Effects of Agricultural Land Use on Desert Soil Classification in Holy Karbala Governorate

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ABSTRACT
This study was conducted to evaluate physical, chemical, and morphological features to classify soils at the subgroup level. The research area, located west of Karbala, consists of three locations, each comprising pedons in both cultivated and uncultivated lands. GPS coordinates were recorded, and morphological descriptions of pedon horizons were made in accordance with the American Soil Survey Manual. This study investigates the effect of agricultural land use on the classification of desert soils in the Holy Karbala Governorate. The results revealed that the dry climate caused diversity in the morphological features of the soils, mainly in horizon type, thickness, and arrangement. Agricultural usage had an impact on diagnostic horizons, particularly the gypsic horizon, and features such as soil color, structure, organic matter, carbonate minerals, gypsum, and root distribution. However, there was no substantial impact on soil texture development, and soils did not show a consistent pattern of soil separation distribution with depth, indicating weak pedogenic processes. The most common texture classes were loamy sand, sandy loam, and sand, with sand contents ranged from 902.08 to 574.12 g kg. Soil bulk density differed from 1.67 to 1.30 Mg m^3, with lower values in farmed areas. Chemical properties were influenced, with soil pH ranging from 8.36 to 7.54, electrical conductivity (EC) from 5.46 to 2.03 dS m, cation exchange capacity (CEC) from 15.25 to 2.05 meq.100g, organic matter from 43.51 to 1.18 g kg, carbonate minerals from 461.18 to 174.06 g kg, and calcium sulfate from 182 to 21 g kg. The soils were classed as Aridisols because they were found in a dry desert with an Aridic moisture regime. The presence of distinctive saline layers such as Calcic and Gypsic was discovered, resulting in the classification of cultivated soils as Typic Haplocalcids and uncultivated lands as Typic Calcigypsids.

1. Introduction

Desert lands of the Holy Karbala Governorate are notable because they are uncultivated and unexploited, making them ideal for growing a variety of crops and vegetables. These lands occupy a large region, accounting for approximately 85% of Karbala's total area. Desert soils have a dry surface and soil particles that are loose and fragile, making them susceptible to erosion. They have a fragile structure and high sand content, particularly in the surface layers, as well as low clay content and organic matter due to limited flora and high temperatures (El-Asmar et al., 2000). Despite the dry climate, desert soils performance as moisture reservoirs, conserving moisture through deposited clays and salts, as opposed to humus in temperate and cold regions.

The Aridisols order dominates dry regions, representing 62.2% of total soil area in Iraq, reflecting the country's environmental circumstances, which include annual rainfall of less than 150 mm and temperatures above 22°C. These soils feature an Aridic moisture regime and a Hyperthermic temperature regime, with low vegetation and carbonate-rich parent materials. These conditions are reflected in soil characteristics, such as poor organic matter content, fragile structure, and salt accumulation in topsoil layers, resulting in saline horizons (Al-Mashhadani, 2018). One pedon, located south of Husn- Al-Ukhaidir in the Karbala Governorate's desert regions, is part of the middle Miocene (Nfayil) formation. The area's geography is nearly flat, with an arid environment and yearly rainfall of less than 100 mm. The parent material is calcareous and gypsiferous, groundwater is deep, and the soil is well-drained and uncultivated. According to studies, the soil texture in horizon A is sandy loam, and the majority of desert soils in western Karbala are classified as Aridisols, with suborders Gypsid and Calcid and great groups Haplogypsid and Haplocalcid (Al-Jubouri, 2012).

Vegetative restoration of desertified areas has generally improved soil parameters, such as bulk density, organic matter content, cation exchange capacity, and nutrient availability (N, P, K) when compared to nearby bare lands (Qi et al. 2015). The type of vegetation cover and land use for agricultural purposes, whether for vegetables or crops, as well as agricultural practices such as tillage, irrigation, fertilization, and pest control, all contribute to the determination and differentiation of soil morphological properties (Al-Askari, 2019).

Reclaiming desert lands for agricultural purposes has a major impact on soil chemical characteristics, increasing bacterial diversity, organic carbon, total nitrogen, and total phosphorus levels following reclamation (Li et al., 2021). Understanding how diverse land uses and geographical locations affect soil physical and chemical qualities is important for sustainable soil management. Most soil physical and chemical qualities are different and lower in cultivated fields, indicating that soil fertility management is essential to ensure agriculture's sustainability in these places. Soil pH, electrical conductivity (EC), and quantities of exchangeable calcium, magnesium, and salt reduced in agricultural areas compared to uncultivated lands (Ibrahim et al., 2023). As a result, the purpose of this work is to create a database for these soils by investigating some of their physical, chemical, and morphological qualities and classifying them at the suborder level.

2. Methodology

Study Area and Location

The research was conducted in the arid lands of the Ain Al-Tamr district, which is situated approximately 50 km from the city center of Karbala, in the western region of the Holy Karbala Governorate. The studied area, which covers approximately 364,000 dunams, is bounded by Al-Hurr district to the east and Al-Anbar Governorate to the other directions. According to Map No. 1 and the satellite image, the geographic:

coordinates are (32° 42′ 3″) N, (32° 7′ 47″) S, (43° 8′ 11″) W, and (43° 44′ 27″) E (Figure 1).

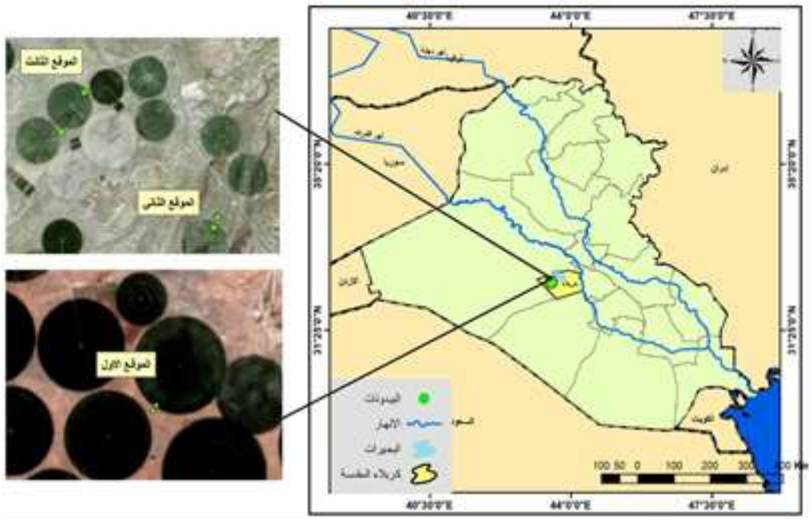

Figure 1. shows the satellite image indicating the locations of the study pedons

Preliminary Procedures

At initial stages, the study area was the subject of data and information collection, previous studies were reviewed, and maps were generated. Identifying the agricultural areas within Ain Al-Tamr district, which was chosen as a representative arid soil area for agricultural use in Karbala, was facilitated by the Directorate of Agriculture in Holy Karbala.

Field Procedures

Pedon locations were chosen using criteria derived from field inspections, data from the Directorate of Agriculture, and information from nearby farmers:

1. Selecting sites in areas of agricultural usage, giving longer-used lands top priority.

2. Choosing spots on pristine, uncultivated land.

The research turned up six pedon sites:

Site 1: Desert area section 20 Island (Ain Khudaira area), 4km southwest of Husn- Al-Ukhaidir, with pedon (1) in agricultural land used for 6 years and pedon (2) in uncultivated land.

Site 2: Desert area section 20 Island (Al-Shakhat area), 7km south of Ain Al-Tamr center, with pedon (3) in agricultural land used for 10 years and pedon (4) in uncultivated land.

Site 3: Desert area with section 20 Island, 5km south of Ain Al-Tamr center, with pedon (5) in uncultivated land and pedon (6) in agricultural land used for 12 years.

Following American Soil Survey Manual criteria, the pedons were excavated and morphologically documented in November 2023; coordinates were recorded using GPS (Soil Survey Division Staff, 1993). Each horizon's two-kg soil samples were gathered, labelled, and kept in plastic bags for chemical and physical study. Based on the 2014 Soil Survey Staff classification, the soils fell into subgroups.

Laboratory Procedures

Soil samples from each horizon were air-dried and carefully crushed with a wooden hammer to retain mineral structure. Sieved with a 2 mm mesh, placed in plastic containers, labeled, and sent for physical and chemical examination.

Physical Properties

Particle Size Distribution: Determined using the hydrometer method described by Bouyoucos (1962) after eliminating binding materials.

Bulk Density: Determined using the paraffin wax coating method for cohesive samples (Black, 1965) and the approach described by Bashour and Saigh (2007) for non-cohesive samples.

Chemical Properties

Soil Reaction (pH): pH was measured in a 1:1 soil-water extract using a pH meter (Page et al. 1982).

Electrical conductivity (EC) is measured using an EC meter (Page et al., 1982).

3. Results and discussion

The morphological description results of the research region pedons revealed a relative variation in characteristics due to similar environmental circumstances and the majority of soils in the area having the same mother material. Agricultural land use, although its short duration, had an effect on the prevalence of diagnostic horizons. Non-agricultural pedons had a gypsic horizon, whilst uncultivated pedons had calcic and gypsic horizons. In contrast, only the calcic horizon was discovered in cultivated pedons, illustrating how agricultural operations influence horizon formation, particularly the dissolution and downward transit of gypsum in cultivated areas.

Color, soil structure, and texture/consistency were the primary morphological parameters considered.

- Stickiness, root and horizon borders.

Calcareousness, gypsum content, and gravel presence are all field-diagnosable morphological features Table (1 and 2)

The following is a morphological description of the research region pedons

Table 1: Pedon Descriptions of Typic Haplocalcids and Typic Calcigypsids Soils in Karbala, Iraq

Pedon No.	**1**	**2**	**3**	**4**	**5**	**6**
Classification	Typic Haplocalcids	Typic Calcigypsids	Typic Haplocalcids	Typic Calcigypsids	Typic Haplocalcids	Typic Calcigypsids
UTM	38 s 366618 X 3585955 Y	38 s 366608 X 3585938 Y	38 s 363395 X 3596341 Y	38 s 363442 X 3596449 Y	38 s 362385 X 3597445 Y	38 s 362074 X 3597012 Y
Location	Karbala - south of Kasr	Karbala - south of Kasr AL-	Karbala - about (7km)	Karbala - about (7km) south of	Karbala - about (5km) south of	Karbala - about (5km) south of

	AL-Akhider about (4km).	Akhider about (4km).	south of Ain AL-Tamur.	Ain AL-Tamur.	Ain AL-Tamur.	Ain AL-Tamur.
Topography	Nearly level	Nearly level	Nearly level	Nearly level	Nearly level	Nearly level
Elevation	62 m above sea level	62 m above sea level	82 m above sea level	82 m above sea level	75 m above sea level	75 m above sea level
Land Use	Planted	Fallow	Planted	Fallow	Planted	Fallow
N.Vegetation	The land is planted with wheat	Brassica Arvensis, Artemisia Scoporia, Achillea Fragranti	The land is planted with wheat	Alhagimaurorum, Artemisia Scoporia, Tamarix sp.	The land is planted with wheat	Alhagimaurorum, Prosopis farcta, Tamarix sp., Artemisia Scoporia
Climate	Arid	Arid	Arid	Arid	Arid	Arid
Parent Material	Calcareous gypsiferous alluvium	Calcareous gypsiferous alluvium	Calcareous alluvium	Calcareous alluvium	Calcareous alluvium	Calcareous alluvium
Drainage	Excessively well drainage	Excessively well drainage	Excessively well drainage	Excessively well drainage	Good drainage	Good drainage
G.W.D	Deep	Deep	Deep	Deep	Deep	Deep
Date	25-11-2023	25-11-2023	26-11-2023	26-11-2023	28-11-2023	28-11-2023

Table 2: Soil descriptions of six pedons (1-6)

Horizon	Pedon	Depth (cm)	Soil Descriptions
Ap	1	0-18	Yellowish brown 10YR 5 6 (d) to Dark Yellowish brown 10YR 4 6 (m); loamy sand; weak very fine crumb; friable (d), very friable (m), slightly sticky and non-plastic (w); many fine, medium, and coarse roots; clear smooth boundary.
Bk1	1	18-40	Brownish Yellow 10YR 6 6 (d) to light Yellowish brown 10YR 6 4 (m); loamy sand; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); few fine roots; clear smooth boundary.
Bk2	1	40-58	Brownish Yellow 10YR 6 6 (d) to Yellowish brown 10YR 5 6 (m); loamy sand; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); no roots; accumulation of lime as powder with many small gravel; clear smooth boundary.
Bk3	1	58-90	Yellow 10YR 7 6 (d) to brownish Yellow 10YR 6 8 (m); loamy sand; structureless, single grain; friable (d), very friable (m), non-sticky and non-plastic (w); no roots; accumulation of lime as powder with many small gravel; clear smooth boundary.
Ck	1	90-120	Very pale brown 10YR 8 4 (d) to brownish Yellow 10YR 6 8 (m); loamy sand; structureless, single grain; friable (d), very friable (m), non-sticky and non-plastic (w); no roots; accumulation of lime as powder with many gravel (5-50mm) diameter.
A	2	0-20	Brownish yellow 10YR 6 6 (d) to Yellowish brown 10YR 5 6 (m); loamy sand; weak very fine crumb; friable (d), very friable (m), slightly sticky and non-plastic (w); few fine roots; clear smooth boundary.
Bky1	2	20-50	Brownish Yellow 10YR 6 8 (d) to Yellowish brown 10YR 5 8 (m); loamy sand; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); few very fine roots; many small gravel; clear smooth boundary.
Bky2	2	50-70	Brownish Yellow 10YR 6 8 (d) to brownish Yellow 10YR 6 6 (m); loamy sand; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with few small gravel; clear smooth boundary.
Cky1	2	70-90	Yellow 10YR 7 6 (d) to brownish Yellow 10YR 6 6 (m); sand; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many small gravel; clear smooth boundary.
Cky2	2	90-112	Very pale brown 10YR 7 4 (d) to brownish Yellow 10YR 6 8 (m); sand; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w);

			no roots; many gravel (5-50mm) diameter.
Ap	3	0-19	Yellowish brown 10YR 5 8 (d) to Yellowish brown 10YR 5 6 (m); sandy loam; weak very fine crumb; friable (d), very friable (m), slightly sticky and non-plastic (w); many fine, medium, and coarse roots; few 5-70mm diameter rock fragments (gravel) on soil surface; clear smooth boundary.
Bk1	3	19-55	Brownish Yellow 10YR 6 8 (d) to brownish yellow 10YR 6 6 (m); sandy loam; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); few fine roots; few small gravel; clear smooth boundary.
Bk2	3	55-85	Yellow 10YR 7 6 (d) to brownish yellow 10YR 6 8 (m); loamy sand; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many small gravel; clear smooth boundary.
Ck	3	85-120	Yellow 10YR 8 6 (d) to brownish Yellow 10YR 6 6 (m); sandy loam; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many gravel (5-70mm) diameter.
A	4	0-17	Brownish yellow 10YR 6 6 (d) to Yellowish brown 10YR 5 8 (m); sandy loam; weak very fine crumb; friable (d), very friable (m), slightly sticky and non-plastic (w); few fine roots; few 5-70mm diameter rock fragments (gravel) on soil surface; clear smooth boundary.
Bky	4	17-63	Yellow 10YR 7 8 (d) to brownish yellow 10YR 6 6 (m); loamy sand; weak very fine sub angular blocky; friable (d), very friable (m), non-sticky and non-plastic (w); few very fine roots; accumulation of gypsum nodes with many small gravel; clear smooth boundary.
Bk	4	63-93	Yellow 10YR 7 8 (d) to brownish yellow 10YR 6 6 (m); loamy sand; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many small gravel; clear smooth boundary.
Cky	4	93-120	Yellow 10YR 7 6 (d) to Yellowish brown 10YR 5 8 (m); sandy loam; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many gravel (2-70mm) diameter.
Ap	5	0-20	Yellowish brown 10YR 5 8 (d) to Yellowish brown 10YR 5 6 (m); sandy loam; moderate fine granular; friable (d), very friable (m), sticky and non-plastic (w); many fine, medium, and coarse roots; clear smooth boundary.
Bk1	5	20-65	Brownish Yellow 10YR 6 6 (d) to light yellowish brown 10YR 6 4 (m); sandy loam; weak very fine sub angular blocky; friable (d), very friable (m), slightly sticky and non-plastic (w); few fine roots; clear smooth boundary.
Bk2	5	65-95	Yellow 10YR 7 6 (d) to brownish yellow 10YR 6 6 (m); sandy loam; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with few small gravel; clear smooth boundary.
Ck	5	95-120	Yellow 10YR 7 8 (d) to brownish Yellow 10YR 6 6 (m); sandy loam; structureless, single grain; hard (d), friable (m), non-sticky and non-plastic (w); no roots; accumulation of gypsum nodes with many gravel (2-25mm) diameter.
A	6	0-10	Brownish yellow 10YR 6 8 (d) to Yellowish brown 10YR5 8(m); sandy loam; weak very fine crumb ; friable (d) ,very friable (m) , slightly sticky and non plastic (w); few very fine roots; many 5-70 mm diameter rock fragments (gravel)on soil surface ; clear smooth boundary.
Bky1	6	10 - 48	Very pale brown 10YR 8 4 (d) to yellow 10YR7 8(m); sandy loam; structure less , single grain ; hard (d) , friable (m) , non sticky and non plastic (w); no roots; accumulation lime as powder with many small gravel ; clear smooth boundary.
Bky2	6	48 - 88	Yellow 10YR 8 6 (d) to yellow 10YR7 6(m); sandy loam ; structure less , single grain ; hard (d) , friable (m) ,non sticky and non plastic (w) ; no roots ; accumulation of gypsum nodes with many small gravel ; clear smooth boundary.
Bky3	6	88 - 110	Yellow 10YR 7 8 (d) to Yellow10YR7 6(m); sandy loam; structure less , single grain ; hard (d) , friable (m) ,non sticky and non plastic (w) ; no roots

			; accumulation of gypsum nodes with many gravel (2-50mm) diameter.

Morphological Characteristics of the Study Area Pedons:

The morphological description results of the research area pedons' horizons usually revealed that agricultural use had an impact on various soil morphological traits, particularly in the surface and subsurface layers. The thickness of the surface and subsurface horizons in pedons from agricultural areas differed across all study locations, ranging from 0-18 cm to 0-20 cm for the surface horizons and 18-40 cm to 20-65 cm for the subsurface horizons. In contrast, the thickness of the surface and subsurface horizons in pedons from uncultivated areas ranged from 0 to 20 cm in the surface horizons and 10-48 cm to 17-63 cm in the subterranean horizons, respectively.

The results revealed that the soil color in all pedon strata had a wavelength of 10YR, indicating a shift in soil color in the research region pedons. The soil color in agricultural pedons varied from yellowish-brown when dry to dark yellowish-brown when moist. The soil color in pedons from uncultivated fields varied from dark yellow when dry to yellowish-brown when damp. The soil texture in all pedon layers was sandy, sandy loam, or loamy sand.

The results also revealed a minor impact of agricultural use on soil structure, owing to the short duration of this usage, particularly in the surface and subsurface horizons of the study area pedons. The surface horizons of the pedons from agricultural fields ranged from medium fine granular to very weak fine granular, whereas the subsurface horizons ranged from very weak fine angular blocky. In contrast, the pedons from uncultivated fields had soil structure ranging from extremely weak fine granular in the surface horizons to structureless single grain in the subterranean horizons. Soil consistency and stickiness were loose in the dry state, very loose in the damp state, low in stickiness, and non-plastic in the wet condition in the surface and subsurface horizons of agricultural pedons. The consistency and stickiness of the pedons from uncultivated lands were solid in the dry state, very loose in the moist state, low in stickiness, and non-plastic to non-sticky and non-plastic in the surface and subsurface horizons, respectively.

The results revealed that agricultural usage influenced the number and size of roots in both the surface and subsurface horizons. There were many and varied roots in the surface strata, but only a few and fine roots in the subsurface horizons of agricultural pedons. In contrast, the roots were few and fine in the surface strata and extremely few, very fine, and rootless in the subsurface horizons of uncultivated pedons. The impact of agricultural use on some morphological characteristics of pedons in agricultural lands in the study area is due to management practices and field operations, such as tilling, irrigation, fertilization, crop residue presence, soil microorganism activities and secretions, as well as root secretions and organic matter accumulation. This influenced the development of various morphological soil properties in the surface and subsurface horizons of the pedons in the study region, including soil depth, soil color, and root number and size, along with minor changes in soil structure, consistency, and stickiness. This agrees with Henderson et al. (1989) and Al-Askari (2019).

Physical Estimates:

The mechanical examination results of the soil samples from the study area pedons, shown in Table (3), revealed that there was no unique pattern of soil separation distribution with depth in the study area pedons. This represents the weak pedogenic processes that generate clay accumulation horizons as a result of arid conditions, the nature of the calcareous material, and the soils' limited agricultural usage. In all research areas, sand was the dominant material, followed by silt and clay. Sand concentration ranged from 574.12 to 902.08 g kg, silt content from 32.64 to 399.84 g kg, and clay content from 53.04 to 93.84 g kg throughout all soil strata. Soil textures were loamy sand (46.154%), sandy loam (46.154%), and sand (7.692%). These results were consistent with the results of Abd et al. (2017), Al-Ghanami (2017), Al-Shammari (2020), and Al-Awadi (2020). Bulk density measurements ranged from 1.30 to 1.67 Mg/m^3. In all study sites, bulk density values in pedons from agricultural lands decreased significantly, which was consistent with the results of Beit Al-Mal

(2010) and Akram and Abdul Ghafour (2022).

Table 3. Physical Characteristics of Soil Pedons in the Study Area

Bulk Density (Mg m³)	Texture	Sand (g kg)	Silt (g kg)	Clay (g kg)	Depth (cm)	Horizon	Land Use
1.4	Loamy Sand	791.92	155.04	53.04	0 - 18	Ap	Cultivated Land
1.43	Loamy Sand	771.52	175.44	53.04	18 - 40	Bk1	
1.48	Loamy Sand	800.08	146.88	53.04	40 - 58	Bk2	
1.36	Loamy Sand	832.72	114.24	53.04	58 - 90	Bk3	
1.48	Loamy Sand	853.12	93.84	53.04	90 - 120	Ck	
1.65	Loamy Sand	779.68	167.28	53.04	0 - 20	A	Uncultivated Land
1.61	Loamy Sand	812.32	134.64	53.04	20 - 50	Bky1	
1.57	Loamy Sand	873.52	53.04	73.44	50 - 70	Bky2	
1.67	Sand	893.92	32.64	73.44	70 - 90	Cky1	
1.52	Sand	902.08	44.88	53.04	90 - 112	Cky2	
1.37	Sandy Loam	547.12	399.84	53.04	0 - 19	Ap	Cultivated Land
1.37	Sandy Loam	628.72	292.84	73.44	19 - 55	Bk1	
1.52	Loamy Sand	791.92	155.04	53.04	55 - 85	Bk2	
1.54	Sandy Loam	689.92	236.64	73.44	85 - 120	Ck	
1.4	Sandy Loam	567.52	338.64	93.84	0 - 17	A	Uncultivated Land
1.33	Loamy Sand	779.68	167.28	53.04	17 - 63	Bky	
1.4	Loamy Sand	779.68	167.28	53.04	63 - 93	Bk	
1.36	Sandy Loam	730.72	195.84	73.44	93 - 120	Cky	
1.3	Sandy Loam	616.48	330.48	53.04	0 - 20	Ap	Cultivated Land
1.34	Sandy Loam	616.48	330.48	53.04	20 - 65	Bk1	
1.35	Sandy Loam	689.92	236.64	73.44	65 - 95	Bk2	
1.35	Sandy Loam	677.68	269.28	53.04	95 - 120	Ck	
1.39	Sandy Loam	751.12	175.44	73.44	0 - 10	A	Uncultivated Land
1.37	Loamy Sand	861.28	85.68	53.04	Oct-48	Bky1	
1.37	Sandy Loam	718.48	208.08	73.44	48 - 88	Bky2	
1.33	Sandy Loam	710.32	216.24	73.44	88 - 110	Bky3	

The chemical estimations:

Table (4) shows the chemical analysis results of soil samples from pedon layers in the research region, which revealed pH values ranging from 8.36 to 7.54, agreeing with (Al-Ghazali, 2018). The EC values ranged between 5.46 and 2.03 dS m, which is consistent with Al-Khazai (2018). The CEC values ranged from 15.25 to 2.05 cmol kg soil, which is consistent with the results of (Al-Rafai and Al-Azzami, 2000; Al-Azzami, 2006). Organic matter values varied from 43.51 to 1.18 g kg, which corresponds to the results of both (Al-Ghanemi, 2017) and (Al-Shammari, 2020). Carbonate minerals also revealed substantial variance, ranging from 461.18 to 174.06 g kg, which is consistent with the results of Al-Ghazali (2018). Calcium sulfate levels varied from 182 to 21 g kg.

Table 4. Chemical Properties of Soils pedon in the Study Area

O.M gm kg^{-1}	Carbonats gm kg^{-1}	Gypsum gm kg^{-1}	CEC meg 100g	EC $ds.m^{-1}$	pH	Depth cm	Horizon	Land use
43.51	331.98	81.3	6.55	2.22	7.81	0 - 18	Ap	Cultivated Land
11.73	401.96	96.3	6.03	2.2	8.09	18 - 40	Bk1	
13.67	421.58	88.8	7.57	2.28	8.16	40 - 58	Bk2	
13.78	398.68	61.4	7.73	2.22	7.99	58 - 90	Bk3	

7.52	207.28	82	6.48	2.17	7.93	90 - 120	Ck	
7.19	425.24	61.3	6.02	2.1	8.24	0 - 20	A	Uncultivated Land
5.82	385.32	132	8.06	2.16	8	20 - 50	Bky1	
4.91	380.78	143.5	6.02	2.29	7.6	50 - 70	Bky2	
8.25	184.56	141	7.88	2.22	7.6	70 - 90	Cky1	
9.51	196.62	182	6.66	2.03	8.13	90 - 112	Cky2	
16.99	370.38	54	11.31	2.8	7.56	0 - 19	Ap	Cultivated Land
14.07	435.98	65.5	11.33	2.4	8.04	19 - 55	Bk1	
11.31	397.26	67.6	7.76	2.2	7.99	55 - -85	Bk2	
9.83	334.68	72.1	9.65	2.29	7.66	85 - 120	Ck	
15.21	352.22	105.6	11.09	2.6	8.07	0 - 17	A	Uncultivated Land
6.27	225.82	162.5	7.83	3.4	8.12	17 - 63	Bky	
1.18	359.36	72	7.76	2.57	7.96	63 - 93	Bk	
11.23	174.06	68	2.05	2.6	7.97	93 - 120	Cky	
11.08	352.42	41.5	10.33	2.65	7.72	0 - 20	Ap	Cultivated Land
10.97	461.18	21	15.25	2.95	7.89	20 - 65	Bk1	
9.44	417.06	32	11.62	2.8	7.54	65 - 95	Bk2	
9.19	180.46	26	10.3	3.02	7.95	95 - 120	Ck	
8.97	434.62	152	9.96	2.25	7.84	0 - 10	A	Uncultivated Land
7.57	371.5	132.6	6.24	3.63	8.36	10.- 48	Bky1	
10.83	357.58	127.8	9.82	4.12	8.28	48 - 88	Bky2	
9.85	371.12	173.3	13.91	5.46	8.21	88 - 110	Bky3	

Classification of the Study Area Soils:

According to the results of the morphological description, as well as the physical and chemical qualities, the soils in the research area belong to the group Aridisols (Soil Survey Staff, 2014). This classification is based on their location in an arid desert area with an Aridic moisture regime. The results also revealed the presence of diagnostic horizons, such as the Calcic and Gypsic horizons. These horizons are distinguishing characteristics of Aridisols, and they were utilized to categorize lower taxonomic entities at the suborder and great group levels.

The Calcic horizon was found to be dominant in cultivated soils, indicating favorable conditions for its production by calcium carbonate leaching downhill under moderately moist conditions, which was aided by irrigation activities. In contrast, cultivated land did not have a gypsic horizon due to projected gypsum leaching and downward movement. In contrast, both Calcic and Gypsic layers were clearly present in uncultivated land, indicating that they had not been disturbed and that there was enough water to prevent gypsum from leaching. Based on these outcomes, developed soils were classed as Typic Haplocalcids, and uncultivated lands as Typic Calcigypsids.

4. Conclusion and future scope

The results clearly show that agricultural land usage has a considerable impact on many soil characteristics, leading to enhanced characteristics. The morphological, physical, and chemical features of the soils in the research area all suggested that they belonged to the Aridisol order. Diagnostic saline horizons, such as the Calcic horizon in cultivated areas and the Gypsic horizon in uncultivated lands, are distinguishing characteristics used to classify Aridisols at lower taxonomic levels. Thus, cultivated soils were classed as Typic Haplocalcids, and uncultivated soils as Typic Calcigypsids.

Conflict of interest

The authors have no conflict of interest.

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