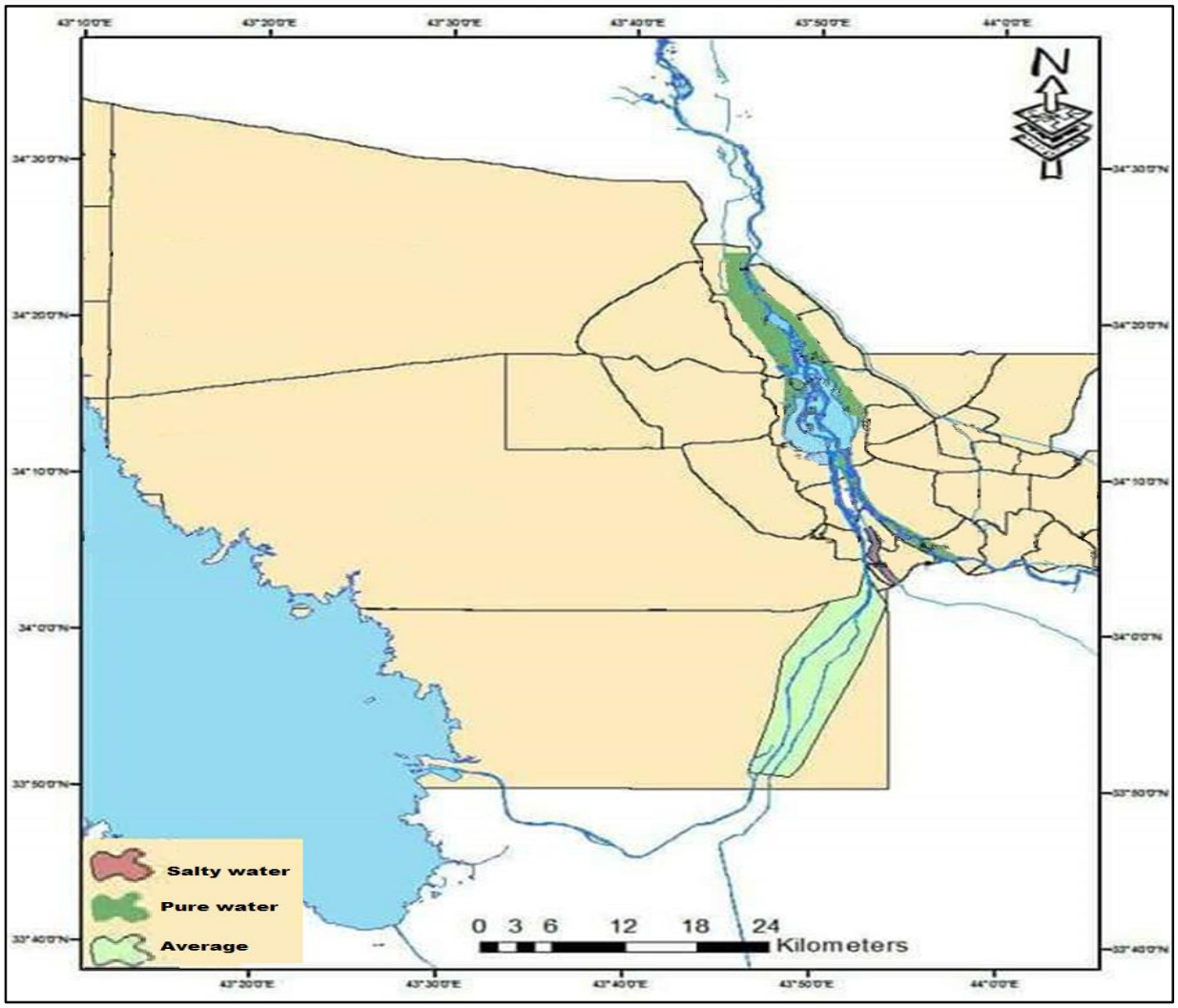
The importance of subterranean water is considered in the fact it is the subterranean water reservoir that complements irrigation projects, as it compensates to some extent the verification of water resources, and the formation of the lower Muqdadiyah al-Bakhtiari is the most important reservoir for Subterranean water (Kastridis & Stathis, 2020). Subterranean water is important in arid and semi-arid regions, as it is the main source in establishing and expanding agriculture, and relying on wells, the depth of which ranges between (5-10) meters. It led to the dispersed settlement pattern.

A-Numerical Distribution of Wells:

The numerical distribution of wells gives a clear idea of the volume of subterranean water, its level, and its production capacity, as the subterranean water system is changes in its level, temperature, chemical composition, and flow, as well as the factors affecting on this system (**Bilan**). Al-Jawfiya, Salah al-Din branch, it was revealed to us that the distribution of wells in the study area from one place to another and that all of them reached (4929) wells distributed in the study area, which are of two types, automatic wells and spring wells, where the number of mechanical wells in the region reached (1178) wells while the number of Spring wells (2851) wells distributed over the provinces of the region.

Map 6: Spatial distribution of surface water quality
Source: The researcher based on the outputs of (Gis v 10 3).

B-subterranean water movement: The movement of subterranean water is very slow when the Average in which it moves is rough gravel and close to the surface, while the movement is more slows in the depths far from the rough surface, and in general, as in the map (7) which shows the digital elevation of the study area, while subterranean water movement is with the geological formation and stratigraphic units. Affected by folding and fracturing are depended on hydraulic



gradient (Knights, 2017). Rainwater is the other source of nutrition as it seeps into the ground through the soil pores during floods and increases until the intensity of the rain measured in (mm / hour) becomes greater than the filtration capacity of the soil measured in (mm / hour), after which the fall on the surface turns into runoff A surface or part that turns into (evaporation / transpiration) and we return again to the atmosphere, and accordingly, the part entering the soil is the main source of nutrition for the subterranean water reservoir (Pournelle, 2007).

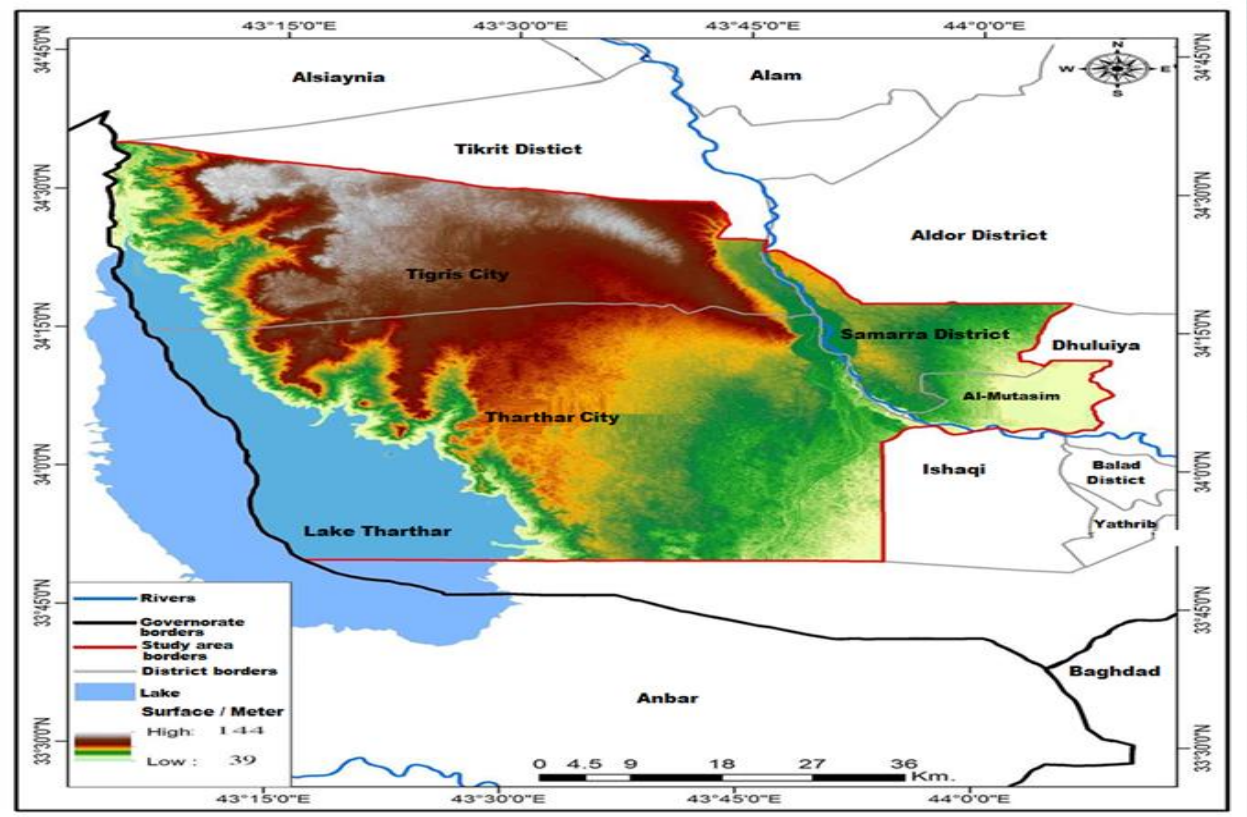
Table No. (3):
The Number of Wells in The Study Area

	Boycott	**Hereability**	**Artesian**	**Total wells**
District Center	Snas	70	20	90
	Zincor	30	20	50
	Abu Delf	16	11	27
	Fadelat	212	17	229
	Arfaa	163	13	176
	Armoshia	14	15	29
	Taktak	46	22	68
	Azdear	26	14	45
	Tell Al-Alaj	120	23	143
	Hawe Albustat	6	1	7
	Aum talayeb	98	11	109
	Mujil and Alokah	28	3	31
	Mashhad	4	3	7
	Alqalai	25	26	51
Tharthar City	Alqweer	10	15	25
	Almuchatla	198	98	296
	Um Alrahala	309	230	539
	Alajouri	85	54	139
	Abu Algeel	318	79	397
	Kaiat	80	33	47
	Drashii	79	52	27
Al-Mutasim City	Saioah	82	29	53
	Tell Al-Kour	130	33	97
	Tell Al-Aoura	40	15	25
	Hueshat	66	17	49
	Banat Al Hassan	92	11	81
	Jbereeah	115	28	87
	Alqadisiyah	58	20	38
	Mukeshefahlrak	175	25	150
	Abu Twaina	71	18	53
Tigris City	Al Qadriyah	20	9	11
	Diwaniya Hweselat	19	11	8
	Semum	29	17	12
	Aljazeerah	349	114	235
	Almuali	96	26	50
	Ayen Alfares	70	20	50
Total		*4029*	*1178*	*2851*

Source: Researcher depending on the General Authority for Groundwater / Salah Al-Din Branch.

C-The Subterranean Water Level:

it is the upper surface and the saturated level of this water, and it is a measure of the water pressure when it is zero, and it is not completely horizontal line, and the difference in this level is controlled by several factors, including the natural rocks and the topography of the region and the climate, as it increases in the winter when rain falls and there are two types of levels: **Static levels**: it refers to the constant water and it is the level when the subterranean water settles before the start of the withdrawal, where the atmospheric pressure and hydrostatic pressure at the surface of that water from the reservoir before the start of the withdrawal.



Map (7): Digital elevation model of the study area
Source: Researcher based on (Arc Gis).

Table No. (4):
The Water Level Fixed and Variable.

	Well number	Boycott	Constant water level (m)	Variable water level (m)
District Center	1	Armoushai	31.9	28.9
	2	Abudoliph	26.6	16.6
	3	Tell Al-Alaj	45	38
	4	Jupirt	33.8	23.6
	5	Azrer	24.5	7.5
	1	Alajouri	54	19
	2	Aljazeerah	55	36
Tharthar City	3	Aljazeerah	27	7
	4	Alqalai	70	55
	5	Almuchatla	25	8
	1	Drashii	56	46
	2	Banat Al Hassan	54	41
Al-Mutasim City	3	Tell Al-Kour	41	5
	4	Alqadisiyah	55	48
	5	Saioah	40	8
	1	Aljazeerah	86	79
	2	Almuali	78	57
Tigris City	3	Kaiat	89	49
	4	Abu Twaina	84	51
	5	Aljazeerah	97	60

Source: Researcher depending on the General Authority for Groundwater / Salah Al-Din Branch.
As shown in Table (4), the depths of the fixed levels in the wells vary, as the lowest levels were

concentrated in the district center and the western part of Al-Mu'tasim side, which was concentrated on the eastern and western sides of the Tigris River, and everything that goes away from the river increased the depth of the level, the reason is due to the activity of the river feeding process. **And moving levels:** the variable level is defined as that level when the subterranean water of the wells stabilizes after the process of withdrawing water for a period of time. The wells vary in the depths of the changing water levels in them, and these levels vary in the wells from one region to another, where the lowest levels were concentrated in the Thirthar area.

D-Depth of Subterranean Water:

The depth of subterranean water is mainly depending on the geological, topographical, and structural nature of the area, and this is reflected in the variation of the depths of wells in it to:

Deep Wells:
These are welling whose depth exceeds (20 m) and receive their water from the water layer below the permeable layer. This classification is not fixed and varies according to the location.

Shallow Wells:

which reach depths of (10-20 m) and receive water from the ground soil under the layer. Also, wells near the Tigris River differ in depth from wells far from the river, and after relying on the data collected; we find that there is a difference in the depths of wells in the region from one province to another, even from another well in the same province. As shown in Table (5).

Table No. (5):
The Depth of Wells in the Study Area

	Well number	County name	The depth of the well
District Center	1	Armoushai	41
	2	Abudoliph	16.6
	3	Tell Al-Alaj	23.8
	4	Jupirt	46
	5	Azrer	48.3
	1	Alajouri	8
	2	Aljazeerah	60
Tharthar City	3	Aljazeerah	50
	4	Alqalai	64.3
	5	Almuchatla	55
	1	Drashii	41
	2	Banat Al Hassan	48
Al-Mutasim City	3	Tell Al-Kour	5
	4	Alqadisiyah	8
	5	Saioah	14
	1	Aljazeerah	60
	2	Almuali	57
Tigris City	3	Kaiat	45
	4	Abu Twaina	51
	5	Aljazeerah	64

Source: Researcher depending on the General Authority for Groundwater / Salah Al-Din Branch.

E-Chemical analysis of well water:

The aim of studying the physical and chemical characteristics is to determine the origin and quality of subterranean water (Sissakian & Fouad, 2014). Accordingly, the quality of subterranean water varies from place to place as well as from one layer to another. Seasonal changes have also varied and because it determines its suitability for different uses.

Positive Ions:

The ion is defined as an atom or a group of atoms that lost one or more electrons, and then carry one or more positive electrical charges equal to the number of lost electrons. It is clear to us from the previous table as following:

Calcium Ion:

It is one of the positive ions are mainly concentrated in the Subterranean water. As the most important source of this type of ions is limestone, as well as from bucket mite, gypsum, and anhydrates. It is located to the east of the study area, as shown in the same table no. (12), as it reached (696) mg / liter, while the rate of this ion was lowest in the same area in the Sa'awiya district in Aita No. (15), but it reached only (109) mg / liter.

Magnesium Ion:

Is produced from dissolving some rocks in the subterranean water, such as lime, dolomite, clay and limestone minerals. The rate of magnesium varies from the region and this is a result of the difference in rocks containing this water. While the rate of this ion was lowest in Armoushia district in the district center, at a rate of (54 mg / liter)

E-Chemical Analysis of Well Water

The aim of studying the physical and chemical characteristics is to determine the origin and quality of subterranean water (Tampekis et al., 2015). Accordingly, the quality of subterranean water varies from place to place as well as from one layer to another. Seasonal changes have also varied and because it determines its suitability for different uses. The (20) samples were laboratory analyzed to study the properties of water.

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Sodium Ion:

Its appearance is due to the presence of rock salt and clay stones for evaporators such as secondary gypsum (gypsum) in formations containing subterranean water (Changeux, 2012) and that the value of sodium varies from one province to another, but from one sample to another within the same district, where the highest value of sodium was reached in the district of Kaiyat by (1389 kg / liter) and the lowest value in the district of Sa'aiyat by (15 mg / liter).

Potassium Ion:

The potassium ion is more stable than the sodium ion because of high resistance to chemical weathering factors and its ease of absorption from clay minerals. Potassium is present in quantities of sedimentary rocks because it is less soluble in water and that potassium concentration is lower in natural waters than the sodium ion. Laboratory analyzes of the water samples taken from the study area show us that the potassium ion value varies from one province to another and from one well to another, and the potassium percentage increases in the Kaiyat district of the Tigris sub-district by (1108 kg / liter).

Negative ions

Sulfate ion:

sulfates are produced from oxidation of sulphide ores and through the melting of gypsum and anhydite minerals, as well as gypsum soils in the study area, which is the main source for it. Jubayriyah B (193 kg / liter).

Chlorine:

Is considering one of the negative ions in Subterranean water, and the water has a salty taste, especially if it is associated with other ions of magnesium and calcium ion. The high content of chlorine ion in the water has severe effects on metal pipes as well as its negative effects on plants (Deikran, 2008). As for the study area, the percentage of chlorine is large in the region's water, which varies, and in general it is limited between (1491 kg / liter) in the district of Kaiyat and (117 mg / liter) in the district of Al-Agoudi.

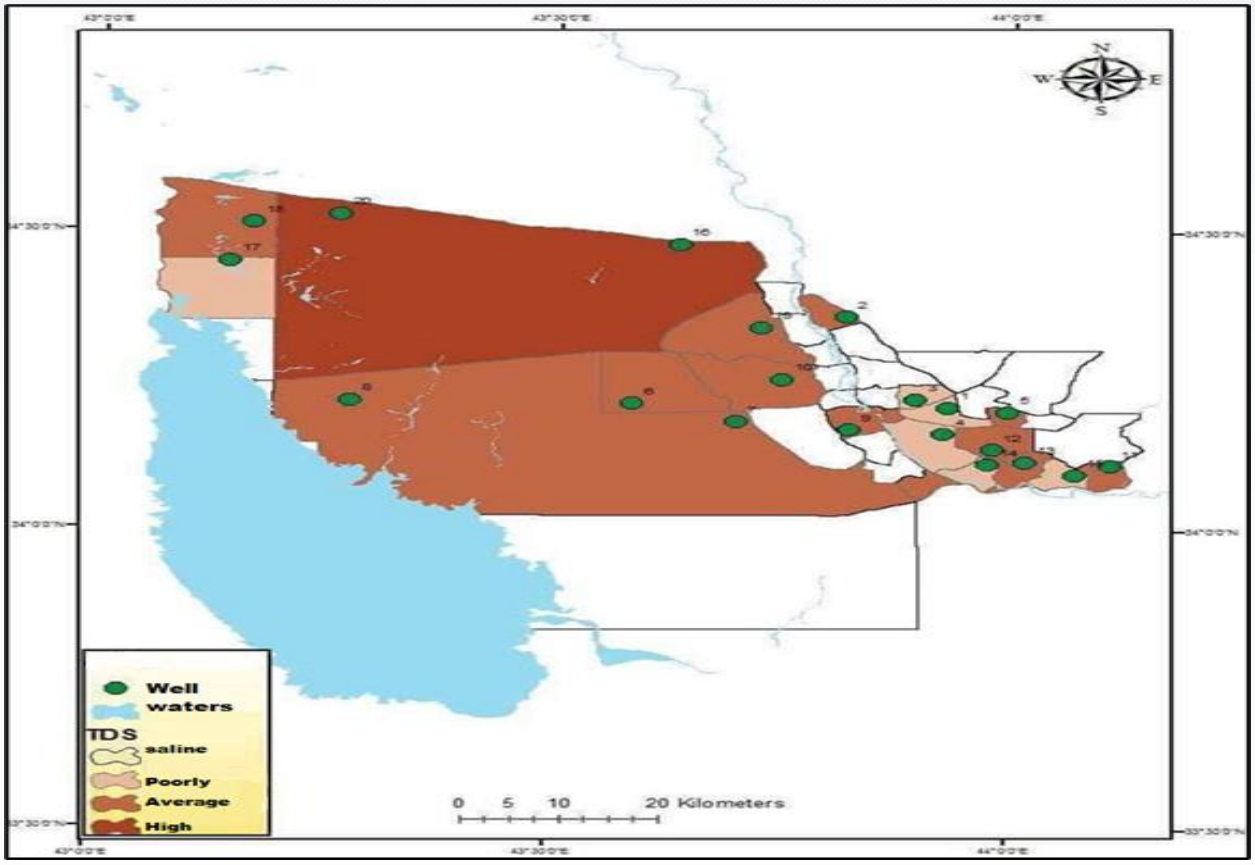
Nitrates:

Nitrates are considered a component of secondary subterranean water and there are several sources of nitrates, including due to the use of chemical fertilizers in the soil and the decomposition of plants and leaves, including organic matter resulting from human and animal excrement. As the nitrate ion concentrations in the area indicate the presence of pollution in it, and there is an inverse relationship between the depth of the well and the percentage of nitrate concentration, as the greater the depth in the well, the less nitrate concentration, and vice versa, and the highest nitrate value in Majtalah district of Tharthardistrict was (187 mg / liter) and the lowest rate in Tal Al-Alej district (301 mg / liter).

G- A model of spatial distribution of subterranean water quality:

The quality of the subterranean water in the study area varies according to the natural and human conditions in the area and from the map (8). The freshwater and the conversion of many desert

lands into irrigated lands for agricultural products, and the spread of weak saline water in a small area to the far northwest and far southeast, while the medium salty water spreads over a large area in the area represented in the center and the far northwest of it, as well as the presence of scattered areas in the far south. Whereas the salty areas are concentrating in the wide areas far north of the region.



Map (8) The spatial distribution of the solid salts of the samples taken from the groundwater of the study area wells. Source: Researcher based on (Arc Gis).

The effect of high-water salinity concentrations on the agricultural situation in Samarra district

First. Surface Water Investment for Agricultural Purposes:

The Tigris River represents the main superficial water resource on which it depends in investing its water for agricultural production mainly, either directly or through irrigation projects that have been mainly relied upon for agricultural investment, represented by the irrigation project that passes through three provinces of the region (Mashaid, Muajil, Al-Rakah, Umm Al-Talayeb) total area (23,152) dunams, and these districts are located on the left side of the Tigris River, and the Tigris irrigation project, which was relied upon to irrigate an area estimated at (16).

Second. Investment Of Groundwater for Agricultural Purposes:

the area is considered one of the lands in which all crops are grown in different proportions, which will be presented according to their importance, including: (cereal crops, vegetable crops, horticulture, industrial crops, fodder) and this is what distinguishes the soil of the Tigris River basin in the region with the texture of Sand and silt sediments allow the filtering of groundwater and the non-deposition of salts in the area of plant roots, so groundwater is used in the area for agricultural purposes despite its high salinity and the shortage of water resources in areas far from irrigation projects. The crops varied in the area between field (summer and winter) and crops. a strategy of wheat and barley.

A-Cereal Crops:

The cultivation of cereals is a great nutritional and economic importance in the region, due to the availability of the appropriate climate for their cultivation, and among the most important of these crops.

Wheat:

Wheat is topping the cultivated cereal crops in terms of its nutritional and economic value. Figure (1) shows that the area cultivated with the wheat crop varies from one side to the other, as the Tigris region occupied the first place in area and production, where the area reached (33488) dunums and the productivity reached (98796) tons, while Al-Mu'tasim district occupied the second place in area and production, as the area reached (16744) dunums,

Table (6)
Variation Of Areas Cultivated Cereal Crops and The Quantity of Production in The Study Area for The Year 2019 (Dunam / Ton).

Boycott	Area of wheat	Wheat production	Area of corn	Corn production	Area of barley	Barley production
District Center	6363	1881.1	2033	1564.6	963	262.3
Tharthar City	10381	3058.7	3330	2526.6	1574	262.3
AlMutasim City	16744	4939.8	5363	4091.2	2537	524.6
Tigris City	33488	9879.6	10726	8182.4	5074	1049.2
Total	66976	19759.2	21452	16364.8	10148	2098.4

Source: Samarra Agriculture Division, Planning and Follow-up Section, Plant Production Department (unpublished data, 2016.

Yellow Maize or Corn:

It is one of the most important food and industrial cereal crops in many regions of the world. The crop comes in second place in the study area after wheat. This crop is grown in the region. Area and production, which amounted to (2033) dunums with a productivity of (1564.6) tons,

Barley:

It is one of the important crops in the world, The area cultivated with the barley crop varies from one side to the other in the study area, where the Tigris sub-district occupied the first place in terms of production and area, where the area cultivated with the crop reached (5074) dunums and the productivity (1049.2) tons.

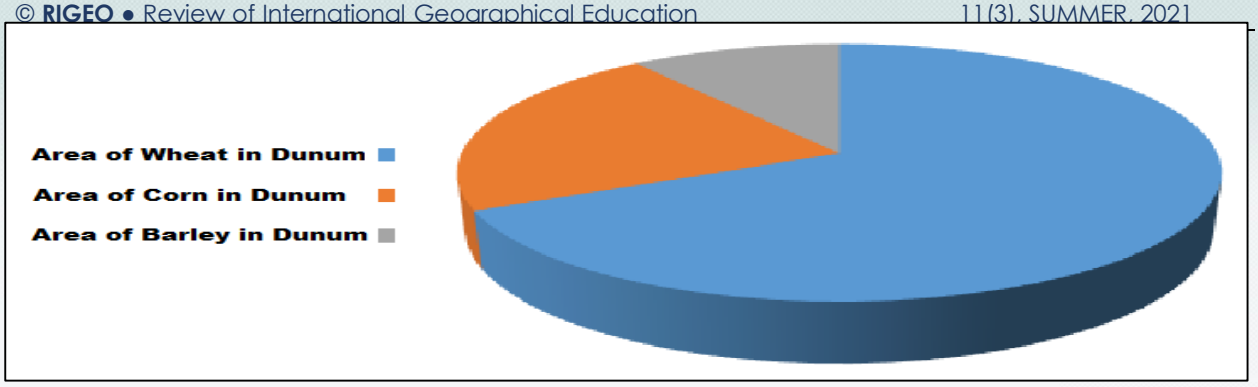


Figure (1): Area of Cereal Crops in the Study Area
Source: Researcher based on Table 7.

B-Vegetable Crops:

Vegetables come after grains in terms of their nutritional importance, as it is considered one of the main crops grown in the region, which depend on ground water, because of their nutritional and economic importance, as confirmed by the people of the region during field visits.

First: Summer Vegetable Crops:

They are among the most important types of vegetables that are grown in the region depending on groundwater. These crops are grown in a protected and open manner and include (watermelon, tomato, cucumber, eggplant, melon, pepper, okra, pumpkin, cowpea, potato) and vegetable crops. Summer, the cultivated area reached (4350) dunums with a productivity of (12,262) tons, and the Tigris district occupied the first place in agriculture and production of summer vegetables, as the cultivated area reached (23316 dunums, with a productivity of (65770) tons, as shown in Table (4) and Figure (2).

Second. Winter Vegetable Crops:

It is one of the important crops that constitute less than the summer vegetable crops and include crops (onions, potatoes, radish, lettuce, celery, cress, rapeseed, rapeseed, chard, garlic) and it is characterized by its multiplicity, Table No. (8) and Fig. No. (2).

Table No. (8)
The variation of the areas cultivated with summer and winter vegetables and the quantity of production in the suburbs of Samarra for the year 2019 (Dunam / Ton).

Boycott	Summer vegetable area	Summer vegetable production	The area of winter vegetables	winter vegetable production
District Center	4350	12262	2407	10542
Tharthar City	7308	20623	3859	17180
AlMutasim City	11658	32885	6266	27722
Tigris City	23316	65770	12532	55444
Total	46632	131540	25064	110888

Source / Agriculture Division, Samarra, Planning and Follow-up Section, and Plant Production Department (unpublished data), 2016.

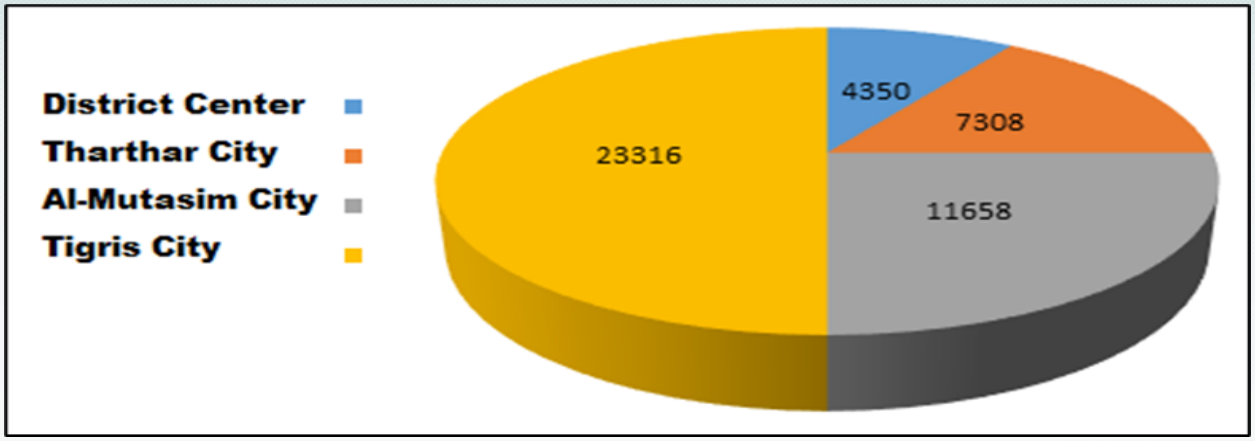


Figure (2): The area of summer and winter vegetables in a dunum.
Source: Researcher based on Table 8.

The area cultivated with winter crops varied from one side to the other, as (Tigris sub-district) ranked first in the cultivation and production of winter crops, as the cultivated area reached (1532) dunums with a productivity of (55444) tons while The district center occupied the last place in area and production, as the cultivated area reached (24079) dunums with a productivity of (10542) tons, and this is evident from the effect of the percentage of groundwater salts on the diversity of agricultural crops and their variation in terms of salts, as they ranged between few and medium as shown in the map (8).

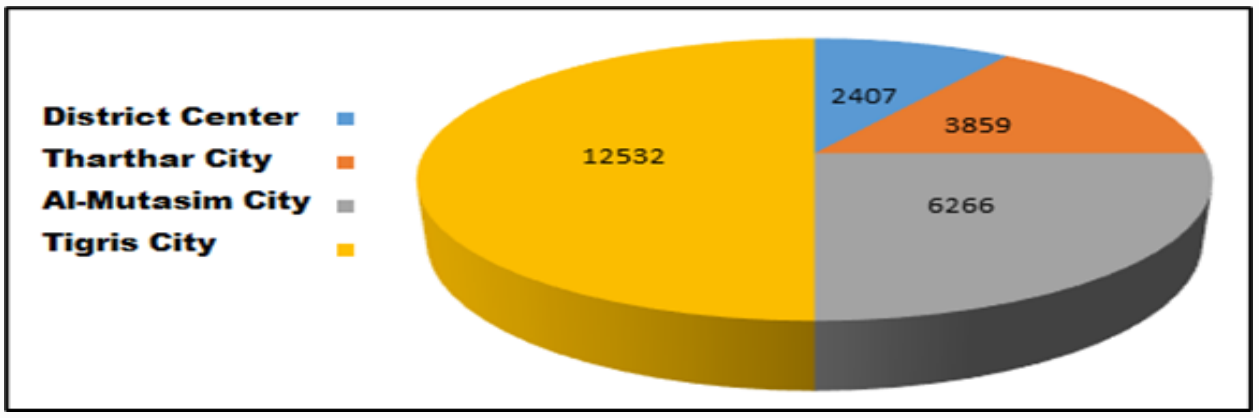


Figure (3): The area of summer and summer vegetables in a dunum
Source: Researcher based on Table 8.

Conclusions

- The depth of the groundwater in the area between (10-20 meters) in the neutral parts of the river on the eastern and western sides. The obvious effect of the fluctuation of rain, which led to a decrease in groundwater levels and the variation in its distribution from one region to another.
- The effect of geological formations and formative movements on the depth and quantity of groundwater and aquifer, as well as the clear effect on the variation in the percentage of salts.
- The importance of using modern technologies in hydrological studies in analyzing and converting raw spatial data into a digital database in the process of analysis and building various models.
- Classifying agricultural crops, determining their areas and the possibility of expanding them through the interest in determining the quality of the crop and the appropriateness of the percentage of salts in the water used for irrigation, whether surface or underground. Increasing the number of wells in the areas west of the Tigris due to the absence of irrigation project.
- Avoiding random drilling of water wells that greatly affect the quantity and quality of the extracted water, and the need for its investment to be efficient and rational.

- Encouraging the expansion in the use of covered greenhouses and protected agriculture, with use the modern technologies, including drip and sprinkler irrigation, and reducing the waste of used irrigation water.
- Guidance farmers to grow crops according to specific principles consistent with the number of salts in the water, as well as the quality of the soil and the quantity and quality of fertilizers needed to achieve the highest production rates, as well as an emphasis on using modern irrigation methods to preserve drinking water and irrigate crops and reduce water waste.
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