Research Article

The use of dual spectrum reflectivity (NDSI, SI) in diagnosing the distribution of some types of salts in the founding organelle in the basra and wasit contacts.

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Abstract: Background: The study was conducted in three regions of southern and northern Iraq. The first region is in Basra Governorate, represented by three Al-Asmadah sites, Al-Seeba, and Um Al-Rasas, located within the geographical coordinates that are between the longitudes 47.59 and 48.15 degrees east, with two latitudes 30.25 and 30.20 degrees. To the north, the second area is in Wasit Governorate, with three locations: North Gharaf, East Al-Gharaf, and Al-Janabi They are located within the geographical coordinates that are between longitudes 45.57 and 46.9 degrees east, with latitudes 30.15 and 32.10 degrees north. The study was conducted in three stages, starting with the office work stage, represented by reviewing previous studies, maps, and data available on the selected areas, and determining the best representative of the soil of the study area. Fieldwork was then carried out by conducting field tours to identify the depth that represents the nature of the variations in the characteristics of the soil depth Laboratory work included bringing soil samples and preparing them by performing drying, grinding, and sieving operations to study soil characteristics The purpose of using the characteristics of the electromagnetic spectrum is to diagnose the presence of gypsum and lime and their movement within the soil sector and to determine the spectral fingerprints of the soil for both Basra Governorate and Wasit Governorate. Six sites were chosen at three depths for each site: 30-60, 15-30,0-15 cm.

The sites chosen for Basra Governorate were Al-Seeba, Um Al-Rasas, and Al. Asmedah. While the locations of Kut / Wasit District were north of Al- GHARAF east of Al- GHARAF, and Al-Janaba site. The spectral reflectivity of these soils was measured using a spectroradiometer. The results showed that the soils of the study area were rich in calcium carbonate (lime), especially the studied soils of Basra Governorate compared to the soils of Wasit Governorate, as they ranged between 570-550 gmkg-1, in addition to the loss and gain processes, which are the most effective in determining the size distribution of soil particles, especially the silt of the soils of Wasit Governorate, in addition to Limited weathering processes, as well as calcification and decalcification processes, and there is variation between the textures of soil materials in the study area. It ranged from fine to medium-textured soil, and little variation was observed in the types of textures in the vertical direction within the soil sector. This reflects the influence of geomorphological processes, especially the erosion and sedimentation processes prevailing in the study areas. The results showed variations in the spectral reflectivity values of the study sites, as well as differences in the different spectral bands and ratios in one site. The study showed that the highest rate of soil salinity index (SI) was with a highly significant positive correlation of .955**, followed by .940** As for Wasit Governorate, for Basra Governorate, there is no positive correlation with the salt index.

Keywords: soil profile, gypsum and, limestone soils, spectral evidence, soil reflectivity, remote sensing

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1. Introduction

Satellite remote sensing technology has been used to study and map the soil, as the quantity and quality of electromagnetic rays reflected from the surface of the soil within multiple spectral bands depend on the physical and chemical properties of the soil. Thus, it is possible to separate the different types of soil, and the processes of their formation and origin can be known by studying the features. Spectral spectrometry, determining its suitability for agricultural uses and the degree of its production capacity, and tracking it at different annual intervals [45]. The spectral reflectivity of soil is an aggregate characteristic derived from the internal spectral behavior of the soil components. The value of reflectivity varies depending on the wavelengths of the electromagnetic rays, which is why the concept of remote sensing emerged in studying the natural properties of objects without touching them through the electromagnetic waves reflected or emitted from them. The spectral behavior of soil and its components is the basis for remote sensing information, as Manchanda et al., [31] pointed out: The spectral response patterns of soil are governed by the characteristics of the soil components that affect reflectivity, and computer techniques are useful for classifying spectral differences. Response patterns can also help in identifying homogeneous areas, which can be used as a basis for concluding field investigations and proposed models between remote sensing and metrology. Al-Haqali. The presence of gypsum in large quantities by weight of the soil leads to weak soil structure Louis et al., [30], and weak bearing strength, when soil moisture is high and causes collapses and subsidence of the soil Martin, 2016

From a chemical standpoint, gypsum works to reclaim saline alkaline soils, as it leads to the replacement of sodium by calcium, and lowers the pH of the soil. It also leads to the replacement of sodium with calcium at the exchange sites and reduces the effect of sodium in the dispersion of soil particles. Shaaban et al., [41]. As for fertility, gypsum has an important role in improving fertility characteristics. Gypsum is used as a fertilizer for agricultural crops, and it also plays an important role in reducing the pH of the soil to almost neutral, which works to increase the readiness of most nutrients, except for molybdenum, which needs a pH of more than 7.5 Favaretto et al., [20] and Founie, [21].

There is also an inverse relationship between lime and gypsum in the soil. A decrease in the calcium carbonate content is matched by an increase in the gypsum content in the pydon horizons of the study area and vice versa. [6] Therefore, soil is one of the important natural resources in human life, as it is the natural medium upon which agriculture is based, which contains the nutrients necessary for plant growth, the quantity and quality of which are affected by the chemical properties of the soil, such as salinity, organic matter, calcium carbonate, and gypsum. Basel, [16] ,Bhagaban Behera et al., [17] pointed out that factoring spectral reflectivity into remote sensing techniques is one of the most important techniques used in evaluating soil properties, as well as the role of near-infrared spectral reflectivity that can be used to monitor and map soil properties, and analyze these properties. Spectral reflectivity analysis techniques give fast and accurate results compared to traditional methods. Spectral analysis of soil reflectivity has become a pioneering technique for measuringsoil properties that provide data for classification and drawing of digital maps. Hamad et al. 2021, so this technique today is considered one of the modern methods in this field. Therefore, this study aims to show the importance of using ground-based technologies in remote sensing, especially radiometric measurements, to identify the characteristics of the spectral reflectance curves of soil through the following: Knowing the effect of the soil content of gypsum and calcium carbonate on the spectral reflectivity (SR) values of these soils and the relationships existing between them, in addition to employing remote sensing techniques and geographic information systems programs in calculating the values of some spectral indices such as SI and NDSI as well. To determine the nature of these spectral relationships with the main soil components. Choosing spectroscopic evidence and a spectroradiometer to show spectral reflectance differences.

2. Materials and working methods

Six sites were chosen to study spectral reflectivity under different geomorphological conditions to represent soil units of varying characteristics for both Basra and Kut Governorates, and three are located on the left side of the Tigris River, north of the city of Kut in Wasit Governorate, as soil sampling sites. As shown in Figure 1

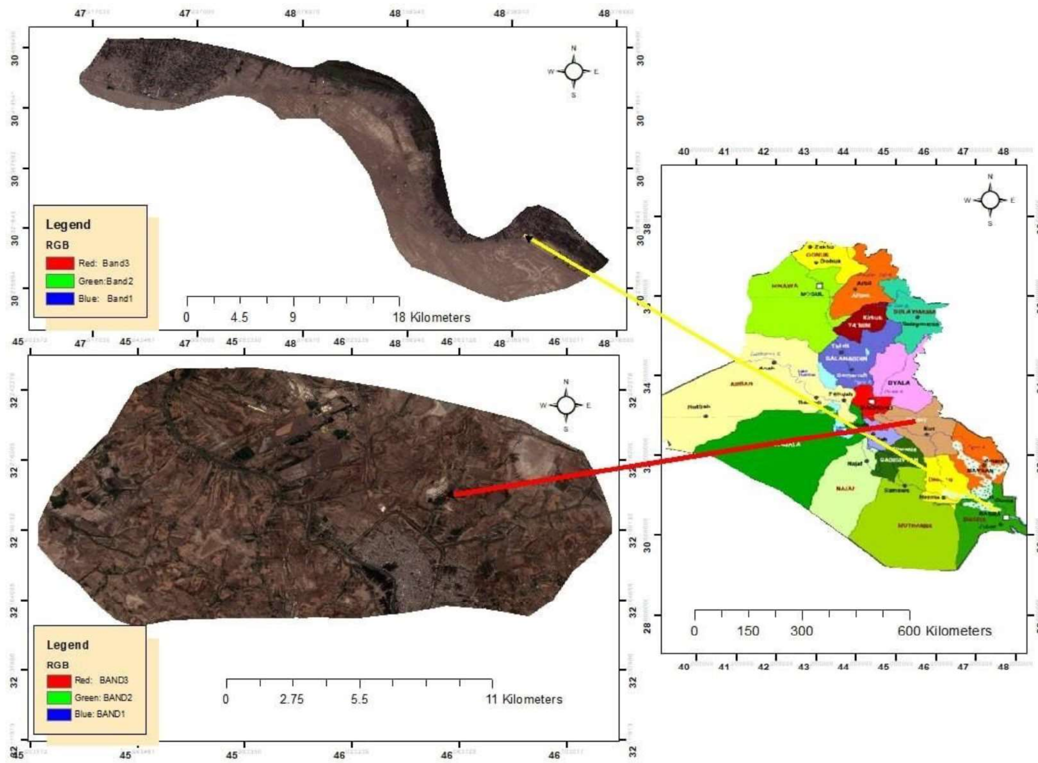

Figure 1. Location of the study area

The geographical coordinates of the locations were determined in the form of Software used: The geographic information system program (Arc Map 10.1) was used to correct the reflectance values of the satellite visuals of the OLI sensor beams carried on board the American satellite Landsat 8 by applying special mathematical equations [15,19]. To calculate the spectral reflectivity, using the same program, the values of the plant indices NDSI and SI were calculated using the Raster Calculator tool located within the Spatial Analyses Tools. This tool calculates the spectral reflectivity between selected wavelengths from within the set of wavelengths available in satellite imagery using a mathematical relationship specific to each. Vegetarian indicator.The most important non-vegetative spectral standards that are suitable for the study soils, saline soils, were used:

Firstly . Salinity Index SI: Applied Khan.,2005

Salinity Index (SI1) = (B1 * B3) 0.5............................(1)

secondly. Normalized Difference Salinity Index (NDSI).

According to the equation of Khan et al .,2005.

NDSI = (B3 – B4) / (B3 + B4). ....(2)

Laboratory work and procedures:

It includes conducting some physical and chemical analyzes and measurements. The soil texture was estimated according to Bauder and Gee, 1986, and the electrical conductivity (Ec) was measured with a 1:1 extract as stated in Pege et al., [35], and the degree of soil PH interaction was measured with an extract (1:1). 1) Estimation of gypsum by the method of precipitation of the filtrate with acetone according to Richard, 1954, and estimation of carbonates by the method of delamination according to what was stated in the book of Ryan et al., [39], as shown in Table (1) and Table (2).

Table 1. Concentrations of dissolved ions (positive and negative) in the soil of the study area

Ca+2	Mg+2	CI-	SO4-2	CO3	HCO3-	K /	Na /	Depth cm	location
10	30	66	0.594	0	3.1	0.826	42.468	0-15	North GharaF
20	29	10	8.695	0	2	0.474	42.468	15-30	
12	28	12	0.594	0	2	0.362	26.940	30-60	
10	30	8	0.727	0	1	0.314	26.940	0-15	East Gharaf
12	21	20	2.063	0	2.3	0.025	3.649	15-30	
20	11	30	3.398	0	1.7	0.025	26.940	30-60	
46	82	160	1.350	0	1.2	0.506	3.649	0-15	Janabi
20	12	8	1.261	0	2	0.383	3.649	15-30	
2	30	32	0.505	0	1	0.436	3.649	30-60	
22	58	1250	18.042	0	1.2	0.193	229.440	0-15	Al-Seeba
20	40	220	0.905	0	2	2.918	135.636	15-30	
24	18	192	2.063	0	1.3	2.884	30.683	30-60	
13	47	242	3.887	0	1.2	1.548	81.366	0-15	UmAl-Rasas
10	40	251	2.686	0	2	0.030	65.760	15-30	
21	42		0.772	0	1.3	0.250	179.751	30-60	
20	40	370	2.552	0	2	0.189	167.329	0-15	Al.Asmedah
12	48	280	1.706	0	2	0.652	104.580	15-30	
20	42	460	6.469	0	1.3	0.400	135.636	30-60	

Table 2. Some chemical characteristics and characteristics of the soil of the study sites

Clay gmkg-1	Silt gmkg-1	Sand gmkg-1	CaCO3 gmkg-1	CaSO4 gmkg-1	Soil Texture	PH	EC	Depth cm	Analysis the site
52.98	847.68	103.31	540	14.299	Silty	8.064	11.05	0-15	North Gharaf
109.09 / 41.60	990.96 / 570.71	7.95 25.73	610 / 570	13.804 / 4.086	Silty / Clay loam	7.693 / 7.640	6.92 / 4.16	15-30 / 30-60	
235.29	564.71	178.82	560	6.456	Silty loam	7.535	2.54	0-15	
232.28	650.41	104.52	500	1.745	Silty loam	7.741	2.75	15-30	EAST Gharaf
321.1	596.33	92.88	550	4.961	Silty clay loam	7.753	2.85	30-60	
590.6	322.15	68.45	600	3.663	Clay	7.371	2.57	0-15	
280	680	23	625	3.600	Silty loam	7.377	3.58	15-30	Janabi
138.24	829.5	20.73	525	3.522	Silty loam	7.525	2.20	30-60	
467.83	421.05	88.49	605	5.003	Clay loam	8.172	48.2	0-15	
499.32	384.8	94.01	550	19.250	Silty clay loam	8.176	31.6	15-30	Al-Seeba
400	560	11	695	2.506	Clay loam	7.895	8.37	30-60	
400	600	8	690	14.144	loam clay loam	7.614	17.97	0-15	
458.71	550.46	3.44	560	6.639	Clay loam	7.553	21.2	15-30	Um Al-Rasas
400	579.59	6	665	6.541	Silty clay loam	7.646	28.4	30-60	
160	800	32	650	13.974	Silty loam	7.830	26.2	0-15	
280	680	13	725	10.448	Silty loam	7.40	21.1	15-30	Al.Asmedah
320	680	6	750	10.772	Silty clay loam	7.742	22.2	30-60	

3. Results and discussion

The results of soil analysis in Table (1) indicate that the soil of the southern part of the study area, represented by the sites of Al-Samad, Umm al-Rasas, and al-Siba, is very salinity. The high concentration of salts in these soils may be a primary reason for excluding them from agricultural investment, as well as the scarcity of natural plants in them. The results also indicate that they are gypsum soils with an average content of lime, while the values of calcium sulfate (gypsum) are with depth in the soils of the study area. It is noted that most of the depths in the study area had a low content of calcium sulfate, g kg-1. It showed variation in the gypsum content in the soil and a difference from one site to another depending on the difference in location, in addition to the difference between the depths of the same soil. It ranged between 14.299-1.745 g kg-1, as the lowest value was at the horizon of 15-30 cm in the East Al- GHARAF site, while the highest value was at The surface horizon is 0-15 cm in the soil north of Al- GHARAF, as calcium sulphate values decrease with depth, while in other sites east of Al- GHARAF and Al-Janabi, the values increase in the second site and then decrease in the third site. As for Wasit Governorate, unlike Basra Governorate, the site recorded the highest value of gypsum in The layer is 15-30 cm and reached 19.250 gm kg-1, then it is followed by the horizon of 30-60 cm in Siba with a value of 2.506 gm kg-1. These results are consistent with both Kazem [28] and Abbas [1], who showed that there is variation in values according to geographical and topographical location.

As for the soil of Basra Governorate, it is clear from the results of the physical characteristics of the soil andthe size distribution of the soil particles that there is a variation in the texture of the gypsum soil, as thetexture of the silty clay mixture was dominant, then the silty mixture, then the silty clay mixture, and thesilty mixture, then the clay. The results show a variation in the percentage of gypsum in the soil of the studyarea in the selected areas of the governorate. The soil in Basra Governorate is characterized by relatively low gypsum contents that range between 2,506 - 19,250 cm, except for some locations that show high percentages. the soils of Wasit Governorate show variation in gypsum percentages, except for the North GHARAF site, a decrease with depth. As for calcium carbonate, the distribution of the total calcium carbonate content insoil pedons was opposite to the distribution of gypsum, as the carbonate content increases in horizons with a small gypsum content and decreases significantly in Horizons rich in gypsum, as the total amount of calcium carbonate generally ranged between 500-625 grams. kg-1 for the soils of Wasit Governorate and 550-750 gm. kg-1

Regarding the soil of Basra Governorate, as Al-Jubouri, 2002 attributed the reason for the inverse relationship between lime and gypsum to the process of gypsum substitution during soil formation processes, which led to an increase in gypsum in most horizons at the expense of other soil components, including carbonates, due to the variation in their solubility, as The solubility of carbonate ranges between (0.01 - 0.05) g/l, and the solubility of gypsum ranges between (2.2 - 2.6) g/l. The results of the analyzes showed that the highest percentage of clay was in the Al-Janabi site at a depth of 0-15 cm, reaching 590.6 g kg-1, while the highest percentage of silt and sand was in the North Al- GHARAF site at a depth of 15-30 and 30-60 cm, with a value of 970 and 610 g kg-1. Respectively As for Wasit Governorate, the highest value of clay was in the Siba site with a value of 499 gm kg-1. As for silt and sand, the highest value of silt was in the Fertilizers site with a value of 800 gm kg-1 within the depth 0-15 cm, and sand in the Siba site depth of 15-30 cm. With a value of 94.250 g kg-1, for Basra Governorate. The percentage of clay increases with depth at the fertilizer site on a regular basis. The reason for this increase may be due to the ancient influence of Paleoclimate climatic conditions, which were more suitable for the activity of the pedogenic processes responsible for the formation of these maximum soils, 2006. While at the Umm al-Rasas site, the amount of clay is equal at the first depth, 0-15 cm, and the third depth for both Siba and Umm al-Rasas, 30-45, with a value of 400 grams. kg-1

While it increased at the second depth, the clay content reached 458.71 g. kg-1. At the Siba site, the clay content increases at the second depth, 0-15 cm, with a value of 499.32 g. kg-1. As for the silt separation, it decreases with depth at the fertilizer site, and the value is equal within the second and third depths, 680 grams. Kg-1may be due to the effect of the parent material, and this is in line with Jaata, 2014, Rashid and Kamal, 2020.As for the sites of Umm al-Rasas and al-Siba, the distribution of silt increases in the superficial horizon 0-15cm, then decreases at the second depth, 15-30 cm, then increases again at the third depth, 45 -30 cm. The variation in silt percentages is due to the nature of the original material and the weathering conditions on it,and this agrees with Rasheed, 2005. While the separation of sand decreases with depth only at the Fertilizer site, while there is a difference in the distribution of sand in both the Siba and Umm al-Rasas sites, as thesand content increases at the second depth at the Siba site and then decreases at the third depth, while the opposite is true for the Umm al-Rasas site. The amount of total carbonate minerals is distributed in the soil in different quantities between high and low at all depths. The only exception to this is the fertilizer site in Basra Governorate, where the distribution of calcium carbonate increases. With depth, this may be attributed to its on-site formation as a result of the deposition of calcium and bicarbonate ions transported with bad ground water, 2008,

While the highest quantity was recorded at the third depth of the fertilizer site, 075 g kg-1, and the reason forthis may be due to the depth of the groundwater, and these horizons contained separated from the silt at this depth, and this agrees with both Rashid [38] and Al-Shahmani [11], as They concluded that the reason for the variation in the distribution of carbonate mineral content in the soil is due to the difference rates between the sediment separations (sand, silt and clay) in the study sites as a result of the variation in sedimentation energy. It was found that the value of carbonate minerals is directly related to the silt and clay separation ratio. This variation in the proportions of calcium carbonate is due to agricultural exploitation, the exposure of the soil to washing and dissolving (due to submersion), and its exposure to partial washing in mush soil. Likewise, leaving the land fallow encourages the process of carbonation and salinization. As for the soils of the northern part of the study area, they are non-saline soils with low gypsum levels and medium lime content. The values of gypsum content in the soil of the study sites vary according to the location, as it increases with depth in the North GHARAF site, while its distribution varies in both the East GHARAF and Al-Janabi sites, as its concentration increases at the second depth by 15-30 cm and then decreases at the third depth by 30-45 cm. For the soil of Wasit Governorate, it ranged between 500 - 610 g kg-1. The solubility of carbonates varies within the soil sector depending on the variation in temperature and moisture content with depth. Therefore, carbonates are more soluble at the surface compared to other depths, and there can be an effect of soil solution on carbonate precipitation within this concept. Amundson et al., [13]

In addition to this, soil management plays an important role in its distribution within the soil sector, andthe low concentration of salts and the percentage of gypsum in it is due to the continuous washing process accompanying the irrigation process. In addition to the fact that it is well-drained soil and has a high topography in relation to the Euphrates River, so the river is considered a natural sink for it, in addition to the presence of The network of artificial trocars spread in this part.

The results of the relative distribution of soil separators confirm that there is no specific pattern in the nature of the distribution of soil separators with depth, especially clay. This confirms that there is no case of pedogenictransfer of clay separators with depth at all the depths studied, due to the weak activity of pedogenic processes due to the nature of the prevailing environmental conditions in the study area of Wasit Governorate.

Represented by the continuation of sedimentation processes, in addition to the state of drought and the short period of time for these soils in general, the results indicated that the depositional environment of the study soils is of a calm to moderate type. This was reflected in the dominance of separated alluvium in all soil pedons, with a noticeable increase in the content of the coarse parts in the horizons. Subsurface as a result of the gradual nature of the process of deposition of soil particles and according to the variation in their sizes. The almost flat topography also helped in the occurrence of a gradual state in the early sedimentation process, Al-Badri, Ai Hussein Abbas [5] . It was also noted that the clay content decreases with depth, except for the North GHARAF site, which decreases at the second depth by 15-30 cm, then increases at the third depth, as the clay content ranges between 11.69-590.6 g kg-1.

As for the silt, it decreases at the second depth and then increases in both the North and East Al-Gharaf sites, while it increases with depth in the Al-Janabi site. The silt reached between 322.15-970.76 grams kg-1.It was high at most depths compared to the small amount of sand, and it increased with depth only in theEast Al- GHARAF site, while it decreased. At the second depth, then it increases at the third depth, and the percentage of sand was recorded at 6-178.82 g kg-1. The sand content decreases with the depth of the soil, and the reason for the high increase in silt percentages is attributed to the sedimentation process in the middle of the alluvial plain, which is linked to the sediments of the Tigris River and its tributaries, and their carrying capacity is moderate, and thus it moved. The fine and medium-sized materials were then deposited and the fine materials remained. The results generally indicate a relative increase in clay and silt in the underlying horizons, and this may

It is attributed to the influence of the calm environment, which helped in the gradual process of deposition of soil particles, while the dominance of clay content becomes clear towards the upper horizons, and the silt is deposited in the surface horizon and the rest of the horizons may be attributed to the nature of the topographic location, and this agrees with Al-Husseini, [8], as he indicated that the concentration of clay particles Alluvium and their dominance in a certain horizon in sedimentary soils and under certain conditions may in turn lead to the formation of smooth textured horizons that behave like a hard layer in the soil body. It decreases with depth due to the increase in gypsum aggregates and watery conditions of deposition, and this is consistent with what Al-Houni [7] found. The clay content decreased with an increase in the gypsum content. As for the effect of spatial distribution on the soil texture, it showed clear variation, and this depends on the nature or effect of the geomorphological factor represented by the characteristics and speed of the conveyor, which affects the volume of particles transported during the period of layer deposition, and this was confirmed by Jubeir (2013). It was mentioned that the variation in the proportions of soil particles (sand, silt, and clay) was generally highly variable and that the reason for its variation is attributed to the nature ofsedimentation in the study area. The particles did not show a specific pattern of distribution with depth, and this confirms the weak activity of the pedogenic processes responsible for the formation and development ofsoils as a result of the impact The negative nature of the environmental factors prevailing in the region, suchas drought, short lifespan, and the nature of the source material [4],

The differences in sediment geometry and soil separations with depth strongly reflect fluctuations in sedimentation velocity, which are due to environmental changes at the river basin scale and to channel morphological modifications [33].

Electrical conductivity and salinity index (SI) calculation

Electrical conductivity is a function of the amount of salts present in the soil, as Table (2) shows that the electrical conductivity values ranged from low to medium salinity in the soils of the study areas. It ranged between (2.20-11.05) decimens.m-1 for the soil horizons of Wasit Governorate, as The lowest value was in the side depth at a depth of 30-60 cm, with a value of 20.2 decisions.m-1, and the highest value was in the northern Al- GHARAF at a depth of 0-15 cm, with a value of 11.05 decisiemens.m-1.

The results indicate a clear decrease in the electrical conductivity values of the soils of the study sites in the northern part. This indicates that the soils of the study sites are non-saline and that the reason for this decrease in these soils may be attributed to the high state of precipitation, which leads to the washing of salts and their dissolution outside the body of the soil. Through the interpretation of the results, we notice that most of the northern soils are non-saline and not subject to salinization, and this is consistent with many researchers who have studied the soils of northern Iraq. Therefore, these results were consistent with the results of previousresearchers Al-Husseini, 2010 and Al-Taghlibi, 2018.

While in the southern part, electrical conductivity values ranged between medium to high salinity in the soils of the study areas. It ranged between (8.37-48.2) decisiemens.m-1 for the soil horizons of Basra Governorate, where the lowest value was in the third depth, 30-60 cm, with a value of 8.37 decisiemens.m-1, and the highest value was in Siba, in the depth 0-15 cm, with a value of 48.2 decisiemens.m-1.

This may be attributed to its high content of gypsum and prevailing salts, as well as the lack of natural vegetation cover and the increase in the rate of evaporation, which helps raise the values of salts in the soils of the study sites. This is what was proven by the values and curves of the spectral reflectivity of these soils, as they were high in the study and gave the highest value for reflectivity, and this agrees. With what Hassan et al. [21] found The soil reflectivity values increase with increasing soil salinity. This is also consistent with what Sabah et al. [41] indicated that spectral reflectivity values generally increase with an increase in salts in the soil, i.e. an increase in EC values). Or it may be due to the influence of the climate factor, including temperature and precipitation. The results of the study, Figure 2 (A+B), indicated that most of the lands of the study area are affected by salinity and were represented by the presence of three types that ranged from the lowest salinity index values (0.6-0.45) to the highest value (0.8-0.8185) for Basra Governorate, while the values for the salinity index ranged for the Governorate. Wasit / Kut between the lowest value (0.4318-0.6) and the highest value ranged (0.8-1)

Normalized Difference Salinity Index (NDSI)

This is important evidence for predicting the characteristics of surface soil through spectral data, as it is noted that the ratios that fall within the range less than zero, which represent the lowest reflectivity, represent the lowest salt content in the soil (Al-Kawaz 2015). The results of the study, Figure 3 (A+B), indicated thatmost of the lands of the study area are affected by salinity, as the natural salinity difference index (NDSI) was recorded at the study site on the GHARAF River and Janabiyah Al-Hay (Al-Hay and Al-Mawfiqiya). Values ranged from <_0.1 to <0. While for Basra Governorate, the value was recorded ranging between. 0.3816-0.094). This evidence shows the extent of the soil affected by salinity, and it reflects the extent of ground deterioration with sabkha and shura salts, as well as the effect of humidity on this evidence. Is it from rain, irrigation water, or adsorbed? This is consistent with Al-Khuwailidi (2020). This indicates the presence of sabkha soil or Shura soil, which tends to be dark in color because it contains adsorbed salts such as chlorides, magnesium, and calcium, which are characterized by moisture and viscosity and work to pull water molecules into it, which affects the reflection of rays from its surface. Or the shore soil, which contains a dry white crust. Because it contains sodium and magnesium chlorides and sulfate salts, the researcher explained that the nature of the interaction between sabkha and short salts in such soils may have a role in the ineffectiveness of this guide. Despite this, the results indicate the expansion of soils affected by salinity, especially sabkha soils.

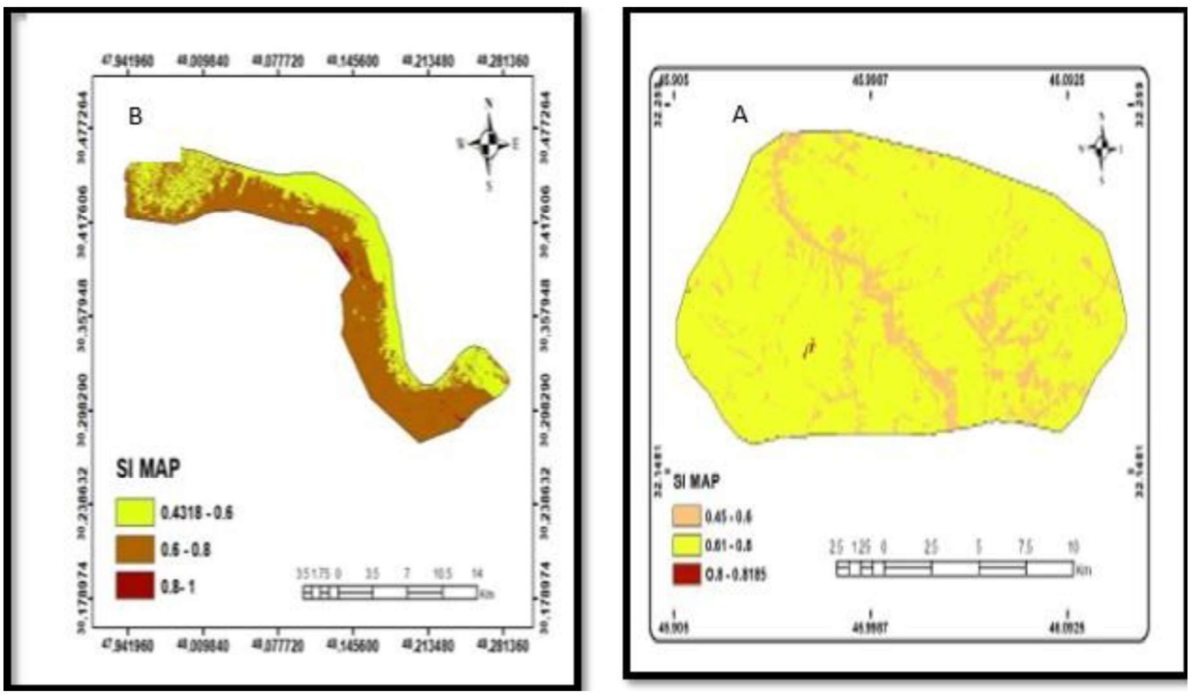

Figure 2. (A+B): Salinity Index (SI) for the study areas

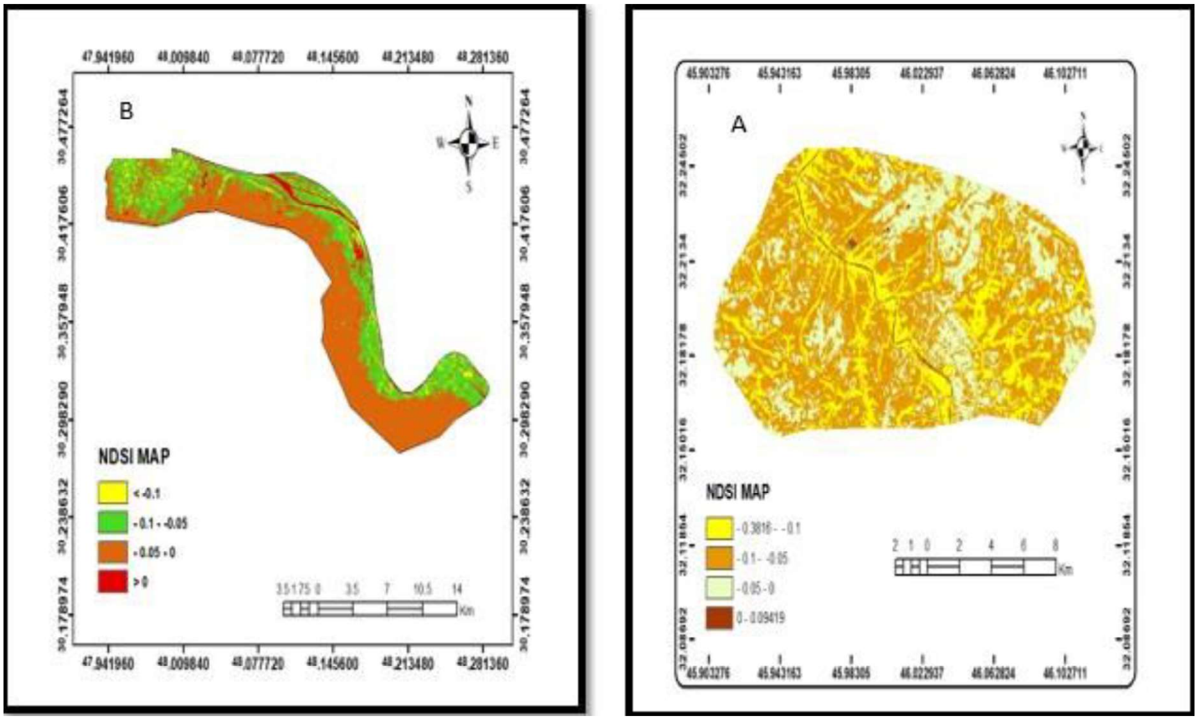

Figure 3. (A+B): Normalized Difference Salinity Index (NDSI) for study areas

Processing spectral reflectivity values mathematically

Table 4 shows the values of the Correlation Coefficient (r), calculated between the gypsum content of the soil and the spectral reflectivity recorded using a laboratory radiometer spectrometer, in the spectral bands equivalent to the beams of the OLI sensor carried on board the American satellite Landsat 8, and from it, it is noted that there is a correlation relationship Highly positive and significant between the studied bands, with the exception of the negative relationship in band B8 for both Basra and Wasit Governorates, and the value of the correlation coefficient, in general, has exceeded 0.900 in all spectral bands except for its value at the infrared bands B5 and red B4 of the visible spectrum, and in the infrared band B4. Medium red B7. The highest correlation was recorded in bands B4 and B3. Its value in package B4 reached about 0.997.

As for its value in package B3, it was about 0.996. There was a highly significant positive correlation with the salt index SI for all packages except for package B8, which was associated with a highly significant negative correlation for Kut, while the soil of Basra Governorate did not show any significant correlation with the salt index due to the type of salts present, which are chlorides and magnesium sulfates, and a decrease in optical reflectivity due to the dominance of hydrated salts, as in Table (1). This is consistent with what Yahya [44] found, that the decrease in spectral reflectivity values in soils affected by salts may be due to the predominance of hydrated salts, such as magnesium chloride and sodium chloride, which increase the soil's ability to absorb light energy, in addition to the nature of the wet, sticky, and sticky surface. One Dark soil characterizes these soils, which leads as a result to low spectral reflectivity values. The study also showed the existence of a negative correlation between the salinity difference index (NDSI) and the carbonates and the bands B1, B2, B3, B4, B5, B6, and B7, while there is a highly significant positive correlation between the bands. For Basra Governorate, there is a negative correlation with all bands, carbons, and sulfates for Wasit Governorate, as in Table (3) and Table (4).

Table 3. Correlations table for Wasit / Kut Governorate

g												
		B2	B3	B4	B5	B6	B7	B8	CaSO4	CaCO3	SI	NDSI
B2	Pearson Correlation	1	.992**	.997**	.761*	.934**	.975**	-.949**	.086	.074	.825**	-.154
	Sig. (2-tailed)		.000	.000	.017	.000	.000	.000	.825	.849	.006	.692
	N	9	9	9	9	9	9	9	9	9	9	9
B3	Pearson Correlation	.992**	1	.996**	.732*	.912**	.963**	-.911**	.112	-.007	.771*	-.107
	Sig. (2-tailed)	.000		.000	.025	.001	.000	.001	.775	.986	.015	.783
	N	9	9	9	9	9	9	9	9	9	9	9
B4	Pearson Correlation	.997**	.996**	1	.750*	.931**	.976**	-.935**	.066	.012	.809**	-.130
	Sig. (2-tailed)	.000	.000		.020	.000	.000	.000	.866	.976	.008	.739
	N	9	9	9	9	9	9	9	9	9	9	9
B5	Pearson Correlation	.761*	.732*	.750*	1	.921**	.824**	-.734*	.083	-.004	.940**	-.738*
	Sig. (2-tailed)	.017	.025	.020		.000	.006	.024	.832	.992	.000	.023
	N	9	9	9	9	9	9	9	9	9	9	9
B6	Pearson Correlation	.934**	.912**	.931**	.921**	1	.978**	-.914**	.072	.030	.955**	-.456
	Sig. (2-tailed)	.000	.001	.000	.000		.000	.001	.854	.938	.000	.218
	N	9	9	9	9	9	9	9	9	9	9	9
B7	Pearson Correlation	.975**	.963**	.976**	.824**	.978**	1	-.943**	.091	.043	.889**	-.276
	Sig. (2-tailed)	.000	.000	.000	.006	.000		.000	.815	.913	.001	.472
	N	9	9	9	9	9	9	9	9	9	9	9
B8	Pearson Correlation	-.949**	-.911**	-.935**	-.734*	-.914**	-.943**	1	-.020	-.248	-.872**	.175
	Sig. (2-tailed)	.000	.001	.000	.024	.001	.000		.959	.519	.002	.653
	N	9	9	9	9	9	9	9	9	9	9	9
CaSO4	Pearson Correlation	.086	.112	.066	.083	.072	.091	-.020	1	.042	-.023	-.191
	Sig. (2-tailed)	.825	.775	.866	.832	.854	.815	.959		.915	.952	.622
	N	9	9	9	9	9	9	9	9	9	9	9
CaCO3	Pearson Correlation	.074	-.007	.012	-.004	.030	.043	-.248	.042	1	.160	-.050
	Sig. (2-tailed)	.849	.986	.976	.992	.938	.913	.519	.915		.681	.899
	N	9	9	9	9	9	9	9	9	9	9	9
SI	Pearson Correlation	.825**	.771*	.809**	.940**	.955**	.889**	-.872**	-.023	.160	1	-.605
	Sig. (2-tailed)	.006	.015	.008	.000	.000	.001	.002	.952	.681		.084
	N	9	9	9	9	9	9	9	9	9	9	9
NDSI	Pearson Correlation	-.154	-.107	-.130	-.738*	-.456	-.276	.175	-.191	-.050	-.605	1
	Sig. (2-tailed)	.692	.783	.739	.023	.218	.472	.653	.622	.899	.084	
	N	9	9	9	9	9	9	9	9	9	9	9
**. Correlation is significant at the 0.01 level (2-tailed).												
*. Correlation is significant at the 0.05 level (2-tailed).												

Table 4. Correlations table for Basra Governorate

Correlations												
		BB2	BB3	BB4	BB5	BB6	BB7	BB8	BCaSO4	BCaCO3	BNDSI	BSI
BB2	Pearson Correlation	1	.995**	.991**	.897**	.964**	.970**	-.675*	-.176	.544	-.445	.614
	Sig. (2-tailed)		.000	.000	.001	.000	.000	.046	.650	.130	.231	.078
	N	9	9	9	9	9	9	9	9	9	9	9
BB3	Pearson Correlation	.995**	1	.997**	.886**	.964**	.968**	-.678*	-.181	.491	-.455	.633
	Sig. (2-tailed)	.000		.000	.001	.000	.000	.045	.642	.180	.218	.067
	N	9	9	9	9	9	9	9	9	9	9	9
BB4	Pearson Correlation	.991**	.997**	1	.890**	.974**	.976**	-.704*	-.160	.493	-.446	.648
	Sig. (2-tailed)	.000	.000		.001	.000	.000	.034	.682	.178	.229	.059
	N	9	9	9	9	9	9	9	9	9	9	9
BB5	Pearson Correlation	.897**	.886**	.890**	1	.908**	.888**	-.839**	-.186	.735*	-.373	.597
	Sig. (2-tailed)	.001	.001	.001		.001	.001	.005	.632	.024	.322	.090
	N	9	9	9	9	9	9	9	9	9	9	9
BB6	Pearson Correlation	.964**	.964**	.974**	.908**	1	.982**	-.756*	-.182	.495	-.442	.602
	Sig. (2-tailed)	.000	.000	.000	.001		.000	.018	.639	.176	.233	.086
	N	9	9	9	9	9	9	9	9	9	9	9
BB7	Pearson Correlation	.970**	.968**	.976**	.888**	.982**	1	-.763*	-.033	.441	-.435	.611
	Sig. (2-tailed)	.000	.000	.000	.001	.000		.017	.932	.234	.242	.081
	N	9	9	9	9	9	9	9	9	9	9	9
BB8	Pearson Correlation	-.675*	-.678*	-.704*	-.839**	-.756*	-.763*	1	-.091	-.482	.386	-.496
	Sig. (2-tailed)	.046	.045	.034	.005	.018	.017		.815	.189	.305	.174
	N	9	9	9	9	9	9	9	9	9	9	9
BCaSO4	Pearson Correlation	-.176	-.181	-.160	-.186	-.182	-.033	-.091	1	-.236	.069	-.087
	Sig. (2-tailed)	.650	.642	.682	.632	.639	.932	.815		.541	.860	.823
	N	9	9	9	9	9	9	9	9	9	9	9
BCaCO3	Pearson Correlation	.544	.491	.493	.735*	.495	.441	-.482	-.236	1	-.147	.333
	Sig. (2-tailed)	.130	.180	.178	.024	.176	.234	.189	.541		.707	.381
	N	9	9	9	9	9	9	9	9	9	9	9
BNDSI	Pearson Correlation	-.445	-.455	-.446	-.373	-.442	-.435	.386	.069	-.147	1	.340
	Sig. (2-tailed)	.231	.218	.229	.322	.233	.242	.305	.860	.707		.371
	N	9	9	9	9	9	9	9	9	9	9	9
BSI	Pearson Correlation	.614	.633	.648	.597	.602	.611	-.496	-.087	.333	.340	1
	Sig. (2-tailed)	.078	.067	.059	.090	.086	.081	.174	.823	.381	.371	
	N	9	9	9	9	9	9	9	9	9	9	9
**. Correlation is significant at the 0.01 level (2-tailed).												
*. Correlation is significant at the 0.05 level (2-tailed).												

4. Conclusion

In light of the results obtained, the following can be concluded:

1. There are many spectral indicators that can be derived from satellite data, and these indicators can be used as preliminary indicators to identify changes that occur in a place within different time periods. In order to determine the state of changes in an area, the interpretation of this evidence must be coupled with field visits and recording information about the topography, soil, rock structures, and vegetation cover in terms of quantity and type, as well as the nature of land use. It may be very useful to integrate this information. Using Geographic Information System
2. There is variation between the textures of the soil site of the study area, as they ranged between a mixture of silty clay, then a mixture of silt, then a mixture of silty clay, and a mixture of silty clay, then clay in between. A small variation was observed in the types of textures in the vertical direction from one

horizon to another, and this reflects the influence of geomorphological processes, especially the processes of erosion and sedimentation. prevalent in the study areas.
3. High soil salinity in some soils of the study area had an effective role in soil degradation and reduced vegetation cover and its impact on reflectivity values using evidence.
4. An increase in the amount of calcium carbonate minerals due to the parent material and a decrease in the amount of water due to a decrease in river levels and the amount of rain, which contributed to changing some soil properties.

5. Ethics approval

The Institutional Ethical Committee (IEC) of DSSWR, Iraq, approved the study.

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References

[1] Abbas, Saadia Mahdi Saleh. (2020). Studying some characteristics of soils affected by salts and their deterioration in Basra Governorate using geospatial techniques. PhD thesis. College of Agriculture - University of Basra.
[2] Al-Abedi, M. (2018) Soil Characteristics of Al-Azizia District and its Impact on Agricultural Production, Wasit: Master Thesis (unpublished) College of Education, University of Wasit, p. 85
[3] Al-Atab, Salah Mahdi Sultan. (2008). Variation in soil properties and classification in some areas of Basra Governorate. Doctoral thesis, College of Agriculture, University of Basra.
[4] Al-Azami, Raad Atta Mahmoud (2006). The effect of physiographic location on the genetic and evolutionary status of some gypsum soils in Iraq. Doctoral thesis, College of Agriculture, University of Baghdad
[5] Al-Badri, and Ai Hussein Abbas (2023) classified some of the soils of Wasit Province only for agricultural purposes with the help of geospatial technologies. Master's thesis, College of Agriculture, University of Basra
[6] Al-Hamdany, A.S. (2017). Characterization, Classification and Prediction of Soil Map Units by Using Remote Sensing and GIS in Bahar-Alnajaf, Iraq. Ph.D Thesis, College of Agriculture, University of Basra, Iraq
[7] Al-Houni, Saleh Qadir Tawfiq.)2013(. The effect of soil gypsum content on phosphorus fractionation and the response of corn plants to phosphate fertilization. Master's thesis, College of Agriculture, Tikrit University
[8] Al-Husseini, Iyad Kazem Ali (2005). Study of the characteristics of some dried Hammar marsh soils in southern Iraq. Master's thesis, College of Agriculture. Baghdad University. The Republic of Iraq
[9] Al-Kawwaz, M. Kareem (2020). Sanctifying the imaginary, is an introduction to a cultural study in the Islamic unseen. Dar Abkalo, Germany, First Edition
[10] Al-Khuailidi Asma Rashid. (2020). Study of the manifestations of desertification in the southwestern region of Wasit Governorate. Master Thesis. College of Agriculture - Wasit University.
[11] Al-Shahmani, Laith Salim Salman Daoud. (2020). Variation in the distribution of sediments from the Al-Gharraf River in Wasit and Dhi Qar governorates. Her doctor's thesis. College of Agriculture - University of Baghdad.
[12] Alwan, Taha Ahmed. 2011. Gypsum Soils Management, Dar Al-Hilal for Printing and Publishing, Beirut, Lebanon.
[13] Amundson, R., Graham, R.C., and Vizcaine, E.F. (1997). Orientation of carbonate lamination in gravelly soils along a winter/summer precipitation gradient in Baja California, Mexico. Soil Sci.,162: 940-952.
[14] Ani, A. Fundamentals of Soil Science: Technical House, Al-Maad Technical Foundation Press, Zafaraniya, Baghdad, p. 219. Al-Ani, A., Al-Kubaisi, A. (2000) Some Technical Developments in Preparing Soil for Agriculture, No. 2, The Iraqi Agriculture Journal, Research Issue, p. 73
[15] Baigab, M.H., Zhanga, L., Shuaiab, T., and Tonga, Q. "Derivation of a tasselled cap transformation based on Landsat 8 satellite reflectance" (2014) Remote Sensing Letters Baigab, M.H., Zhanga, L., Shuaiab, T., and Tonga, Q. "Derivation of a tasseled cap transformation based on Landsat 8 satellite reflectance" (2014) Remote Sensing Letters
[16] Basel, Youssef Sami Haj (2021). Chemical characteristics of soil in Abu Ghraib district. Ministry of Education/General Directorate of Education, Baghdad Al-Karkh I

[17] Bhagaban Behera, Umesh P Borole, Amal Sivaji, Jakeer Khan, Pradeep Kumar, CM Ananda, Harish C Barshilia, P Chowdhury, Jitendra J Jadhav, Design and development of GMR based low range pressure sensor for medical ventilator application, Sensors and Actuators A: Physical 321, (2021) 112581 (I. F. 3.4)

[18] Black, G.R. 1965. Bulk density. In. CA. Black et al. (Eds). Methods of soil analysis, part 1. Agron. 9: 371 – 373. Am. soc. Agron. Madison. The USA

[19] Chander, G., B. L. Markham, and D. L. Helder, 2009: Summary of current radiometric calibration coefficients for Landsat MSS, TM, ETM+, and EO-1 ALI sensors. Remote Sensing of Environment, 113, 893-903.

[20] Favaretto, N., L. D. Norton, B. C. Joern, and S. M. Brouder, 2006. Gypsum amendment and exchangeable Calcium and Magnesium affect Phosphorus and Nitrogen Runoff. Soil Sci. Soc. Am. J. 70:1788-1796.

[21] Fournier, J.M. and Quilici, M.L. (2007) Choléra. La Presse Médicale, 36, 727-739.https://doi.org/10.1016/j.lpm.2006.11.029 Hassan, A., et al. (2017) Frontiers of Chaotic Advection. Reviews of Modern Physics, 89, 025007.https://doi.org/10.1103/RevModPhys.89.025007

[22] Gee, and Bauder .(1986) . Particle size analysis in methods of soil analysis. Part(1) . Physical and mineralogical methods (2nd .ed) .A. Klute: 383- 409.

[23] Hassan, A.A. (2010). A regional compositional study of the Al-Kaara region in the Iraqi Western Desert using satellite image. M.A. Thesis, College of Science, University of Baghdad, Iraq

[24] Jaata, Hisham Ahmed. 2014 The relationship of micromorphological characteristics to the physical and chemical characteristics of some gypsum soils, Master's thesis, Department of Soil Sciences and Water Resources, College of Agriculture - Tikrit University

[25] Jackson, M. L. (1958). Soil Chemical Analysis. Prentice Hall, Inc. Englewood Cliffs, N. J.

[26] Jubeir, Amal Radi (2013). Studying the spatial changes and variable harvest of some soil characteristics in northern Tikrit using statistical concepts via the Geographic Information System (GIS). Al-Furat Journal of Agricultural Sciences, Volume 5 (3): 268-279.

[27] Kamal, Abha M., Rashid, Abdullah A.(2020) The Nature of Iron Oxide Distribution in Some Calcareous and Gypsiferous Soils.Tikrit Journal for Agricultural Sciences 20 (2):107-119

[28] Kazem, Muhammad Ahmed. (2017). Classification of some soils in the eastern Shatt al-Arab region in Basra Governorate and evaluation of the suitability of lands for agricultural purposes using remote sensing techniques. Doctoral thesis. College of Agriculture - University of Basra.

[29] Khan, N. M., Rastoskuev, V. V., Sato, Y., and Shiozawa, S. (2005). Assessment of hydrosaline land degradation by using a simple approach of remote sensing indicators. Agricultural Water Management, 77(1–3), 96–109.

[30] Louis, S., E. Owusu- Bennoah, F. M. Tetteh, 2015. Physico-chemical properties and agronomic performance of maraca liar ice in three salt–affected soils amerced with gypsum – University of Ghana legion in partial fulfillment.

[31] Manchanda , M. L. ; M. Kudrat and A. K. Tiwari (2002). Soil survey and mapping using remote sensing. Tropical Ecology 43(1)pp: 61-74.

[32] Martin, P., 2016. Fearing a flood. Retrieved from The Globe and Mail: http://www.theglobeandmail.com/news/ mosul-dam-could-/perach-anyminute-as-kill-as-many-15-millioniraqis/artc-Le29569107

[33] Martínez-Segura et al., Mar.)2021 (M.A. Martínez-Segura, C. Conesa-García, P. Pérez-Cutillas, P. Martínez-Pagán, M.D. Vásconez-Maza Identifying changes in sediment texture along an ephemeral gravel-bed stream using electrical resistivity tomography 2D and 3D Appl. Sci., 11 (7) (2021), p. 3030, 10.3390/app11073030

[34] Muhammad, D. and R. A. Khattak, 2011. Wheat yield and chemical composition as influenced by integrated use of gypsum, press mud land FYM in saline-sodic soil. Journal of the Chemical Society of Pakistan, 33: 82–86

[35] Page, A. L., Miller, H., and D. R. Keeny. (1982). Method of soil analysis. Part (2) chemical and biological properties, Am. Soc. Agron. Inc., Pub. Madison, Wissonsinsin. USA.

[36] Raed Aziz Mahmoud, Abdulmutallab H. Al- Al-Marsoumi, Anis Abdul Khader Mohammad Ali, 2011, " Study Gypsum Content Of The Soil In Selected Areas Of Basra Province", Basra Journal of Research, Issue XXXVII, the first part, 21-10, ISSN 1817-2695.

[37] Rashid, Abdullah Azzawi (2005). Evidence of development for some Iraqi soils, doctoral thesis, College of Agriculture, University of Baghdad Salinization and Plant-Based Strategies for Sustainable Mitigation. Sci. Total

[38] Rashida, U. ; Anwar, F. ; Moser, B. R. ; Knothe, G.(2008). Moringa oleifera oil: A possible source of biodiesel. Bioresource Technol., 99 (17): 8175–8179

[39] Rayn, J. Garabet, S. Harmsen, K., and Abdul Rashid. (1996). A soil and plant analysis. Manual. Adapted for west Asia and North Africa region /International Center for Agriculture Research in the Dry Area. (ICAR. A.I.).

[40] Richard, L. A. (1954). Diagnosis and improvement of saline and alkali. soils u.s. Salinity laboratory DA. VS Dept, Agron. Handbook, 60, 160p

[41] Shaaban, I. M., M. Abid, and R. A. I. Abou-Shanab, 2013. Amelioration of salt-affected soils in rice paddy system by application of organic and inorganic amendments 59 (5): 227–233.

[42] Shepherd, K.D., and Walsh. M.G. (2002) Development of Reflectance Spectral Libraries for Characterization of Soil Properties. Soil Science Society of America Journal, 66, 988-998.http://dx.doi.org/10.2136/sssaj2002.9880

[43] Taghlabi, Ruaa Qais Mahmoud (2018). Evaluating the state of deterioration and desertification of some soils.Using remote sensing techniques and geographic information systems in northern Iraq, a dissertation Master's degree, College of Agriculture, Tikrit University

[44] Yahya, U. (2011) Why We Set Up Entrepreneurship Studies In Varsities- FG. Available on http://www.thenigerianvoice.com/nvnews/45849/1/why-we-set-up-entrepreneurship-studies-invarsitie.html Accessed June 16, 2012

[45] Zinck J.,) 2008 (remote sensing of soil salinization: impact on land management" CRCpress, Techhology & Engineering, pp(374).