Variance of some Soil Physicochemical Properties and Oxides within the Oases of Al-Bouhyat in the Anbar Desert, Western Iraq

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Abstract

Al-Bouhyat Oasis was chosen. It is located within the boundaries of Anbar Governorate, to the right of the Euphrates River, southeast of Lake Haditha, about 27.45 km, at the coordinates 33°57'59.4"N 42°26'25.4"E, and an area of about 146.55 ha., Soil survey was carried out using the Free Lance method, covered with several pedons with a semi-detailed survey, which numbered 6 pedons. Soil samples were taken from each diagnosed horizon, transferred to the laboratory, and prepared for some physical and chemical analyses. The results showed soil development at the calcareous materials. The soils were classified into the Order of Aridisols, which included two levels of the suborder Gypsids with 78.25 ha (53.39%) and Calcids with 68.30 hectare (46.61%). The study results showed the SiO_2 content in all profiles decreased with depth (range of 28.98 % to 35.14 and that Al_2O_3 values varied from 5.3 to 8.65%. The highest amount of Fe2O3 (4.02%) was in series 131CCW. The CaO range from 21.87 to 31.8% in series 133CKW and series 122CCW. The correlation coefficients showed no significant correlations with depth for Fe_2O_3, SiO_2 and AL_2O_3, with a correlation coefficient of -0.096, 0.093 and 0.086, respectively. The study also showed a positive correlation coefficient between gypsum and sand content, with a significant positive correlation coefficient of 0.67. This indicates the coarse texture of gypsum soils. The study also showed a significant negative correlation coefficient of -0.51 between the gypsum content and the bulk density.

Keywords: Gypsid, elemental oxide, calcium oxide, SPSS

تباين بعض الصفات الفيزيوكيميائية للتربة وأكاسيدها ضمن واحة البوحيات في صحراء الأنبار غربي العراق

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المستخلص

اختيرت واحة البوحيات والتي تقع ضمن حدود محافظة الأنبار ، على يمين نهر الفرات جنوب شرق بحيرة حديثة بحوالي 27.45 كم ، تقع عند الإحداثيات الجغرافية "33°57'59.4 شرقا و "42°26'25.4 شمالا. وتبلغ مساحتها 146.55 هكتار . تم إجراء مسح للتربة باستخدام الطريقة الحرة Free Lance . حفرت 6 بيدونات ممثلة للترب المتوقع وجودها. استحصلت عينات التربة من افاق البيدونات وحددت حدود الافاق وسمك الافق ونقلت النماذج الترابية إلى المختبر لاجراء بعض التحليلات الفيزيائية والكيميائية والاكاسيد المهمة في تصنيف التربة حسب النظام الامريكي Soil Survey Staff. 2014 ونظام تصنيف العكيدي للترب الصحراوية 1981. أظهرت النتائج أن التربة نشأت من مواد اصل كلسية. وصُنفت التربة عند مستوى رتبة Aridisols والتي صنفت الى مستويين من تحت الرتبة Gypsid وبمساحة 78.25 هكتار وبنسبة 53.39٪ والمستوى تحت الرتبة Calcids وبمساحة 68.30 هكتار وبنسبة 46.61٪. لوحظ من خلال النتائج المتحصل عليها انخفاض في نسبة اوكسيد السليكون SiO_2 في جميع البيدونات مع العمق من35.14% الى 28.98% , كما لوحظ أن نسبة اوكسيد الالمنيوم Al_2O_3 تباينت من 5.3 إلى 8.65٪ . وكانت أعلى قيمة لاوكسيد الحديد4.02٪ في السلسلة 131 CCW اما اوكسيد الكالسيوم CaO فقد تراوح ما بين 21.78 إلى 31.8٪ في السلسلة 133CKW والسلسلة 122CCW بالتتابع. اوضحت معاملات الارتباط عدم وجود علاقة ارتباط مع عمق التربة لاكاسيد الحديد والسليكون والالمنيوم وبمعامل ارتباط – 0.096, 0.093 و0.086 على التوالي. كما بينت الدراسة وجود معامل ارتباط موجب بين محتوى الجبس ومحتوى الرمل وبمعامل ارتباط 0.67. وهذا يشير الى خشونة نسجة الترب الجبسية. كما اوضحت الدراسة وجود معامل ارتباط سالب بين محتوى الجبس والكثافة الظاهرية وبمعامل ارتباط –0.51.

الكلمات المفتاحية: واحة البوحيات, اوكسيدات العناصر , اوكسيد الكالسيوم,SPSS

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Introduction

The particle size distribution as a fundamental factor generally controls spatial variations of soil physical properties in the field. Heterogeneity and variation of soil physical parameters in a field due to soil plowing should be considered for successful agricultural management (Gulser et al., 2016).

Soil physical and chemical properties are strongly influenced by soil management systems and changes in land use (Hulugalle et al., 1997).

The main aim of statistical testing is to attach probabilities to those inferences. The tests are prefaced by hypotheses or models, such as no differences among population means or relations between variables, the so-called null hypotheses (Webster, 2021). A typical geostatistical analysis of soil data proceeds on the assumption that the properties of interest are the outcomes of random processes. Many factors have contributed to the soil in the parent material and during its formation (Webster, 2000).

Mzuku et al. (2005) showed that soil physical properties exhibited significant spatial variability across production fields. The trends observed for the measured soil physical properties correspond to the productivity potential of the management zones. Utilizing site-specific management zones could help manage the in-field variability of yield-limiting soil physical properties.

Al-Juraysi, (2021) Mention There is no apparent chemical weathering in the study pedons and for all indications, due to the little leaching of calcium carbonate in sufficient quantities due to the little rain and the accumulation of quartz in the soil surface, which indicates that the soils are newly formed.

Al-Khafagi et al. (2016) showed an apparent increase in immobile oxides of (SiO_2, Fe_2O_3 and Al_2O_3). However, the mobile oxides of (CaO) and the loss in the ignition were increased in Al-Hadher soil and gradually decreased in Al-Qayarah, Hamam Al-All, and Tallafer and reached their lowest levels in Faidah soil. Research on soil variation could be improved by increased coordination of experimental designs and by application of statistical methods suitable for analysis of place-to-place variation, including statistical functions such as spatial autocorrelation (Campbel, 1979).

In a study conducted by Beckett and Webster, 1971 They showed that the variations in soil characteristics from one place to another in the terrestrial perspective are the result of several reasons, including the climate, which causes gradual and sudden changes; topography and material of origin, which cause local differences and short-term variances; and vital activities that cause regional differences.

The state of weathering, its intensity and direction can be known by studying the mineral composition of the soil and the percentage of oxides in the soil volume. He added that the evidence of soil weathering, which is based on the proportions and quantity of oxides and the proportions of minerals present, is essential in the study of the evolutionary state of the soil. (Aljoboury, 2018).

The differences in soil formation factors and processes are due to variables such as parent material, topographical position, and age of the associated landscape (Dengiz and Usul, 2018).

This research aims to detect variations in some physical and chemical properties and oxides in dry desert soils.

Materials and Methods

The study area is located at coordinate central 33 °57'59.4"N 42°26'25.4"E, within the boundaries of Anbar Governorate, shown in Figure 1, which is located to the right of the Euphrates River, southeast of Lake Haditha about 27.45 km, this study was carried out on an area of approximately146.55 ha. Soil samples were collected from six representative profiles in the Al-Bouhyat Oasis through a semi-detailed survey. The coordinates of the pedons' locations were recorded using the GPS device GARMIN. After the soil samples taken from six soil profiles were air-dried, each sample was passed out of a 2 mm sieve. Particle size distribution was determined with the hydrometer method (Bouyoucos, 1962). Bulk density was determined by using undisturbed samples (Black, 1965). and cation exchange capacity (CEC) was measured with the 1 N NH_4OAc (pH7) method (Soil Survey Laboratory Manuals, 2004).

The oxides were analyzed in the laboratory of chemical and mineral analyzes of the Fallujah Cement Factory using an X-ray Fluorescence (XRF) device. The climate is an arid continental climate, and its annual precipitation is 144.85 mm. The mean annual temperature is about 20.36°C. Different types, including desert, Haloxylon salicornicum, Guisum Achillee and Atriplex spp, characterize the natural vegetation of the study area. The soils were classified to the family level based on (Soil Survey Staff, 2014).

Statistical analysis

The relationships between the soil properties were evaluated by obtaining the values of Pearson's correlation, and Descriptive statistics of the soil properties (Mean, Std., Deviation, Minimum, Maximum and coefficient of variation) were calculated using the SPSS program for selected soil properties.

Results and Discussions

The major physical, chemical, and oxide characteristics of the soils in each pedon in the study area are presented in Table 1. Physical and chemical characteristics in the different pedons varied due to a dynamic interaction between climate and parent material (Kibar *et al.*, 2012). Solum depth ranges from 30 to 100 cm, depending upon the stage of the soil formation process. the delineation of soil horizons is affected by lateral and vertical variation in soil properties, which are texture, gypsum, lime, ECe, ESP, and CEC as their importance increases at the soil surface and decreases with depth. Al-Juraysi and Mhede (2021). The dominant soil texture for pedons 2 and 4 was loam and sandy loam. The highest sand content was 864 g kg^{-1}in series131CCW pedon1, formed on Calcareous and gypsiferous material parent material.

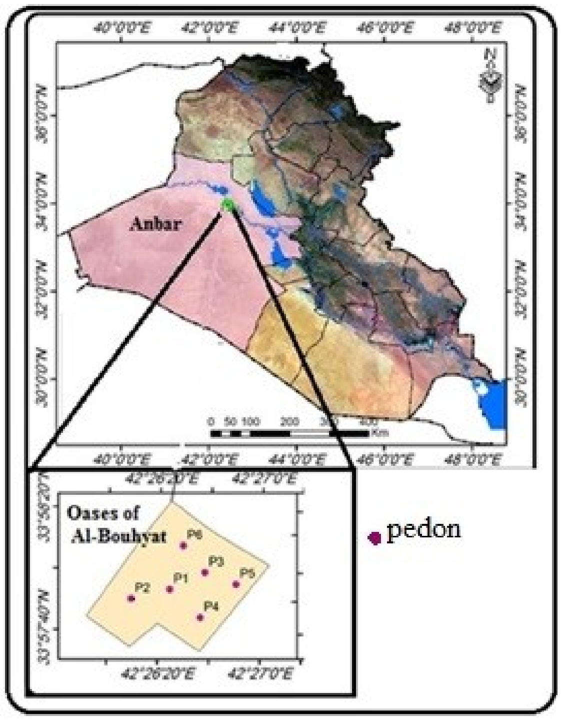

Figure 1. The location of the study area

Gypsum soils generally contain no more than 15% clay. Soil texture largely depends on the nature of the parent material from which the soil is formed and the degree of overlap in gypsum deposits. Very high calcium carbonate content was noted in series 131CCW pedon3 and series122CCW Pedon5 (485 and 495 g kg^{-1}) respectively (Table.1). The original parent materials provided the necessary calcium. This explanation is plausible for parent materials containing limestone and other calcium-rich rocks. While In series131CCW Pedon1(A) the content of calcium carbonate was 100 gkg^{-1}, while series 132XKM pedon4(By) only 290 g kg^{-1}. (Table 1). The content and distribution of the gypsum was noted in series131CCW pedon 1, Pedon3, pedon4 and pedon6 ,340, 223, 280 and 223 g kg^{-1}, respectively. Soil bulk density values ranged from 1.15 to 1.75 g cm^{-3}. with values generally higher in the subsurface horizons as a result of compaction. The low bulk density is due to a relatively low specific weight of gypsum, e.g., 2.3 gr per cm3, in combination with an occasional high porosity. Soil Cation Exchange Capacity varied from 10.5 to 32.8 cmolc kg^{-1}, with the highest CEC in the series133CKW p6 horizons. The lowest CEC value was found in soil classified as series131CCW pedon p1 horizons C_{K2}.This capacity is about inversely proportional to the gypsum content. When the gypsum content increases, the amount of the non-gypsiferous components, including clay, decreases. The ratio concentrations of mobile and immobile elements.

Table 2. shows that the SiO_2 content in all profiles decreased with a depth range of 28.98 to 35.14 % in series133CKW pedon 6 horizon C_{K1} and series122CCW pedon 5 horizon A_K respectively. that Al_2O_3 values

varied from 5.3 to 8.65% in series133CKW pedon p6 horizon C_{K1} and series132XKM pedon p4 horizon A_K respectively. SiO_2 highly resists weathering because it is contained in quartz minerals. In contrast, Al_2O_3 is less resistant to weathering because it is contained in clay minerals; a high content of Al_2O_3 indicates a high content of clay minerals (Demiralay, 1993; Shan et al., 2010). clay152 and 154 $g.kg^{-1}$, series132XKM pedon p4 horizon A_K and series 122CCW pedon p5 horizon A_K. respectively; Table.2. The highest amount of Fe_2O_3 4.02% was in series131CCW pedon p1. Concentrations of CaO are seen in the soils where the parent materials are mostly limestone. Generally, the CaO content in these soils ranges from 21.87 to 31.8% in series 133CKW pedon p6 horizon C_{K1} and series 122CCW pedon5 horizon B_k, respectively.

Table 1. Some physical and chemical characteristics of soil in the study area

pedon	Horizon	Depth / cm	ECe	Lime gkg^{-1}	Gypsum gkg^{-1}	CEC cmolc kg^{-1}	Sand gkg^{-1}	clay gkg^{-1}	silt gkg^{-1}	texture	bulk density gcm^3
P1	A	0-16	0.5	100	140	19.9	428.0	96.0	476.0	L	1.46
	B_{yk}	16-29	4.2	275	340	16.8	763.0	97.0	140.0	SL	1.32
	C_{K1}	29-60	13.0	375	280	18.3	864.0	67.0	69.0	LS	1.15
	C_{K2}	60-100	14.0	400	220	10.5	764.0	68.0	168.0	SL	1.38
p2	A	0-15	1.8	350	150	10.8	387.0	137.0	476.0	L	1.57
	B_K	15-30	3.5	465	160	14.9	763.0	112.0	125.0	SL	1.60
P3	A	0-11	32.2	485	Nil	17.0	337.0	161.0	502.0	SiL	1.39
	B_y	11-24	19.4	485	223	17.3	634.0	121.0	245.0	SL	1.39
	C_{K1}	24-64	19.8	485	50	11.3	703.0	92.0	205.0	SL	1.33
	C_{K2}	64-90	15.1	485	165	13.9	664.0	98.0	238.0	SL	1.40
P4	A_K	0-22	9.0	410	140	18.9	376.0	151.0	473.0	L	1.21
	B_y	22-48	6.7	290	280	12.0	772.0	105.0	123.0	SL	1.25
P5	A_K	0-48	2.7	475	Nil	17.4	545.0	154.0	301.0	SL	1.56
	B_K	48-61	3.4	490	Nil	17.2	196.0	306.0	498.0	SiCL	1.61
	C_{K1}	61-81	2.6	495	Nil	12.0	225.0	253.0	522.0	SiL	1.75
P6	A_K	0-27	0.9	470	Nil	14.8	373.0	176.0	451.0	L	1.39
	B_K	27-57	2.1	450	15	22.0	667.0	130.0	203.0	SL	1.58
	By	57-97	6.6	325	223	32.8	518.0	278.0	204.0	SCL	1.61

Table 2. The elemental oxide concentrations of soils in the study area

Pedon No	Horizon	Depth (cm)	Na_2O	K_2O	SiO_2	MgO	CaO	Fe_2O_3	Al_2O_3
P1	A	0-16	0.11	1.18	32.23	4.612	24.06	4.02	6.74
	B_{yk}	16-29	0.13	0.48	30.04	4.558	24.07	3.27	5.89
	C_{K1}	29-60	0.13	0.57	30.96	4.744	24.45	3.10	6.88
	C_{K2}	60-100	0.15	0.76	30.45	4.677	24.92	3.10	6.19
P2	A_K	0-15	0.12	0.16	31.69	6.614	25.03	3.78	6.98
	B_K	15-30	0.1	0.77	31.31	4.749	27.7	3.17	6.68
P3	A_K	0-11	0.32	1.25	31.63	4.661	25.3	3.65	6.87
	B_K	11-24	0.2	0.78	30.84	4.724	26.31	3.05	6.57
	C_{K1}	24-64	0.19	0.8	31.45	4.883	29.07	2.68	6.95
	C_{K2}	64-90	0.26	0.26	30.46	4.723	27.43	2.67	6.65
P4	A_K	0-22	0.17	1.09	34.4	4.784	26.06	3.77	8.65
	B_K	22-48	0.12	0.47	30.79	4.777	26.57	2.79	6.60
P5	A_K	0-48	0.09	1.27	35.14	4.763	25.83	3.77	8.63
	B_K	48-61	0.1	0.82	32.28	4.916	31.8	2.87	7.57
	C_K	61-81	0.12	1.03	30.68	4.776	31.03	2.81	6.39
P6	A_K	0-27	0.12	1.89	31.96	4.579	24.43	3.77	6.86
	B_K	27-57	0.11	1.03	31.08	4.79	25.49	3.05	6.97
	By	57-97	0.12	1.52	28.98	4.501	21.87	3.39	5.30

Soil classification of the study area

The region's soils were classified according to the modern american classification (Table 3.) into the order of aridisols, which included two levels of the suborders Gypsids with 78.25 hectare 53.39% with two levels of the family, and Calcids with 68.30 hectare 46.61%. With one level of the family coarse loamy, mixed, hyperthermic, super active, Typic petrogypsids. It is a level of desert soil with a moderately coarse texture, originating from materials of limestone origin that have a petroglyphic horizon within 100 cm of the soil surface. (Soil Survey Staff., 2014) Parent material is calcareous and gypsiferous material. The distribution of lime decreases in the second horizon. While gypsum increased with the depth, Flat lands with low slopes of 1% occupied an area of 22.31 hectares, or 15.22% of the total area of the oasis, the natural plant available were *achiiea fragrantssima, piatycerium bifurcatum and urtica diocia*. It was represented by the pedon 4.

Coarse- loamy, mixed, hyperthermic, super active, Typic calcigypsids. Gypsids that have a calcic horizon within 100 cm of the soil surface. (Soil Survey Staff., 2014) with a moderately coarse texture originating from calcareous materials. The texture of its horizons is characterized by its mixture in the upper horizon. Sandy mixture in the rest of the horizons, in which the distribution of lime appears regularly, as it increases with increasing depth. The lands of this series are located within flat lands with a slope of 1% and occupied an area of 55.94 hectares or 38.17% of the total area of the oasis (Table 4) in which *Haloxylon Salicornicum, artemisia herba alba and haioxion*. represented by the pedon 1, pedon 3 and pedon 6. (Figure 2) Coarse loamy, mixed, hyperthermic, super active, Typic Haplocalcids.

It is a level desert soil with a moderately coarse texture and originated from limestone materials. the distribution of lime appears regularly with the depth. Within the flat lands with a slight slope ranging between (1-2%), it occupied an area of 68.30 hectares, with a percentage of 46.61% of the total area of the oasis. (Table 4) represented by pedon 2 and pedon 5 (Figure 2)

Table 3. Soil classification of the study area

order	Sub order	Great group	Sub great group	Family	series	pedons
Aridisols	Gypsids	Petrogypsids	Typic Petrogypsids	Coarse loamy, mixed, hyperthermic, super active topic petrogypsids	132XKM	4
		Calcigypsids	Typic Calcigypsids	Coarse loamy, mixed, hyperthermic, super active, Typic calcigypsids	131CCW	1,3
					133CKW	6
	Calcids	Haplocalcids	Typic Haplocalcids	Coarse loamy, mixed, hyperthermic, super active, Typic haplocalcids	132CCM	2
					122CCW	5

Table 4. Area of Soil classification of the study area

No.	Sub order	series name	Area/hectare	Percentage (%)	pedons
1		G3 131 CCW	33.49	22.85	1,3
	Gypsids	G3 133 CKW	22.45	15.32	6
		G2 132 XKM	22.31	15.22	4
		Sum	78.25	53.39	
2	Calcids	G2 132 CCM	50.88	34.72	2
		G3 122 CCW	17.42	11.89	5
		Sum.	68.30	46.61	
the total area			146.55	100	

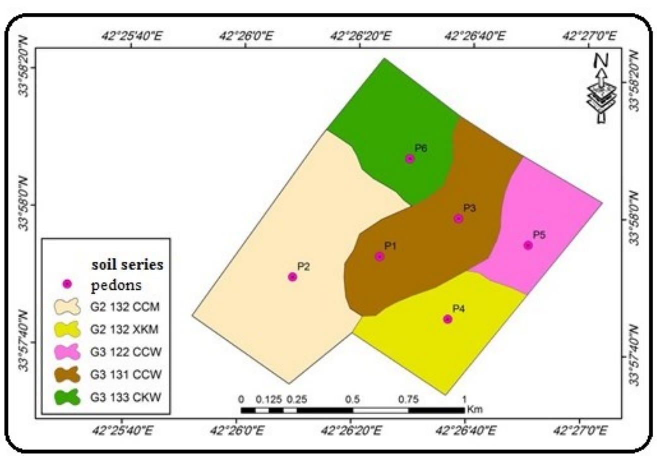

Figure 2. The soil series and locations of the selected pedons Statistical analysis: correlation coefficient

the correlations among the soil properties were calculated using the SPSS program. Most soil properties were significantly positively and negatively correlated with each other. The table.5 shows the correlation among soil properties. All soil properties had no significant correlations with depth. Silicon dioxide (SiO_2) content in all profiles decreased with depth. It strongly resists weathering because it is mainly contained in quartz minerals. With a positive, no significant correlation coefficient of 0.093. Aluminium oxide (Al_2O_3) content in all profiles decreased with depth. It is mainly less resistant to weathering because it contains clay minerals. High content of Al_2O_3 indicates an increased range of clay minerals. (Shan et al., 2010). with a positive correlation coefficient of .086. Iron oxide (Fe_2O_3) content in all profiles decreased with depth. With a negative correlation coefficient of -.096. Potassium Oxide (K_2O) had significant positive correlations with Fe_2O_3 0.47 and SiO_2 0.25 and significant negative correlations with MgO -0.49. SiO_2 had significant positive correlations with Al_2O_3 0.96 and Fe_2O_3 0.51. Calcium Oxide (CaO) had significant negative correlations with Fe_2O_3 -0.58. This situation can be explained by the modifications occurring due to the effects of environmental factors over time . The electrical conductivity (ECe) had significant positive correlations with Na_2O 0.89 and lime content 0.34. and significant negative correlations with bulk density -0.43, clay -0.25, Fe_2O_3 -0.22 and MgO -0.18. Lime had significant negative correlations with Gypsum -0.54 and Fe2O3 -0.39 and significant positive correlations with CaO 0.55. Gypsum had significant negative correlations with silt content -0.65, K_2O -0.52, bulk density -0.51, SiO_2 -0.49, Al_2O_3 -0.47, CaO -0.46 and clay -0.34. The poor K status of soils containing a high percentage of Gypsum and significant positive correlations with Sand content is 0.67 because a gypsic layer can have either a powdery or a sandy appearance, depending on the size of the gypsum crystals, which may vary from 50 to over 2,000 microns. Soil Cations Exchange Capacity content (CEC) had significant negative correlations with CaO -0.49 and MgO -0.37 and significant positive correlations with clay content 0.40 and K_2O 0.49.

Table 5. Pearson's correlation coefficient values show the relationship among the study area soil properties.

properties	Depth cm	SiO_2%	MgO%	CaO%	Na_2O%	K_2O%	Fe2O3%	Al_2O_3%	ECe dSm^{-1}	Lime gkg^{-1}	Gypsum gkg^{-1}	CEC cmolc kg^{-1}	Sand $g.kg^{-1}$	silt $g.kg^{-1}$	clay $g.kg^{-1}$	density
Depth cm	1															
SiO_2%	.093	1														
MgO%	-.205	.126	1													
CaO%	-.215	.171	.078	1												
Na_2O%	-.207	-.126	-.122	.008	1											
K_2O%	.250	.25	-0.49*	-.235	-.105	1										
Fe_2O_3%	-.096	.51*	.170	-.589*	-.115	.47 *	1									
Al_2O_3%	.086	.96 **	.168	.293	-.053	.097	.310	1								
ECe dSm^{-1}	-.034	-.157	-.180	.008	.894**	-.104	-.222	-.076	1							
Lime gkg^{-1}	.116	.151	-.015	.548*	.320	.094	-.396	.293	.345	1						
Gypsum gkg^{-1}	-.064	-.48*	-.052	-.462	-.058	-.518*	-.138	-.473*	.037	-.544*	1					
CECcmolc kg^{-1}	.151	-.136	-.368	-.493*	-.134	.485*	.277	-.172	-.116	-.247	.083	1				
Sand gkg^{-1}	.345	-.356	-.214	-.321	-.025	-.431	-.371	-.292	.164	-.157	.669**	-.075	1			
Silt gkg^{-1}	-.401	.450	.281	.271	.119	.360	.472*	.372	-.101	.087	-.65-**	-.077	-.95**	1		
clay gkg^{-1}	-.131	.041	-.007	.324	-.125	.380	.056	-.005	-.25	.205	-.341	.273	-.73**	.54*	1	
bulk density gcm^{-3}	-.059	-.062	.205	.319	-.345	.209	-.008	-.127	-.432	.214	-.51*	.157	-.49*	.357	.502*	1

.**Correlation is significant at the 0.01 level (2-tailed) .* Correlation is significant at the 0.05 level (2-tailed)

Sand had significant negative correlations with silt content -0.96, clay -0.75, bulk density -0.49, K_2O -0.43, Fe_2O_3 -0.37 and significant positive correlations with Gypsum 0.67. Clay had significant positive correlations with a bulk density of 0.63, silt content of 0.54, and K_2O is 0.45. Silt had significant positive correlations with Fe_2O_3 0.47 and SiO_2 0.45.

Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. It had significant negative correlations with Sand -0.49 and Gypsum -0.51. The low bulk density is due to gypsum's relatively low specific weight. Significant positive correlations with clay were 0.63 and silt 0.36. It is known that the variation in bulk densities results from differences in soil texture. The parent materials are mainly limestone, and concentrations of CaO are seen in the soils. had significant positive correlations with lime 0.55. The CaO content in these soils ranged from 100 to 495 gkg^{-1}.

Statistical Analysis: Descriptive statistics

Descriptive statistics of the soil properties were calculated using the SPSS program for selected soil properties from all study sites are presented in Table 6. Mean, Std. Deviation, Minimum, Maximum and coefficient of variation, Soil properties having a coefficient of variation (CV) between 0 and 15 % are considered least variable, 15 and 35 %, moderately variable, and bigger than 35 % highly variable (Ogunkunle, 1993). Overall, the Spatial variability of soil physical properties of the sites used in this study was high in sand content, with mean sand ranging from 196.0 to 864.0 g kg^{-1}, and highly variable with a coefficient of variation of 37.2%. The silt was the most variable soil separate, ranging from 69.0 to 522.0 g kg^{-1} and highly variable with a coefficient of variation of 53.2%. The sites used in this study were low in clay content, with a mean ranging from 13.0 to 306.0 g kg^{-1}, and highly variable with a coefficient of variation of 55.1%. The sites used in this study were low in bulk density content, with a mean ranging from 1.15 to 1.75 g cm^3, and the least variable with a coefficient of variation of 11.2%. Spatial variability of soil chemical properties of the sites used in this study was high in The electrical conductivity (ECe), ranging from 0.5 to 32.2 dSm^{-1}, and highly variable with a coefficient of variation of 98.3%. Lime content with mean ranging from 10.0 to 49.5 g kg^{-1}, and moderately variable with a coefficient of variation of 26.0%. Gypsum content with mean ranging from 0.0 to 34.0 g kg^{-1}, and highly variable with a coefficient of variation 86.1%. Soil Cations Exchange Capacity content (CEC) with mean ranging from 10.5 to 32.8 cmolc kg^{-1}, and moderately variable with a coefficient of variation of 31.7%. Distributions of all the studied variables of oxide were the least variable, and their means having a coefficient of variation (CV) between 0 and 15 %, except Na_2O and K_2O, which had CV 41.0 and 48.9%, respectively.

Distributions of all the studied variables were lightly skewed (skewness <1) and their means were close to their medians, except Na_2O, SiO2, MgO, ECe and CEC, which skewed with a value of 1.8, 1.2, 3.9, 1.4 and 1.7, respectively.

Table 6. properties mean and coefficient of variation (CV)for selected soil properties

properties	Descriptive statistics							
	Min.	Max.	Mean	Std. Deviation	c.v%	C.V. class	Skewness	Kurtosis
Sand $g.kg^{-1}$	196.0	864.0	554.4	206.0	37.2	+++	-0.3	-1.2
silt $g.kg^{-1}$	69.0	522.0	301.1	160.3	53.2	+++	0.2	-1.7
clay $g.kg^{-1}$	13.0	306.0	138.1	76.0	55.1	+++	0.9	0.6
bulk density gcm^{-3}	1.15	1.75	1.4	0.2	11.2	+	0.0	-0.7
ECe dSm^{-1}	0.5	32.2	8.7	8.6	98.3	+++	1.4	1.8
Lime gkg^{-1}	10.0	49.5	40.6	10.5	26.0	++	-1.6	2.9
Gypsum gkg^{-1}	0.0	34.0	13.3	11.4	86.1	+++	0.2	-1.3
CEC cmolc kg^{-1}	10.5	32.8	16.5	5.2	31.7	++	1.7	4.8
Na_2O	0.1	0.3	0.1	0.1	41.0	+++	1.8	3.1
K_2O	0.2	1.9	0.9	0.4	48.9	+++	0.4	0.3
SiO_2	29.0	35.1	31.5	1.5	4.6	+	1.2	2.1
MgO	4.5	6.6	4.8	0.5	9.5	+	3.9	15.7
CaO	21.9	31.8	26.2	2.5	9.5	+	0.9	0.8
Fe_2O_3	2.7	4.0	3.3	0.4	13.3	+	0.3	-1.3
Al_2O_3	5.3	8.7	6.9	0.8	11.8	+	0.8	1.8

C.V%: coefficient of variation, + least variable, ++ moderately variable, +++ highly variable

Conclusion

The soil of the study area belongs to the zone of arid soils, and It is located at the same soil-forming factors, topography and climate. The soil of the study area was classified into five key soils, By using the Soil Taxonomy classification system. which are differentiated in terms of their areas and their geomorphological location. The parent materials are mostly limestone.

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