Plant Archives Vol. 19, Supplement 1, 2019 pp. 859-869 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

CHARACTERISTICS AND CLASSIFICATION OF SOIL POTENTIAL FOR AGRICULTURE IN THE TASH DISTRICT WITHIN THE DRY AGRICULTURAL ZONE IN ANBAR PROVINCE OF IRAQ

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Abstract

This study was conducted to identify the main soil characteristics and the classification and assessment of the Tash district of Al-Warar River in Al-Anbar province. The study area is located in the south-east part of Ramadi city in Al-Anbar province. This study can be considered as a scientific and logical basis for any successful agricultural development project to achieve this goal, the main physical and chemical properties, as well as the state of nutrients in different soil types, were identified in these areas through a descriptive and analytical study of five representative dyes and a number of specimens to determine the limits of soil units by using method of free scanning mode (Damien free-lance). The study area is located between longitudes (43° 14'55.48", 43° 15'33.20") at the east and latitude (33° 21'21.44", 33° 23'42.60") to the north. The study area was about 2256 square hectares and it considered a connection point between Al Ramadi city and the desert areas. The GIS mapping system was used as well as the use of Lands at satellite images and digital elevation maps to determine the physiology of the area. Soil analysis results showed that the soil of the study area was distributed between coarse tissue (sandy soil, mixing sand and sand mix), medium (sandy mud) and soft (clay and mud). These soils formed and developed on different originals of sediments and desert formations of nature Lime and silicates in different environmental conditions, as well as salinity distribution in the study area between non-saline and moderately saline. The soil classification of the area of the study was carried out in the US Soil Survey Staff, 2014. The results indicated that the soil of the study area belongs to the arid soils and subgroup (Typic calcigypsids - Haplogicids). The present study aims to assess the state of the agricultural potential of the area and its agricultural abilities using the California Storie Index (1973). The results showed that most of the soils have limitations represented in soil salinity, rock spread on the surface and limestone as well as determinants of fertility and lack of nutrients and the severity of some parts of that region, and found that the soil area of the study belong to two levels of agricultural ability as follows:

- The third category (III) is moderate (Fair) and occupies an area of 1157.3 ha and 48.7% of the area of study area in the piedons represented 4.2.
- The fourth category IV Poor among the 1,300 square meters represented by the area of 1157.7 square meters, or 51.3% of the total area studied.

Key words: Tash District, Agricultural Development, Land ability, Water Quality-Ramadi.

Introduction

Iraq is characterized by geographical diversity and divided into four main regions, the desert (West Euphrates), the island (between the Upper Tigris and the Euphrates), Lower Mesopotamia, and the sedimentary plain which extending from Tikrit city to the Arabian Gulf. The development process in general, including sustainable agricultural development, requires successful management methods that to increase productivity while preserving the land from the processes of degradation accompanying with different uses of lands in order to achieve self-sufficiency of the country. This process needs to know the land resources and their agricultural potential through conducting operations survey of soil conditions. Soil surveys play an important role in this area to implement the administrative programs related to soil through a series of overlapping processes that include classification of soil and its evaluation for different purposes. The assessment of soil potential was the greatest concern for soil science, and the current study was conducted to assess the potential of soil in the province of Tash and its extension of desert, due to the availability of water resources.

Dent and young, (1981) demonstrated that the concept of land covers all elements of the physical environment that influence the possibility of using the earth. The earth refers not only to the soil but also includes all other components such as geology, soil, climate, hydrology, Biological and past and present human activities. Scherr, 1999, pointed that the World Food Policy Research Institute (IFPRI) presented a bleak outlook on global food production and the rate of increase in global food production between 1995-2020 predicted to be 1.5% per year, an increase not commensurate with the observed increase in the demand for food as a result of the growing population growth, which draws on the various specialists, including researchers in the field of soil science to devise appropriate solutions in the management, conservation of soil and sustainability as one of the ground resources and then develop its productive capacity. As a result of the serious climate and environmental changes facing humanity, the continuous increase in population growth and the unsustainable exploitation of the land has led to the deterioration of large areas of land in the world in general and Iraq in particular. Therefore, the incidence of degradation and desertification has increased continuously until the proportion of land affected by all forms of desertification reached to 92.5% of the total area of Iraq (ACSAD, 2004).

Gad, (2015) classified the land ability of some western desert oases in Egypt, using remote sensing and GIS, two desert oases (Kharga oasis and Dakhla) located in the western desert of Egypt. Soil characteristics data, ETM + satellite imagery, and climate database were integrated into the GIS model. The Digital Elevation Model (DEM) was developed using SRTM satellite images, as well as altitude and contour lines, derived from topographic maps. The ground resources database established for land-based assessment and mapping was used under FAO (1985). The obtained data indicated that the high ability soil accounts for 24.5% of the oases and 19.2% of the oasis of Dakhla. This soil was associated with the major groups Haplotorrerts and Typic Torrifluvents. The soil with medium capacity is 1.5% of the total area of Al Kharga oasis and 6.1% of Al Dakhla Oasis. It was found to be associated with Typic Torriurents. The low ability soils represent 36.0% of the total area of the Kharga oasis and 20.3% of the oasis of Al Dakhla oasis and associated with Torripsamments group, and the rest of the oases are considered unsuitable for being rocky land, representing 38.0% of the total area of the oasis of Kharga and 54.5% of the oasis of Dakhla and concluded that desert oases are sustainable areas, which may have potential importance in supporting national development programs in addition to the importance of using the information system Remote sensing data with digital soil map.

Road *et al*. (2016), studied the province of Shuswap in Colombia and showed that the classification of the agricultural potential of the studied cultivars was in Class 5 because there were determinants in the topography, low water retention capacity and negative soil traits, as well as stoniness. Any improvements to these soils are useless for the severity of the determinants, which are affecting the capacity of the soil and limited agricultural production, except the cultivation of some types of feed and use for seasonal grazing, and any improvements to agricultural suitability was not practical. Additionally, the land suitability and capacity by integrating remote sensing and GIS in agriculture in Chamarajanagar, Karnataka in India were assessed (Abdul Rahman *et al*. (2016). The objectives of this study were to develop a GIS approach to assess the suitability of land use to help land managers and land use planners to identify areas with determinants for a range of land-specific uses. Geographical soil survey data and fieldwork observations were integrated into the assessment of land-use suitability based on geographic information systems for agricultural planning. Geographical information systems were used to match the suitability of major crops based on crop requirements and the quality and characteristics of the soil, which means soil tissue, depth, erosion regression Floods and the rocky spread of land units were estimated. All these models were combined using a series of logical processes to create suitable maps for land and portability. The degree of relevance and applicability of each land use was developed to illustrate the degree of suitability and the spatial representation of soil suitable for agriculture.

Atalay, (2016) has examined a new approach to classify land susceptibility in Turkey and detected that landability classification is one of the important issues in terms of sustainable land use. The criteria to be considered were topography, slope, soil characteristics, geomorphology of the region, climate, and origin which are factors to be taken into account and in order to establish a scalability classification in Turkey. In accordance with these criteria, (D) substandard cultivars according to the originals of the origin and spread within the mountain regions of Turkey. Silva *et al*. (2016) selected Ollukara Block Panchayat in Thrissur to study the classification of land ability into varieties according to criteria (1973, IS: 6748 (Part I)) (Watershed Conservation Management Recommendations, Indian Standards Office, 1973) and it was found that the area consists of five varieties of susceptibility: II, III, IV, VI and VII, and that the sixth and seventh varieties are not suitable for agriculture. The second, third, and fourth varieties were suitable for agriculture. The third category represents 28.35% of the area. The study recommended appropriate care for the study area in terms of water management, as the area was far from agricultural exploitation. Furthermore, Al Turkumany *et al*. (2017) pointed that drought has become one of the most important problems and dangers facing many countries, especially the poor countries because of their economic and scientific inability to face it and with climate changes Climatic Changes increased the desert land, and the soil was exposed in arid areas to the deterioration of physical and chemical properties, which led to the loss of plant life and biodiversity therefore, the inability of the soil on agricultural production and support for animal and human life, which is known as desertification and this problem turned into a threat for many countries of the world. Water is an important environmental resource and the backbone of any agricultural or social development. Planning is the first step in dealing with water resource issues either in response to urgent needs and meeting future needs and real agricultural development. The field study was conducted in 2017-2018 after the return of the stability of the security situation that occurred in those areas, where samples were collected representative of the soil and groundwater available, which will be used in irrigation to conduct the necessary analyzes for this purpose, the main objective of this study is to know its potential for agricultural use In order to bridge the food gap in Anbar province in particular, and Iraq in general. The importance of the location of the study area and the availability of water and soil of good quality for the development and agricultural exploitation in these areas, biodiversity, physiography and geomorphology and its proximity to transportation methods were chosen to carry out this study. This study is summarized as follows:

- Conducting a semi-detailed survey of soil from the Euphrates River and south to the desert plateau.
- Classification of the soil area of the study under the classification of the US Department of Agriculture 2014.
- Assessment of water quality for agricultural use in the study area.
- Classification of land units according to their potential and their applicability to agricultural use.

Materials and Methods

General Description of Study Sites

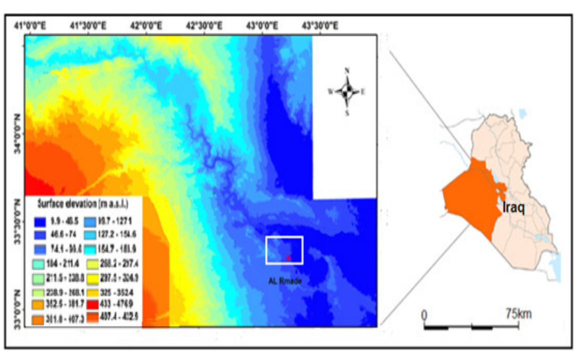

Fig. 1 : The digital height model for a part of Anbar province shows the height of the selected areas of study compared to sea level (Source: Digital elevation model (DEM) (2011) The shuttle radar topography mission, of western desert of Iraq

Study areas are located in the western part of Iraq and a physiography within the main unit: (Desert - the Northern Badia). The topography of the region is generally flat, interspersed with some valleys. The height of the region ranges from 51 to 63 meter above the sea level. Figure. 1 representing the digital elevation model. The lands of this region were formed of successive calcareous and gypsum deposits in their strata (Buringh, 1960).

Field work

A semi-detailed survey of the area of 2256 square hectares was conducted. Four representative handouts were selected. Each geographical location was identified using a Garmin's GPS 72 personal navigator, which was manufactured in Taiwan. The land was chosen for scientific, technical and economic reasons. Morphological Morphology and Geomorphological Interpretation The perspective and topographical features allowed by the field movement adopted the free-lance soil survey method, which uses the method of investigating the effects of soil factors and processes as well the associated differences in field-specific characteristics, Topography, natural vegetation, salinity, color, and nature of exploitation, leading to the diagnosis of soils. This method was the best soil survey method currently available in the field of survey work, after locating the field pidons at each point of examination. Piedon revealed the representative, a person and a field description based on the Soil Survey Staff (2000), and then obtained earth samples from the horizons that were characterized. Figure (2) shows the soil of the sites of piedons and wells studied for the sites. Fieldwork requires the following equipment and supplies:

Maps - Topography - Geomorphology - Space images (2018 CNES / Airbus -Digital Globe) - GPS module, compass - Soil Survey Staff (1993) - Soil Taxonomy Guide - Manual description Mud color Munsell - Shovel, Ax, Auger hole - Hammer - pH-knife - Hand bag (x10) - Transparent plastic bottles - Nylon bags and soil samples.

Laboratory Tests

The following measurements were performed after drying the samples of the horizons

Physical measurements

1. The following physical measurements were estimated according to the methods in Black *et al.* (1965) as follows:

- Perform mechanical analysis in a hydrometer method and determine the soil texture using soil texture triangle.

2. Chemical analysis

1. The following characteristics were estimated according to the methods in Richards (1954) as follows:

- Electrical conductivity (ECe) using a saturated soil paste extract according to paragraph a/2.
- Soil reaction (pH). Using the glass pole in the saturated soil paste extract according to paragraph b/2.
- The exchange capacity of positive ions. It was estimated by displacement of sodium oxides with a reaction rate of 8.2 and replacing ammonium with sodium as per paragraph (19)
- Reciprocal ions. Estimated by paragraph (18)
- Saturation ratio. Estimated according to paragraph (20a) as follows:
  Saturation ratio = total of positive cores/100 x CEC

2. Equivalent of total carbon minerals. Piper (1971) was estimated by comparing it with 1 HCl and retrograde with 1 NaOH.
3. Soil content of organic matter. Estimated in Wackily and Black in Jackson (1958)
4. Gypsum content of the soil. The sedimentation method was estimated according to the method proposed by Zubaidi *et al.* (1980) using a mixture of 80% acetone with 20% acetic acid and a few drops of calcium nitrate contained in Rahi et al (1991).
5. The exchange capacity of positive ions for the clay fraction. Estimated according to the method (Savant, 1994) according to the following equation:
   Apparent CEC = (CEC soil / Clay%) x 100

Table 1: Irrigation water quality criteria according to the World Food Organization (Ayers, Westcot, 1989)

Potential Irrigation Problem	Units	Degree of Restriction on Use		
		None	**Slight Moderate**	**to Severe**
Salinity (affects crop water availability) ECw (or) TDS	dS/m mg/l	<0.7	0.7-3.0	**>3.0**
Infiltration (affects Infiltration rate of water into the soil. Evaluate using ECw and SAR(sodium adsorption ratio, RNa) together)				
SAR = 0-3 and ECw =		<0.7	0.7-2.0	**<0.2**
= 3-6 =		<1.2	1.2-0.3	**<0.3**
= 6-12 =		<1.9	1.9-0.5	**<0.5**
= 12-20 =		<2.9	2.9-1.3	**<1.3**
= 20-40 =		<5.0	5.0-2.9	**<2.9**
Specific Ion Toxicity (affects sensitive crops)				
Sodium (Na)				
Surface irrigation	SAR	<3.0	3.0-9.0	**>9.0**
Sprinkler irrigation	me/l	<3.0	>3.0	
Chloride (Cl)				
Surface irrigation	me/l	<4.0	4.0-10.0	**>10.0**
Sprinkler irrigation	me/l	<3.0	>3.0	
Boron(B)	me/l	<0.7	0.7-3.0	**>3.0**
Trace Elements				
Miscellaneous Effects (affects susceptible crops)				
Nitrogen (NO_3-N)	me/l	<5.0	5.0-30.0	**>30.0**
Bicarbonate(HCO_3)(overhead sprinkling only)	me/l	>1.5	1.5-8.5	**>8.5**
PH	**Normal Range 3.0-9.0**			

In this study, water samples were collected from 4 wells in the study area and drilled at depths of 15-40 cm in 1.5 liter sealed plastic bottles. They were transferred to the laboratory where they were subjected to chemical analyzes under APHA (1995) Standard. The analysis of the water samples and the determination of: the degree of reaction, PH - electrical conductivity EC - dissolved soluble salt, dissolved sodium and potassium - dissolved magnesium - dissolved sulphates - dissolved chlorine - carbonates and dissolved bicarbonates - dissolved nitrates-boron and ASR. Irrigation water quality criteria according to FAO, Ayers, Westcot (1989, 1976) were used for their validity for agricultural use (Table 1).

Study of Natural Land Resources

Natural land resources included climate, natural vegetation, the origin and geological composition of the region. A preliminary analysis of the information available for the study areas was carried out to highlight the factors involved in soil composition of the areas under study.

Climate Study Area

The climate is an effective and fundamental factor in determining the appropriateness of land for different uses, especially agricultural ones. According to the available climate information for the Ramadi Aerial Station (climate-data.org-2018), the climate of the study area is arid desert with a hot summer of high evaporation and wet winters. The average monthly temperature during the year was 22.3 m (Table 2).

The average temperature for June, July and August is 33.1 ºC in Ramadi. While the average temperature for the winter months (December, January and February) reached 10.9 ºC. Table 2 shows that the highest monthly temperature was recorded in July, while the lowest monthly temperature was in January, and that the lowest monthly mean temperature was 3.7 ºC. While the highest value of the monthly average of the maximum temperatures recorded in the summer amounted to 43.3 ºC. The annual precipitation was 115.0 mm, a monthly average of 9.58 mm, indicating the lack of rainfall in the region and its concentration in the winter with the absence during the summer months. Table 2 shows that the months during which rain falls are from October to May, while the months from June to August are dry months. The level of evaporation from the surface of the earth was an annual total of 2713.9 mm at the Ramady monitoring station, there is a difference of 23 mm in rainfall between the drier months and the rainy months. The year-round temperature change is 25.2 °C.

That the maximum evaporation recorded during the summer accounted for 45.7% of total annual evaporation, and these values are very high and affecting the environment in the region. The factors of high temperatures and wind speed are among the most important factors that increase the evaporation in the region. The highest relative humidity in the region was 72.1% in the winter, and in the summer to a low of 32.4% in July. The driest month was June, with 0 mm of rainfall. The largest amount of rainfall occurs in February, an average of 23 mm.

Table 2: Annual rates of Ramadi city 2018

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	9.3	11.7	16	21.6	27.8	31.9	34.5	34	30.2	24.1	16.8	11
Min. Temperature (°C)	3.7	5.3	9.1	14.4	19.7	23.2	25.7	25	21.1	15.6	9.9	5.1
Max. Temperature (°C)	15	18.2	22.9	28.8	35.9	40.7	43.3	43.1	39.4	32.7	23.8	17
Precipitation / Rainfall (mm)	18	23	15	12	5	0	0	0	0	2	20	20

Source: Climate-Data.org. (2018).

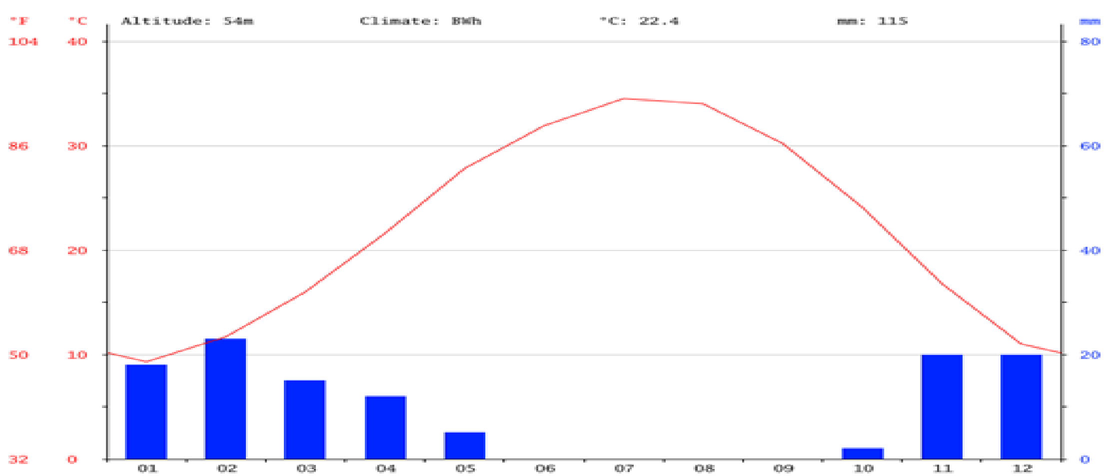

Fig. 3: Climate plan for temperature and rainfall values for the study area

Geological Formation and Origin

Western desert is a part of the Arabian Shield, which descends from the north-west towards the Euphrates, part of the tectonic continental end, which is divided into the first wetlands-the island and the second - the Salman (Jassirn *et al*., 1986). The study area was located within the first range. The depth of the basal rocks ranges from 9 to 7 km, the depth is less than 6 km in the western part, and the average and triangular thickness is not more than 2 km, and in some areas it is hundreds of meters. During the Cretaceous and Tripartite Era, formative movements caused formation of convex folds that appear in the southeastern part of the range and depressions in the form of concave folds that appear in the northeastern part of the range (Hebarsum *et al*., 1985). Geomorphology is a flat plateau in the form of a wide plateau with very little inclination (2-1 m) for the layers except for the low of the oval, which represents an almost oval-shaped depression with a diameter of tens of kilometers with a flat bottom. This plateau has a large number of valleys and hills (Obeidi, 1989).

Physiographic Study Area

All the areas under study are located within the physiological unit of the lower valleys, which form a band of 90-40 km. It is located between the Dabdiyah plain in the south-east and the stone rock plain in the south-west, bordered by the upper valleys and Syria from the northwest, and the lower island plains in the northeast. The area is flat-wavy, with shallow channels and tables running south-east. Parts of this unit discharge its water to the Euphrates River or in the depressions, such as Abu Debes or Habbaniyah. The rocky foundation of this unit consists mainly of lime rocks with some marl and the glacial rocks of the modern era (Middle Meosin) (1979, Thalen).

Natural Plants

Based on the map of natural vegetation of Iraq prepared by (Guest, 1966), Anbar province falls within the sub-desert area where the distribution of natural vegetation within the sub desert zone and there are many plant species within the Euphrates river flood area. Field observations showed that natural vegetation in the study area was low density and low growth due to lack of rainfall and drought. The plant species are *Lagonychium facrctum, Alhagi mororum, Dactylon Cynoden, Carthamus oxicanthas, Imperata cylindrica* and *Convolunnus pilosillaefolius*.

Soil Classification

The soil was classified using soil classification keys, US Department of Agriculture, 1994, based on the morphological description, field observations and chemical and physical properties, ranging from the soil rank to the subgroup.

Evaluation of land use for agricultural purposes using Storie Index Rating System

The storie index rating system was modified by O'Geen *et al*. (2008) classified soils according to its suitability to agriculture. Assessments from grade 1 soils (from 80 to 100 ° C), which have determinants that hinder the agricultural process were few or no for agricultural production, soil under Category 6 (less than 10), which was not suitable for agriculture. The system is based on four factors - soil characterization, soil surface tissue, general soil regression, and other soil segment characteristics such as natural drainage, basal or aromatic content. The percentage values of the four factors are multiplied to get the STORIE INDEX rating

(University of California, 1978, p. 1), as follows:

From the Storie rating = A × B × Y× X × C

- A = Percentage of the soil section
- B = Percentage classification of surface horizon tissue
- C = percentage of land slope classification
- X = percentage of classification of soil characteristics such as salinity, soil pH, carbonate content, gypsum content, organic matter, etc.

The percentage of each factor (A, B, B, X) was increased with an appropriate increase in character, so that as the land productivity index approaches 100 percent, the agricultural quality of the land increases. Conversely, undesirable lands have low indicators of the value of the attribute. The following are the percentages of the revised Storie Index and its associated overall productivity estimates.

Result and Discussion

Morphological Characteristics of the Soil Study Area

The study of the morphological characteristics of the area of the study showed that the origin of the sites was calcareous and gypsum. All sites are located within the physiological unit (Lower valleys) and the topography of the region was almost flat with a slight slope towards the Euphrates River, with water between 15-40 meters while Ap horizon thickness ranged between (0-20 cm) depending on the nature of the composition processes of those soils. The horizon B below the surface has varied in thickness, as the range ranged from (24-19) cm and this difference was due to the nature of the processes during the formation phase of this region. As for the character of tissue, which is one of the important morphological characteristics and most consistent with time. The texture of the surface was varied between sandy (coarse), soft (soft) and soft tissue with heterogeneity of the septum vertically with the dominance of sandy tissue, sand and clay molluscs and sandy clay mismatch in the first horizon of piedons 4,3,2,1 respectively. The color observed from the morphological description of the study columns and table (3) shows that the prevailing wavelength of all the horizons was 10YR with differences in values and chroma with the difference of these indices in both dry and wet measurement. The values ranged for dry land 5-7, wetlands were 4-5, dry chroma ranged from 1-6 and wetlands 1-8. Table 3 also shows the predominance of the subangular blocky and massive. The grade strength ranged from weak to moderate, but the average size was between the medium, smooth and for all the horizons of the studied piedons. Soil values have varied between very firm and very dry in the dry state and between the slightly sticky and slightly sticky textures in the wet state depending on the volume distribution of the soil separators. As shown in Table 3, the study of the distribution of roots in the soil body, as shown by the morphological description of the studiedpiedons (Figure 4) and their distribution was common and very few. Ranging from very fine to coarse, as well as the distribution of pores and sizes. The boundaries ranged between the obvious and sudden for the width of the border and the level of the shape due to the nature of the processes that affected the composition.

Chemical Properties of Soil Study Area

Electrical conductivity ranged from low salinity to medium salinity as in P2 and P4 as well as high salinity P1 and P3. The electrical conductivity values in Table (4) showed the distribution of salts in the soil body, ranging from $dS.m^{-1}$ 21.43 to 1.63 which means between non-saline soils (less than $dS.m^{-1}$4.0) and moderate salinity (at least $dS.m^{-1}$8.0). Table 9 showed that the estimated pH values ranged from 6.9 to 2 g/kg^{-1} soil, where P2 recorded the highest value of 6.2 g/kg^{-1} soil as average, while P1 recorded the lowest value. Moreover, carbonate values ranged from 25.5 to 29.2 g/kg^{-1} soil with the presence of heterogeneity in the content of carbonates with depth and in all piedones, that the presence of this high proportion of this component in the soil of the region and under iraqi dry conditions, can be considered the main link in soil for low content of organic matter, making soil construction more rigid and cohesive because of the work of pores between granules, that the soil content of calcium sulphate has ranged between 13.3 g. Kg -1 in P1 and 30.0 g/Kg^{-1} soil in P3. The results in Table 4also showed a significant effect of soil use type in soil content of total nitrogen where the highest value was recorded in P3, which was 3.0 g/kg^{-1}, while the lowest value of this attribute was in P4, which was 2.0 g/kg^{-1}, and the quantities of phosphorus available was the highest value in P1 was 3.1 and the lowest value inP4 was 2.4 mg/kg^{-1}, while basal saturation ranged from 27-33% and for all biodons. The cation exchange capacity ranged from 15.7 Cmol (+) $/kg^{-1}$ in P4 and 20.5 Cmol (+) kg^{-1} in P3, and all these qualities were taken into consideration when evaluating the feasibility of these soils.

Classification of soil Study area

Soil classification was the process of establishing rules based on the characteristics of soil in the diagnosis and organization of soils within the limits of the specification of information based on the extent of heterogeneity of the characteristics in a statistical framework reflects the relationships between the soil and the degree of development and the amount of information available for each class of varieties. The soil classification was based on understanding the specifications and recording in such a way as to facilitate the process of reviewing the conditions of each soil and its economic need to provide the effort, money and time in the management of these soils. According to US soil classification and climatic data, the area examined was thermic temperature and Torric soil moisture, Landsat ETM +, DEM and field observations were used to determine the physical units in the area studying. Based on the morphological characteristics and results of laboratory analyzes of the physical and chemical properties of the soil sections within the study area as well as the temperature and soil moisture systems, the soil of the study area was classified under the American Classification System (USDA, 1994), within the Ardisols under the following major group:

- *Typic calcigypsids.*
- *Haplogicsids.*

The Typic calcigypsids of the total area of the study area represented 26.5% of the total area of 597.8 hectares while Haplogypsids represented 73.5% occupied an area of 1658.5 hectares.

Table 3: Morphological Characteristics of the Study Area Pidons

No.	pedon	Horizon		Depth	cm	Colour (dry)		(miost)		Texture		Structure	Grade Size Type	Consistence Dry Moist Wet		Root	Abun. size	Pores	Abun. Size	Boundary		
Profile 1 USDA (1994): *Typic calcigypsids* 52 msl Local. (G.B.S) (33°21′08.83″ N) (43°19′56.35″ E)																						
P1		A1 B1k	Ck	0-13 13- 32	32- 70	10Y R 5/1 10Y R 6/3	10Y 5/3	10YR 4/1 10Y 5/3	Y 5/310	S SL	LS	We, f , sg mo, mu, ma	mo, mu, ma	SH, fr, no sp SH, lo, St,np	SH, lo, St,np	C, f vFe, f	non	C, f, Fe, mu	Fe, mu	A S CS	CS	Accumulati on of salts - gypsum crystals.
Profile 2 USDA (1994): *Typic calcigypsids* 51 msl Local. (G.B.S) (33°23′36.46″ N) (43°17′30.58″ E)																						
P2		A1 Bk	Ck	0-10 10- 33	33- 67	10Y R 5/6 10R 6/4	10YR 7/4	10YR 4/4 10YR 5/4	10YR 5/4	SL LS	SC L	We,f, pl We,f, sbk	We, lo, sbk.	SH , Fr ,ss,S p H, fr ss, ss,S p	H, fr ss, ss,S p	c,F vFe,v F	non	Fe,F Fe,me	Ma,f	CS CS	CS	Accumulati on gypsum fragments limeston
Profile 3 USDA (1994): *Haplogypsids* 51 mslLocal. (G.B.S) (33°22′12.50″ N) (43°17′34.88″ E)																						
P3		Ap B1y	B2y	0-12 12- 36 36- 65	59- 82	10Y R 6/4 10Y R 6/4 10Y R 5/6	10YR 6/4	7.5YR5/ 4 7.5YR5/ 8 10YR 4/6	10YR 5/6	C SiC SL	CL SL	mo,me, ma Mo, F, sbk We, mu, sbk	We, mu, sbk	H,Fr, S, p H, Fr, ss, Sp SH, Fr, ss, Sp	H, Fr, ss, Sp	Vf, ma,F Co,f	Co,vf	Ma,f Fe,mu, F CO,f	CO,f	CS CS	CS Ab, s	Accumulati on of salts - gypsum crystals.
Profile 4 USDA(1994): *Typic calcigypsids* 55 msl Local. (G.B.S) (33°22′02.03″ N)(43°15′33.80″ E)																						
P4		Ap B1y	B2y	0-20 20- 37	37- 74	10Y R 5/4 10Y R 5/4	7.5YR5/ 4	10YR 4/6 7.5YR4/ 4	7.5YR4/ 4	SCL CL	SC	Mo-Sf, sbk mo,me, ma	mo,me, ma	H, vFr, SS,S p SH, Fr, SS,S p	H, Fr, SS,S p	Co,f ma,F	non	Fe,F Fe,F	Fe,F	Ab, s Di,	CS	Accumulati on gypsum fragments limeston

Abbreviations

Fine=F, sbk=subanglar blocky, Mo=moderate. Me = Medium, we=weak, cm=common, SiC = Silt clay, C=clay,SL=sandy loam,CL = Clay loam, SC = Sandy clay, SCL = Sandy clay loam, C = Clay, L = Loam, Pl =platy, Sg: single grain, SL=Slightly, St =Sticky, pla=plastic, Fr = Friable, , Vf = very firm,Fe = few, Co=coarse ,Fm=firm ,H=hard, CS = Clear smooth boundary, Ma =many, g=gradual A=abrupt WV=wavy, Vf = very firm, WD = well drained, PD = poorly drained, Sb = Sub-angular blocky.

Table 4: Chemical and physical properties of pidones representing the study area

Pedon No.	Horizon	Depth cm	Sand	silt	clay	texture	EC dS.m^{-1}	pH	$CaCO_3$	$CaSO_4$	Org.C	Total N	Avail.P	BS %	CEC	**Surface Stony %**
			%						%		g.kg^{-1}		mg.kg^{-1}		Cmol(+).kg^{-1}	
	Profile 1 USDA(1994): *Typic calcigypsids*															
P1	A1	0-13	88. 9	10.9	1.1	S	7.5	7.0	24.6	13.3	2.9	5.9	3.5	30.1	12.6	20
	B1y	13-32	74.8	15.2	10.0	SL	6.6	7.1	25.2	14.7	2.6	3.4	3.8	32.4	20.0	
	B2y	32-70	80. 0	10.9	9.1	LS	5.1	7.2	26.8	15.0	2.0	2.2	2.2	29.5	19.7	
	mean	70	81.2	12.3	6.7	LS	6.4	7.1	25.5	14.3	2.5	2.8	3.1	30.6	17.2	
	Profile 2 USDA(1994): *Typic calcigypsids*															
P2	A1	0-10	70.8	16.4	12.9	SL	2.4	7.3	27.3	16.4	8.4	4.6	4.3	19.8	22.65	15
	B1k	10-33	79.6	11.4	9.0	LS	2.5	7.6	28.4	18.3	6.2	3.3	2.4	27.7	20.22	
	B1k	33-67	62.3	14.3	23.4	SCL	2.4	7.0	29.3	20.1	4.2	1.3	0.8	35.4	16.81	
	mean	67	70.9	14.0	15.1	SL	2.4	7.3	28.3	18.2	6.2	3.0	2.5	27.6	19.8	
	Profile 3 USDA(1994): *Haplogypsids*															
P3	Ap	0-12	34.69	13.26	52.0	C	7.1	7.3	27.8	31.70	6.9	2.1	3.5	32.7	25.87	30
	B1y	12-36	15.1	44.7	40.1	SiC	7.3	7.2	29.3	31.70	4.7	0.3	3.4	35.2	19.61	
	B2y	36-65	63.46	18.94	17.59	SL	7.4	7.2	30.5	26.88	4.5	0.45	1.7	34.0	16.96	
	mean	65	37.75	25.7	36.5	CL	7.2	7.2	29.2	30.0	5.3	0.95	2.8	30.9	20.5	
	Profile 4 USDA(1994): *Typic calcigypsids*															
P4	Ap	0-20	47.4	20.1	32.5	SCL	2.1	7.3	28.0	17.3	2.9	1.3	2.9	31.8	15.12	22
	B1y	20-37	44.0	21.3	34.7	CL	2.4	7.3	31.7	18.7	4.9	2.1	2.1	33.7	13.48	
	B2y	37-74	50.3	14.5	35.2	SC	2.2	7.2	28.0	18.8	3.1	2.8	2.3	36.3	16.78	
	mean	74	47.2	18.6	34.1	SCL	22.	7.2	29.2	18.2	3.6	2.0	2.4	33.9	15.0	

Determination of soil breeding capacity for agricultural use

Many systems are used to classify the potential of land for agricultural use. Evaluations need to study and record all data relevant to soil characteristics to develop recommendations for the agricultural process and methods that allow for the most intensive and appropriate use of land without undue risk of soil degradation. In this study, the modified Storie rating system was used to assess the soil capacity of the studied soil. The area of the third category (III) was Fair (1157.3 hectares), and includes the second and fourth pidon, which was part of the soils adjacent to the river and its desert extension, the soil in this category was characterized as suitable only for general agricultural use and was limited use because of the presence of slopes and streams of dry valleys, moderated soil depths and low permeability, rock and gravel ratios exist, and low fertility levels. For the fourth category IV (Poor) among the ponies represented 1, 3 occupied an area of 1157.7 square hectares, or 51.3% of the total studied area, as these lands are not suitable soil. They are very limited in their agricultural potential because of the shallow soil depths of some places and the variable topography of the land of this unit of the dry valleys, as well as the existence of small heights, and fertility levels ranging from low to moderate with a percentage of flood risk from light to moderate. Table 6indicated the possibility of soil units for agricultural use. The most important determinants of the study area are soil salinity, topography, erosion in some areas of study, shallow depths, and the presence of stones and rocks scattered in some places of the study area, as well as gypsum and lime within these soils. Some determinants of crop production are non-permanent and can be improved through the implementation of good management practices.

Table 6 : Storie Guide to estimating the soil area of the study

No. Pedon	Factor A	Factor B	Factor C	Factor X				Soil Rating	lasses
				Soil condition					
	Physical profile	Texture	Slope	Gravel Rate dS/m	EC stats	Flooding level	Fertility%		
1	100	80	100	95	75	80	75	34.2	IV
2	100	100	100	90	95	90	70	53.8	III
3	95	80	100	90	80	100	70	38.3	IV
4	90	95	95	85	95	100	65	42.6	III

Source: Map produced in Desert Studies Center 2018

Water Resources in the Study Area

The water resources in the study area were two types: surface water from the Warar River in the north of the study area and groundwater aquifers were located within the area, as well as water resources from rainfall. The present study assessed the validity of irrigation water in the study area due to lack of studies associated with water quality irrigation in the region, the use of irrigation water and the adoption of agriculture in the region on the groundwater especially, in desert areas. The obtained results of laboratory analyzes showed that the water of the studied wells was classified as S1C4 (very high), within the waters of Sever (Ayers and Westcot, 1989) and in terms of irrigation capacity according to the FAO in terms of the risk of plant impact, for all the evaluation of the criteria in this study there was a possibility of using them for irrigation for agriculture according to the use of different management methods and irrigation techniques. Table 6: The annual rate of chemical analysis of water samples which were collected from the study area.

Table (6): The rate of chemical analysis of water samples collected from the study area

Studied traits	TDS	EC	pH	Ca^{+2}	Mg^{+2}	CO_3-1	HCO_3	SO4⁻2	Cl^-	K^+	Na^+	NO_3N	SAR	Water type
	ppm	ds/m										ppm		
Annual average	5785	8.66	7.43	21.2	18.8	-	5.4	20	24	1.6	6	0.02	1.34	S1C4

Conclusions and Recommendations

- The assessment of the potential of soil was the greatest interest of soil science, and the current study was conducted to assess the possibility of soil in the province of the Dawar and its extension of the desert.
- The studied area has promising land for agricultural expansion and agricultural development, about 2256 hectares, which can be exploited to fill the acute shortage of food yields and stop importing crops, vegetables and animal products from countries.
- Selection of good soil and water management through drip irrigation systems or spraying and selection of crops resistant to salinity and dry conditions.
- Most land tenure determinants for crop cultivation can be maintained and eliminated through good land management practices.
- This study does not recommend the use of groundwater for agricultural use and high salt concentrations and reliance on the water of the River Al Warar to avoid the salt accumulation of these soils, through the establishment of irrigationsystem with modern technologies.

References

AbdelRahman, M.A.E.; Natarajan, A. and Hegde, R. (2016). Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India.

Al-Obaidi, Q.A.M. (1989). Petrography and Geochemistry of Palatine Composition in Western Sahara Region. Master Thesis, Faculty of Science - University of Baghdad.

Atalay, I. (2016). A new approach to the land capability classification: Case study of Turkey, International Conference – Environment at a Crossroads: SMART approaches for a sustainable Future. Procedia Environmental Sciences, 32: 264 – 274.

Buringh, P. (1960). Soils and soil conditions in Iraq. Ministry of Agriculture, Baghdad, Iraq.

Dent, D. and Young, A. (1981). Soil Survey and Land Evaluation. Georg Allen and Unwin Publishers, London.

F.A.O. (1989). Quality of Water for agriculture. Paper. (33). Ayers, R.S. and D.W. Westcot. Rome. Italy.

Gad, A. (2015). Land capability classification of some western desert Oases, Egypt, using remote sensing and GIS.

Guest, E.R. (1966). Flora of Iraq. Volume one. Introduction to the Flora, an account of the geology, Soils, Climate and ecology of Iraq with gazetteer, glossary and biolography. Min. Agric. Iraq, 313.

Hambarsum, A. and Adnan, D. (1985). Geomorphology, Synthetic Geology and Geology of Iraq. Ministry of Higher Education and Scientific Research - University of Baghdad - Faculty of Science.

Jasim, S.Z. and Goff, J.C. (2006). Geology of Iraq, published by Dolin, Prague and Moravian Museum, Brno. methods for the examination of water and wastewater, 19th Edition,

Jassim, S.Z.; Tamr, A.Y. and Bassam, K.H. (1986). Excursion guid 7th. Iraq Geol. Congr. Baghdad, Iraq, 46P.

Munsell (1954). Munsell Soil Color Charts. Edition, Inc., 10 East Franklin St., Baltimor, Md., U.S.A.

O'Geen, A.T.; Southard, S.B. and Southard, R.J. (2008). A revised Storie Index for use with digital soils information. University of California, Division of Agriculture and Natural Resources, ANR Publication 8335, USA.

Parsons, R.M. (1955). Groundwater Resources of Iraq. Dulaimliwa. Baghdad. Vol. 10: 12.

Richards, L.A. (1954). Diagnosis and Improvement of Saline Alkali Soils, AGSIC Handbook 60, U.S. Dept. AGSIC, Washington, D.C., 160.

Road, H.C. and Bay, G. (2016). Soil and Agricultural Capability and Suitability Assessment

Scherr, S.J. (1999). Soil degradation: A threat to developing-country food security by 2020? 2020 Vision Discussion Paper 27. Washington, D.C., USA: IFPRI.

Silpa, M. and Nowshaja, P. (2016). Land Capability Classification of Ollukara Block Panchayat Using GIS. alsiver. International Conference on Emerging Trends in Engineering, Science and Technology. ScienceDirect, Procedia Technology 24: 303 – 308.

Soil Survey Staff (2000). Field Book for Describing and Sampling Soils. National Soil Survey Centre, NRCS, USDA, Washington, USA.

Soil Survey Staff. (1993). Soil Survey Manual, USDA. Handbook no 18, US Government printing office Washington. D.C., 20402.

Storie, R.E. (1978). Storie index soil rating (revised). Special Publication Division of Agricultural Science: University of California, Berkeley, California.

Thalen, D.C.P. (1966). A preliminary evaluation of biomass and production in the desert rangelands of Iraq pp 184-198 in: Proc. First Sci. Conf., Sci. Res. Found (25-30 March) Min. of Higher Educ. And Sci. Research, Iraq.

Thalen, D.C.P. (1974). Range Resources of Iraq X. An appraisal of *Rhanterium epaooosum* (Oliv.) vegetation. Tech. Rep. No. 54 Inst. For Appl. Resources, Abu Ghraib, Iraq, 46.

Turkmen, Joudeh Fathi, Mahmoud Abdelfattah Anbar. Geography of Dry Lands. Arab Culture Department, Cairo.

University of California, Division of Agricultural Science. 1978. Special Publication 3203: Storie

USDA, .2010. Keys to Soil Taxonomy. United States Department of Agriculture, twelve Edition, USA.