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Sort by the Validity of the Agricultural Production in Wasit Governorate

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Abstract: The research aims to classify the soil viability of Wasit Governorate, as it included the physical characteristics (bulk density, real density, porosity of the soil), while the chemical included (organic matter, degree of soil interaction, electrical conductivity, and some positive and negative ions). Samples were taken from sites. Different from the study area with a depth of (0-30) (31-60) cm, and after studying the results of the laboratory analyzes, the results were projected onto the map of the study area to produce spatial distribution maps, and the spatial analysis was based on the (Arc Map 10.5) program, and by classifying some of these Characteristics It was found that (25.7)% of the soils in the study area are of high validity in terms of physical and chemical properties. As for medium hardness soils, a percentage of (73.0)%, as for non-ideal soils, it formed (1.3)%.

Keywords: Classification, Viability, Soil.

1. INTRODUCTION

Soil is nothing but rock fragments resulting from erosion factors and organic matter resulting from the erosion of plants and animals, and it is part of the earth's crust that is penetrated by plant roots and consists of mineral and organic materials, and the study of its various properties (physical and chemical) is nothing but a highlight of the contrast of these properties according to different types and knowledge Its positive and negative characteristics and the extent of its impact on the productive capacity of soils. Soil science specialists resort to other classifications such as those of bulk density, porosity, organic matter and others.

Research problem

The research problem includes asking the following question:

1- Do soil characteristics (physical and chemical) affect the viability of agricultural production in Wasit Governorate, and what is the extent of this impact?

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Research hypothesis

1- The variation in the values of the different properties of the soil (physical and chemical) between its various locations and different depths has clear repercussions on the extent of its suitability, ideality and lack thereof for agricultural production in Wasit Governorate.

Research goal

The aim of the study is to identify the extent of suitability and ideality of the soil of Wasit Governorate for the production of specific varieties of crops and to conduct mapping modeling according to the results.

Research boundaries

Wasit governorate is one of the eighteen Iraqi governorates which is located in the eastern part of the central Iraqi governorates between two latitude **33° 27´ 10˝ (31° 56´ 40˝** -) north and longitude **(44° 30´ 50˝ _ 46° 32´ 50˝)** east, bounded on the north by the governorates of Baghdad and Diyala and from To the south, Dhi Qar Governorate, and from the southeast, Maysan Governorate. On the west side, it is bordered by the governorates of Babel and Qadisiyah, and on the east by the State of Iran. The area of the study area is estimated at (17,153) km^2, and thus it occupies (3.9%) of the total area of Iraq, which amounts to (441,000) km^2, Wasit governorate also includes many administrative units, the number of which is (17) administrative units, including six districts and fourteen districts (Wasit Provincial Council official website , 2013) See map (1).

Field work

Samples were taken at two depths of (0-30) (31-60) cm and at a rate of 172 map samples (2), taking into account their random distribution appropriate to the soil area of the study area in order to represent all soils.

This research included three axes

The first axis: classification of some physical properties of soil.
The second axis: classification of some chemical properties of soil.
The third axis: Modeling some physical and chemical properties of soils.

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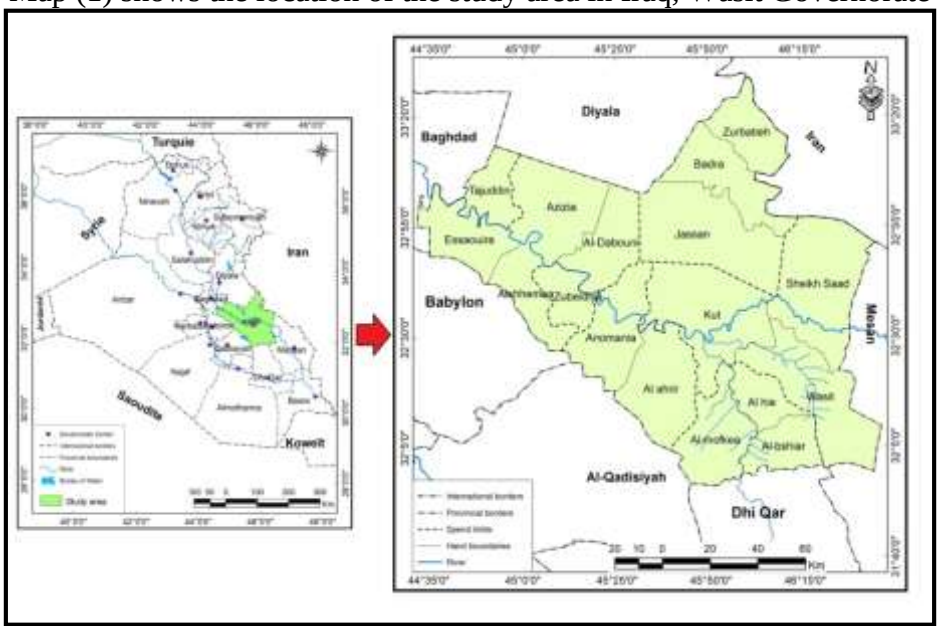
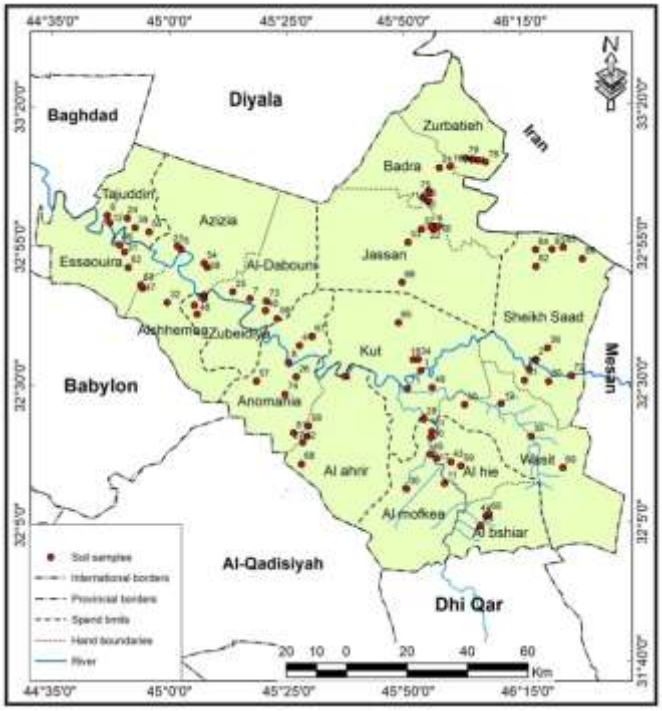
Map (1) shows the location of the study area in Iraq, Wasit Governorate



Source: Ministry of Water Resources, General Survey Authority, Iraq Administrative Map, Scale 1: 1,000,000 for the year 2010 AD

Map (2) showing the locations of soil samples in the study area



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Source: Based on the field study, the use of the GPS device and the outputs of the (Arc GIS 10.5) program.

The first axis: classification of some physical properties:
The research relied on spatial estimation technique (Interpolation) through geostatistical analysis using Arc GIs 10.5, which is considered one of the most prominent GIS software.

bulk density
From Table (1) and Map (3) it becomes clear that the soil is ideal with respect to bulk density when its value ranges between (0.2 - 0.6) g / cm^2, which is not included in any of the study areas. As for the ideal medium soils, they are when the values of bulk density range. Between (1.00 - 1.20) g / cm^2, which are soils that are suitable for vegetables of all their varieties, as their area out of the total area of the study area is (45 km^2), which is a percentage of (0.3)%, as for soils whose ideal ranges between (medium to non Ideally) are those whose apparent density values are between (1.20 - 1.40) g / cm^2, which are suitable soils for growing cereal crops such as (wheat, barley, and yellow corn) and included large areas of Wasit Governorate with an area estimated at (11,073) km^2 with a percentage of (64.5)% It is a high percentage compared to the rest of the ratios, as for soils whose apparent density values exceed (1.40 or more) g / cm^2, they are considered imperfect soils and are not suitable for agricultural crops, except for some crops that have a high ability to absorb nutrients. Km^2 and its percentage (35.2%)

Table (1) classification of soil viability in relation to the bulk density in the study area

Properties	**Bulk density G / cm^2**	**Validity**	**Area km^2**	**percentage %**
Very low density (ideal)	0.2 -0.6	The soil is suitable for all crops	-	-
Low to medium density (ideal medium)	1.00 -1.20	Convenient for vegetables	45	0.3
Medium high density (medium ideal to non-ideal)	1.20 – 1.40	Soil is suitable for grains (wheat, barley, yellow corn)	11073	64.5
High density (not ideal)	1.40 or more	Soil is only suitable for crops that have a high capacity to absorb nutrients	6035	35.2
Total			17153	100.00

Source: the two researchers depending on the results of the physical properties and the outputs of (Arc GIS 10.5).

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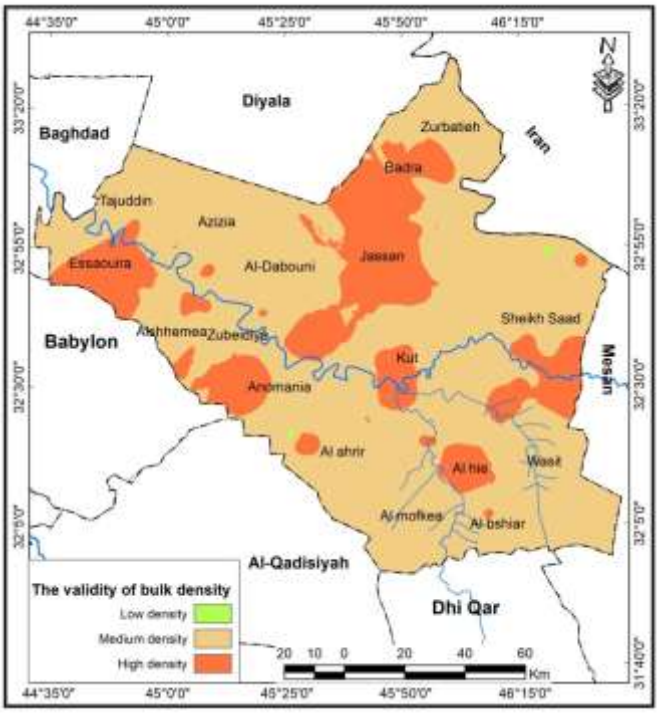
Map (3): Classification of soil viability in relation to bulk density



Source: the two researchers depending on the results of the physical properties and the outputs of (Arc GIS 10.5).

Classification of percentage sizes of soil pores

From Table (2) and Map (3) it became clear that the soil is considered excellent (very ideal) if the porosity percentage increased from (50% or more), which was represented by an area of (1653) km^2 of the area of Wasit Governorate, i.e. 9.6%, but if The percentage of porosity ranged between (45-50)%, so the soil would be good (ideal) and it was represented by an area of (13788) km^2 of the area of the study area with a percentage of (80.4), which is a very high percentage. The values of the porosity are between (40-45)%, which was represented by an area of (1712) km^2 of the area of the study area and by (10.0)%, while soils are considered unacceptable (not ideal) if the porosity is less than (40%) and represented by a very small area of (18) km^2 of the area of the study area, at a percentage (0.1%).

Table (2) Classification of soil according to the percentage of pore size in the study area

Porosity quality	Pore size%	Area Km^2	percentage%
Excellent	50 or more is ideal	1653	9.6
Good	45-50 is perfect	13788	80.3
acceptable	40 - 45 ideal / medium	1712	10.0
Unacceptable	30-40 is not perfect	18	0.1

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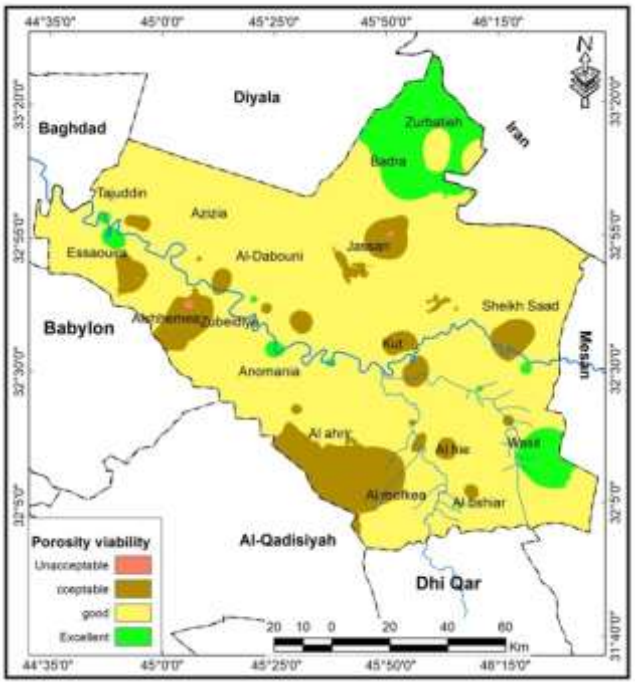
very bad	Less than 30 is not ideal	-	-
Total		17153	100.00

Source: the two researchers depending on the results of the physical properties and the outputs of (Arc GIS 10.5).

Map (4): Classification of soil according to the percentage of pore size



Source: the two researchers depending on the results of the physical properties and the outputs of (Arc GIS 10.5).

The second axis: classification of some chemical properties of soil.
Classification of organic matter content in soil

Table (3) and map (5) show that the values that range between (2-3)% of the organic matter are considered (ideal) and occupy an area of (28) km^2 of the area of the study area, i.e. a rate of (0.16%). Its area is (3924) km^2 and its percentage (22.88%) of the area of Wasit Governorate is considered (ideal average) for the values of organic matter that range between (1-2)%, while (76.96)% of the area of the study area is considered poor in organic matter (Not ideal) which is the value of the organic matter in it (less than 1%) and represents an area of (13201) km^2 of the area of the study area.

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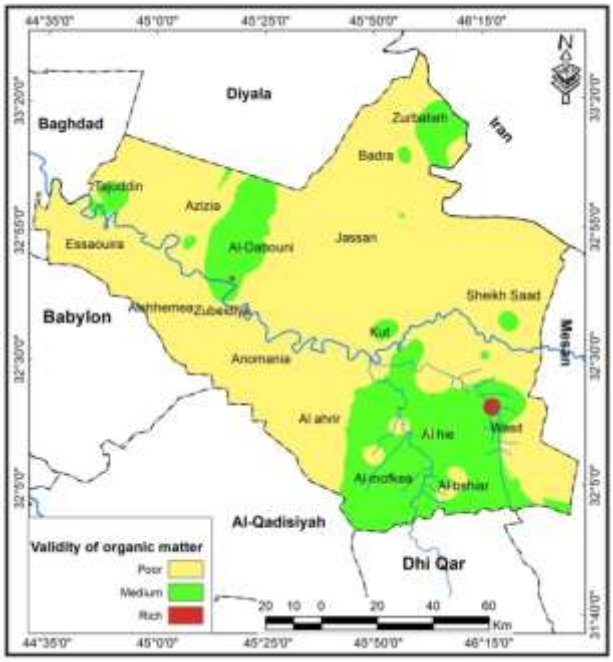
Table (3) classification of soil viability in relation to% organic matter in the study area

Characteristics (soil quality)	Organic matter%	Area Km2	percentage %
Very rich (ideal)	3 and more	-	-
Rich (ideal)	2 -3	28	0.16
Medium (medium)	1 -2	3924	22.88
Poor (not perfect)	Less than 1	13201	76.96
Total		17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Map (5): Classification of soil viability in relation to organic matter



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Classification of soil calcium carbonate content (Lime Caco3):
By studying the details of Table (4) and Map (6), it became clear that (28.79)% of the area of the study area is ideal in terms of its containment of lime, in which the percentage of lime was (more than 15)% and represents an area of (4939) km^2 of the area of the area. The study, while the ideal medium soils are if the lime percentage in them ranges between (3-15)% and occupies an area of (12214) km^2 of the area of the study area, i.e. a rate of (71.21)%.

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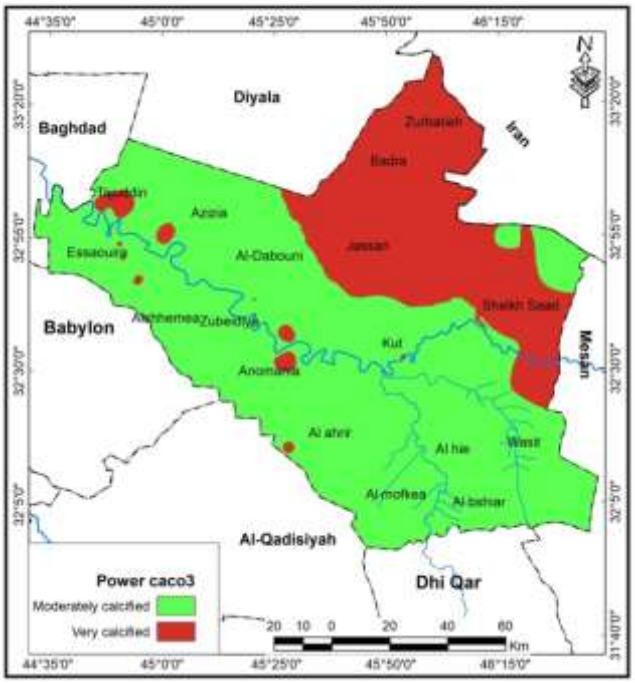
Table (4) Classification of soil on the basis of calcium carbonate (lime caco3) in the study area

Soil Varieties	the description	Area km^2	percentage %
Extremely calcified	Over 15 (ideal)	4939	28.79
Moderate calcification	3 - 15 medium (ideal)	12214	71.21
Poor calcification	Less than 3 (not perfect)	-	-
Total		17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Map (6): Classification of soil viability with respect to calcium carbonate



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Classification of the degree of soil PH reaction:

It is evident from Table (5) Map (7) that all soils in the study area are (ideal) with respect to the PH value, as the areas where the soil PH value ranges between (6.5 - 7.3) are considered neutral areas (ideal) and occupy (84.48)% of the area of the study area i.e. Its area is (14491) km^2, while the areas where the PH value ranges between (7.3 - 7.8) are considered weak alkaline (ideal) and they cover an area of (2581) km^2, i.e. a rate of (15.05%), and we consider

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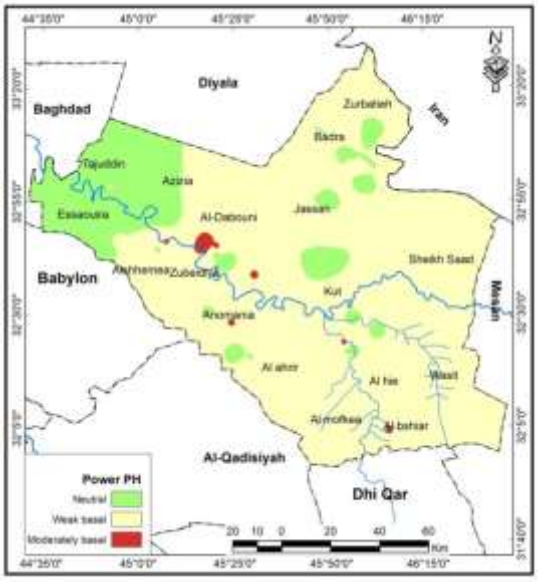
the areas where the PH value ranges. Between (7.8 - 8.4) is considered moderately basic (ideal) and it covers an area of (81) km^2 of the area of the study area, i.e. a rate of (0.47) %.

Table (5) classification of soil ph reaction viability in the study area

Soil Varieties	The limits of the degree of soil reaction	Area km^2	percentage%
Super acidic	Less than 4.5 is not ideal	-	-
Very much acidic	4.5 - 5.0 is ideal	-	-
Very acidic	5.0 - 5.5 is ideal	-	-
Moderate acidity	5.5 - 6.0 is ideal	-	-
Low acidity	6.0 - 6.5 is ideal	-	-
Neutral	6.5 - 7.3 is ideal	14491	84.48
Weak basal	7.3 - 7.8 is ideal	2581	15.05
Moderately basal	7.8 - 8.4 is ideal	81	0.47
Very basic	8.4 - 9 is ideal	-	-
Very much basal	More than 9 is not ideal	-	-
Total		17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Map (7): Classification of soil viability according to the degree of its pH reaction



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

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Classification of electrical conductivity according to its effect on EC salt concentrations

By analyzing the results of Table (6) and Map (8), it is noticed that the areas with EC values ranging between (2-4) decimens / m are considered (ideal) soils and occupy an area of (130) km^2 of the area of the study area and a percentage of (0.76)%. , As for the areas ranging from (4-8) Ds/ m, they are (medium ideal) and produce very specific crops and occupy an area of (859) km^2 of the area of the study area, i.e. a rate of (5.01%). As for the areas where the salinity effect increases, which With EC values ranging between (8 - 16) Ds / m, it is considered (medium - not ideal) and its effect appears in producing acceptable yields for salt-resistant crops only and occupies an area of (6320) km^2, i.e. 36.84% of the area of the study area. While the areas where the EC value is (more than 16) Ds / m is considered (not ideal) soils, which is a large area of the study area, which amounts to (9844) km2 and occupies (57.39)%.

Table (6) classification of validity of EC salt concentrations in the study area

The quality of the effect	Ec grade (Ds / m)	Area km^2	percentage%
The effect on the yield can be neglected	0 – 2 ideal	-	-
It may have an effect on crops	2 -4 ideal	130	0.76
It produces very specific crops	4-8 medium	859	5.01
Only resistant crops produce acceptable yields	8 - 16 medium (not ideal)	6320	36.84
Only a few very resistant crops produce an acceptable yield	More than 16 is not ideal	9844	57.39
Total		17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

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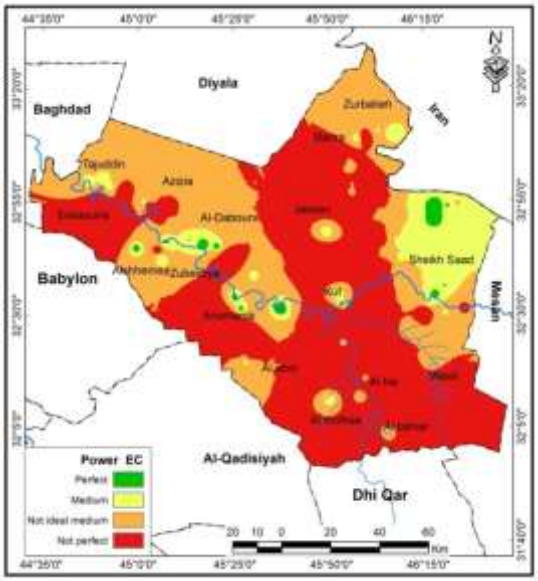
Map (8): Classification of the effect of the salt concentrations Ec on the soil of the study area



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

Classification of soil calcium content (Ca +):

It is noticed from table (7) and map (9) that all soils in the study area are characterized by being very highly classified (ideal) in terms of the presence of calcium, in which there are (more than 9) mmol / liter and an area of (17,153) km^2 and by (100)% Which are outlined in Map (9) in orange.

Table (7) Classification of soil according to the validity of the soil calcium content (Ca +) in the study area

Soil Varieties	Degree of calcium	Soil viability	Area km^2	Percentage %
very high	More than 9	Ideal	17153	100
high	6-9	Ideal	-	-
Medium	3-6	Medium	-	-
Poor	Less than 3	Not ideal	-	-
Total			17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

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Map (9): Classification of soil viability according to its calcium content

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

6- Classification of soil magnesium content (Mg +):

Table (8) and map (10) show that all soils in the study area are characterized by a high percentage of magnesium in them (more than 12) mmol / liter, and they are considered imperfect soils and occupy an area of (17,153) km^2, i.e. a rate of (100)% of the area studying.

Table (8) classification of the viability of Mg magnesium in the study area

Soil Varieties	Soil magnesium content	Soil viability	Area Km^2	Percentage %
High	12 or more	Not ideal	17153	100
medium	6-12	Ideal medium	-	-
Low	6 or less	Ideal	-	-
Total			17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

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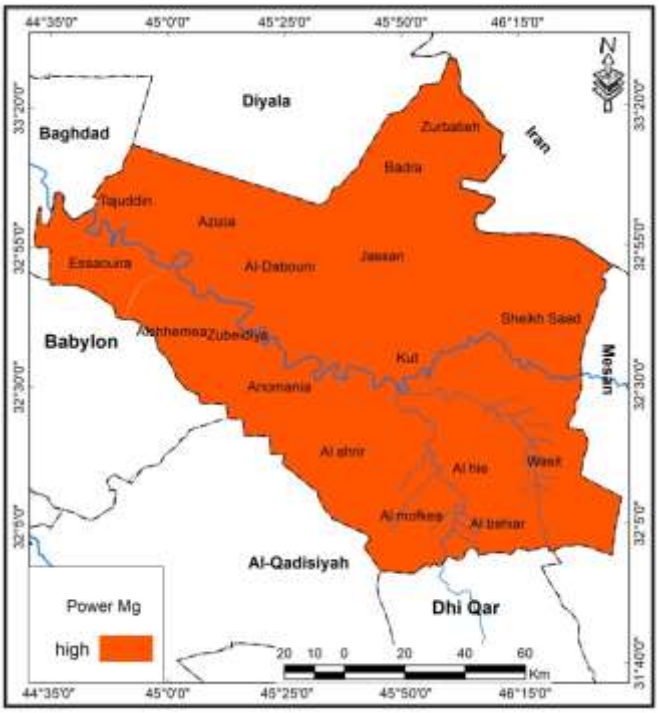
Map (10): Classification of soil viability according to its magnesium content



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

7- Classification of soil exchange sodium content (ESP):

From table (9) and map (11) it is noticed that (17003) km^2 of the area of the study area, that is, its ratio (99.13)% includes non-ideal soils due to the high proportion of exchanged sodium (more than 15%) and with this high percentage of the exchange sodium values are not Suitable for cultivation because of its high risk, as for soils in which the values of sodium exchanged in them are (less than 15%), they are ideal soils and the percentage of sodium in them is suitable and suitable for cultivation and occupies an area of (150) km^2 of the area of the study area and its percentage is (0.87)%.

Table (9) classification (limits of ESP score) in the study area

Soil varieties and their boundaries	Area km^2	percentage %
More than 15% not ideal high risk not suitable for cultivation	17003	99.13
Less than 15% is ideal suitable for cultivation	150	0.87
Total	17153	100.00

Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

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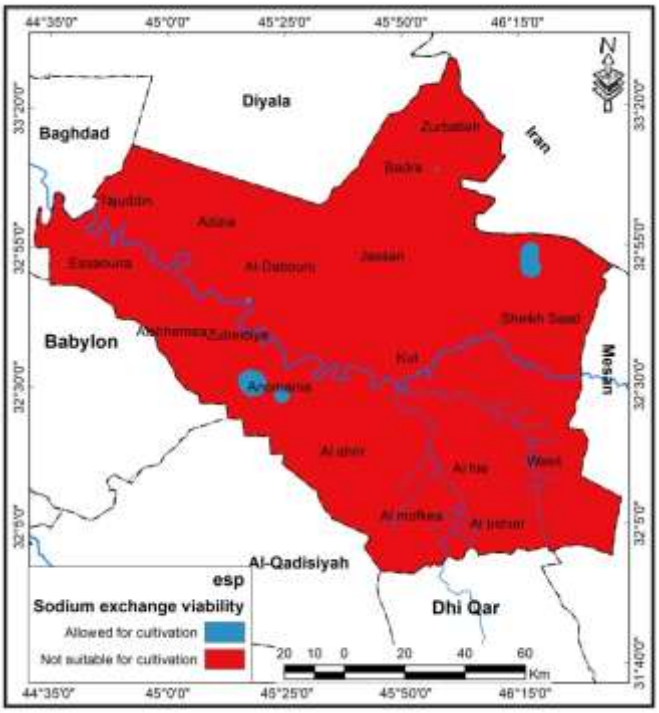
Map (11): Classification of soil viability based on its (ESP) content



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

The third axis: modeling physical and chemical properties:

Spatial analysis method was adopted in ArcMap10.5. And through the spatial modeling tool, the interpolation or spatial synthesis of the characteristics of the samples was activated, by giving a spatial weight for each characteristic and then analyzing the geographical variance of those characteristics through activating the feature of the geostatistical analyst and then accessing the database (Geostatistical Analyst). (Geostatistical Wizard) that produces a new layer, shows the spatial synthesis according to the given values for each of the studied characteristics. By looking at the details of the map (12), it was found that the weight of the bulk density reached (0.08)%, while the weight of the porosity was (0.07)%. As for the chemical properties (organic matter, calcium carbonate, calcium element, and magnesium element) the weights reached (0.08)% for each, as for the weights of (the degree of soil reaction, soil salinity, the proportion of exchanged sodium), it reached (0.15)% for each, and through these weights a validity map of the physical and chemical properties was extracted. And through Table (10) it was found that the areas whose physical and chemical properties have high validity (ideal) have an area of (4403) km^2 and a rate of (25.7%), which is shown in a map (13) in green color, as for the areas whose physical and chemical properties were of medium validity. Its area was (12518) km^2, meaning (73.0)% of the area of the study area, which was identified in yellow in Map (13). As for the areas whose physical and chemical properties are of little validity, their area reached (232) km^2, representing (1.3)% and

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represented in red. In map (13), it is noted that the soils of the study area are considered soils of medium strength in terms of their physical and chemical properties.

Table (10) Classification of soils in the study area according to their suitability for cultivation

Soil Varieties	Area Km^2	percentage%
High validity	4403	25.7
Medium validity	12518	73.0
Low validity	232	1.3
Total	17153	100.00

Source: The two researchers depending on the results of the physical and chemical properties and the outputs of (Arc GIS 10.5)

Map: (12) Weights and modeling of the physical and chemical properties of the soils of the study area

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 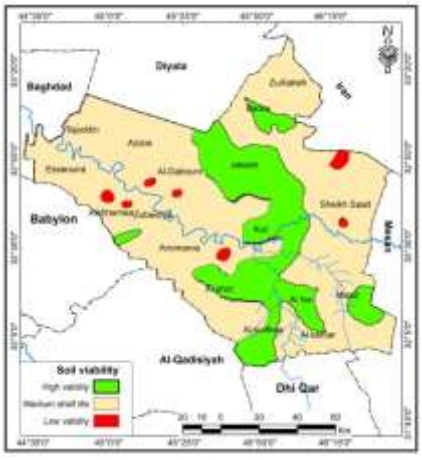
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 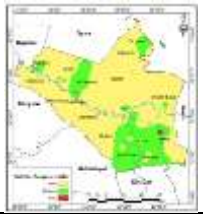 </td>
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 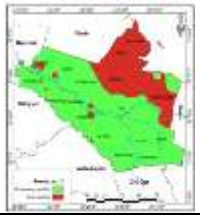 </td>
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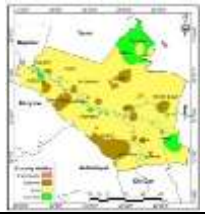
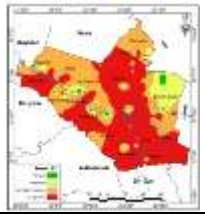
<tr>
<td>Porosityweight%0.07 =
  </td>
<td>Ec weight %0.15 =
  </td>
</tr>
<tr>
<td>Apparent density weight %0.08 =</td>
<td>Ca weight %0.08 =
  </td>
</tr>
</table>

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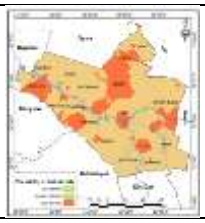
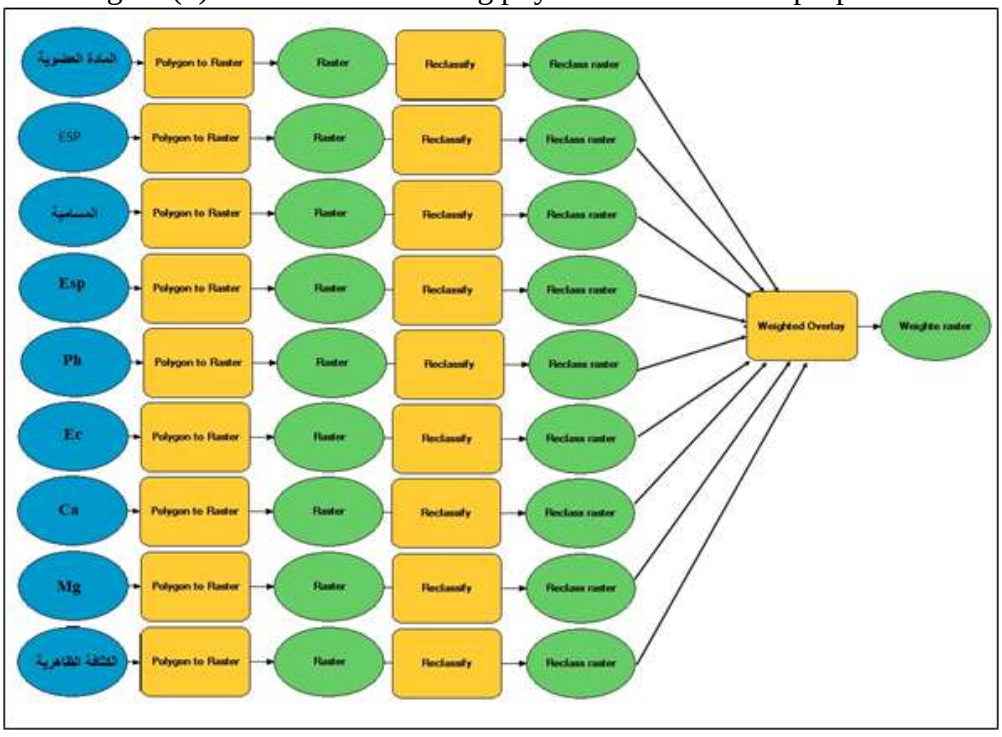
		
		Mg weight%0.08 = 

Source: The two researchers depending on the physical and chemical properties maps and the outputs of the (Arc GIS 10.5) program.

Figure (1) a model for modeling physical and chemical properties



Source: the two researchers, depending on the program (Arc GIS 10.5).

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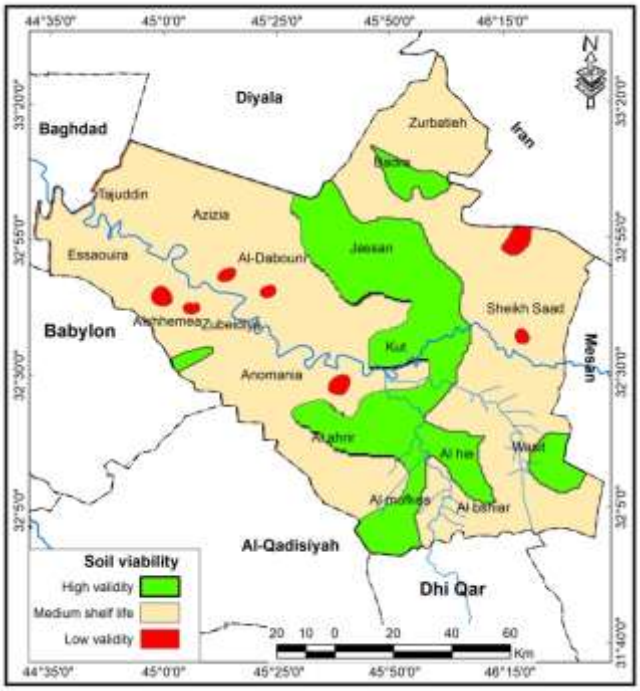
Map (13) The validity of soils for agricultural production in the study area



Source: the two researchers depending on the results of the chemical properties and the outputs of (Arc GIS 10.5).

2. CONCLUSIONS

1- The soil of the study area is (medium ideal - non-ideal) soils due to the increase in the values of bulk density and the reason for this deterioration is due to the lack of agricultural services and the wrong methods used in addition to the lack of organic matter.
2- The soils of the study area are characterized by being good, ideal for the size of soil pores.
3- That (22.88)% of the area of the study area is considered the average ideal for the organic matter, in which it ranges between (1-2). As for (76.96)% of the area of the study area, it is considered poor in organic matter and that the percentage of organic matter in it is less than (1) which is not ideal soil
4- That (57.39)% of the area of the study area is not ideal soils due to the high value of (Ec) in it to more than (16) Ds / m
5- All soils in the study area have the advantage of being ideal in terms of the presence of calcium with an area of 17,153 km^2. As for magnesium, all soils in the study area and with the same area are considered not ideal soils.
6- The soils of the study area with high validity for cultivation in relation to the physical and chemical properties formed an area of (4403) km^2 with a rate of (25.7). As for the soils of medium validity, it formed (73.0)%, while soils of low viability formed (1.3)% of the area of the study area .

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Recommendations:

1- Increasing interest in the agricultural reality and encouraging agriculture by urging farmers to provide them with easy loans

2- Improving soil properties by adding materials to it and carrying out washing operations to get rid of salinity and the exchanged sodium present in it.

3- Getting rid of soil problems through government support for farmers and providing them with everything they need to overcome these problems.

4- Benefiting from the results of the analyzes and maps that were reached in this study regarding the ideal areas for agriculture and not ideal and to provide the various state departments (Agriculture Directorate, Municipal Directorate) in order to determine the appropriate use of this land, whether it is agricultural, residential, or industrial.

3. SOURCES

1. Wasit Provincial Council official website, data published on Wayback Machine, 2013.
2. Ministry of Water Resources, General Survey Authority, Administrative Map of Iraq, Scale 1: 1,000,000 for the year 2010.
3. The field study conducted by the two researchers.