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ACCURACY OF SOIL MAPS PREPARED IN TWO DIFFERENT WAYS FOR SHEKH SAAD PROJECT IN EAST SOUTHERN OF IRAQ

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ABSTRACT

The study area was chosen in the Iraqi alluvial plain, as the Shekh Saad project was chosen in Wasit Governorate, on the left side of the Tigris River. The project lands are confined between longitudes 46° 15´ to 46° 35´ east and two latitudes 30° 32 الى to 32´45° north, the project area is estimated at 79,683 hectares for the purposes of studying the accuracy of soil maps. A geographical correction of the project map was made on a satellite visual After that, a path was determined on the map, then soil samples were taken every 100-500 m according to the size of the map unit and for different depths according to the variation of the tissue. The coordinates were taken by the GPS device. And four depths**.** The study included the following characteristics: the content of clay, sand, and silt, as well as the electrical conductivity Ph, SAR, ESP, and EC. The accuracy of soil maps was studied in two traditional and predictive methods using traditional and geological statistics, and the results were as follows**:** There is a difference in the accuracy of conventional and predictive soil maps when using geological statistics, as the accuracy of the traditionally constructed soil maps was 74.33%, followed by the accuracy of the map that was constructed in a predictive manner using GIS and the Krging method and it was 82.35%, then the IDW method, which surpassed the previous two methods. Its accuracy was 85.14%.
Keywords: Soil maps, Shekh Saad, East southern of Iraq

Introduction

Soil maps are an essential resource for soil scientists and researchers in any fields related to soil, land use, species conservation, hunger reduction, social development, etc. However, detailed soil mapping is an expensive and time-consuming task that most developing countries cannot afford. In recent years there has been a major shift towards digital representation of soil maps and environmental variables that has created the field of predictive soil mapping (Scull *et al*., 2000) where statistical analysis is used to create predictive models of soil properties. PSM requires less human intervention than traditional mapping techniques. However, because most of the money devoted to soil research comes from developed countries, their research in this area has mostly been concentrated in the temperate regions where these countries are located. Where hunger and poverty are in the tropics, they require different statistical models due to the unique characteristics of their weather and environment.

Predictive soil mapping (PSM) can be defined as the development of a numerical or statistical model of the relationship between environmental variables and soil characteristics, which is then applied to a geographic database to create a predictive map. Predictive soil maps have become available thanks to computing techniques developed over the past few decades (Scull *et al*., 2003).

Typically, when mapping predictive soil six steps are followed, as demonstrated by McBratney *et al*., 2003: characterization, examination sites, sample collection, spatial prediction sites, identification of most representative data models, and soil information dissemination and distribution.

The era of exploratory mapping is over, and at the moment the focus has shifted to raster-based soil characteristics information 2009 Sanchez *et al*., This demand coincides with the emergence of a whole host of new observational techniques, digital soil mapping, and a renewed interest in various soil sciences .The ancient tradition and well-known rule of soil mapping are very useful in developing raster-based soil information. Therefore, many new monitoring techniques have been tested and used in soil mapping, but none of these methods have been used routinely so far.

In contrast to traditional soil mapping which is based mainly on the application of qualitative knowledge of experts, the “predictive” approach to soil mapping is generally more quantitative and data-driven in addition to the use of statistical and technological methods (Boettinger, 2010).

And that this percentage varies from region to region in the world and that it has ranged according to the definition of the US Department of Agriculture Soil survey staff; 1975 Between 80% - 90% according to the difference between the common and the soil types it contains. 1977, Webster identified the percentage of impurities within the map units in many surveys, and noted that they reach between 25% - 65%, meaning that they have a purity of between 35% - 75%.

Materials and Methods

Study area

The Shekh Saad project was chosen in Wasit Governorate on the left side of the Tigris River, which is surveyed by the National Center for Water Resources Management, as it is bordered on the north by the border region between Iraq and Iran, on the east by the borders of Ali Al Gharbi district (Maysan Governorate), and from the south by the Tigris River and on the west by the Jabab River. The project lands are confined between longitudes 46 ° 15´ to 46 ° 35´ east and two latitudes 30 ° 32 الى to 32´45 ° north north. The project area is estimated at 79,683 hectares, as shown in Figure (1).

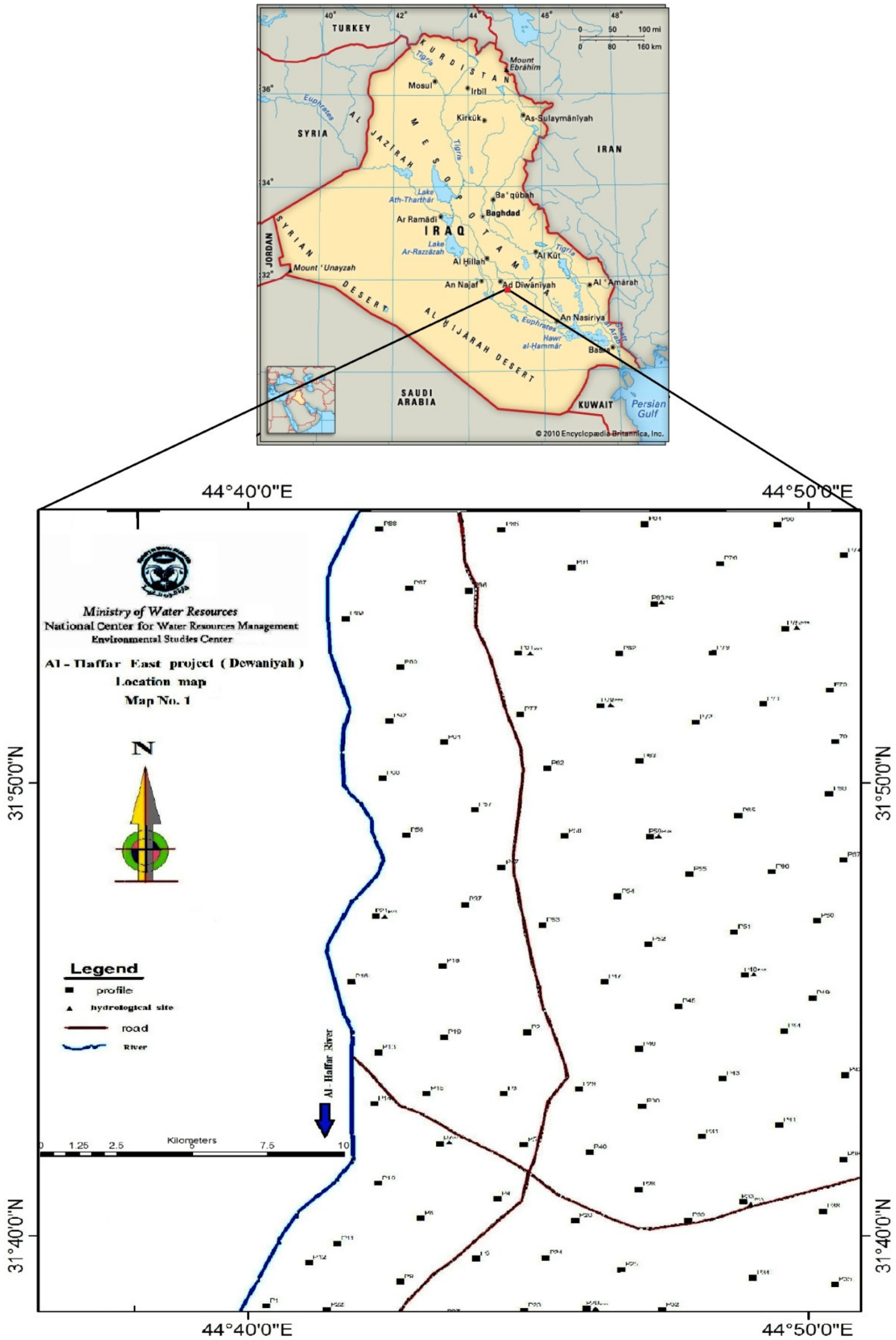
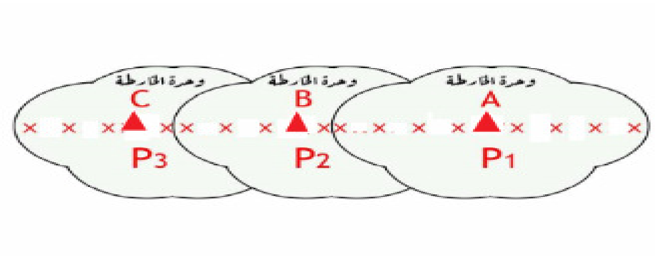


Fig. 1 : The project site for Wasit and Iraq

Field procedures:

After determining the tracks on the map, soil samples were taken every 100-500 m according to the size of the map unit and for different depths according to the variation of the tissue. The coordinates are taken by the GPS device and the morphological characteristics are taken: soil texture, soil color and spotting depth. The following is an illustration of how to conduct the field work:



X = Check sites for audit purposes.

P1, P2, P3 = the original locations of the map units.

20 examination sites were selected, as shown in Figure (2).

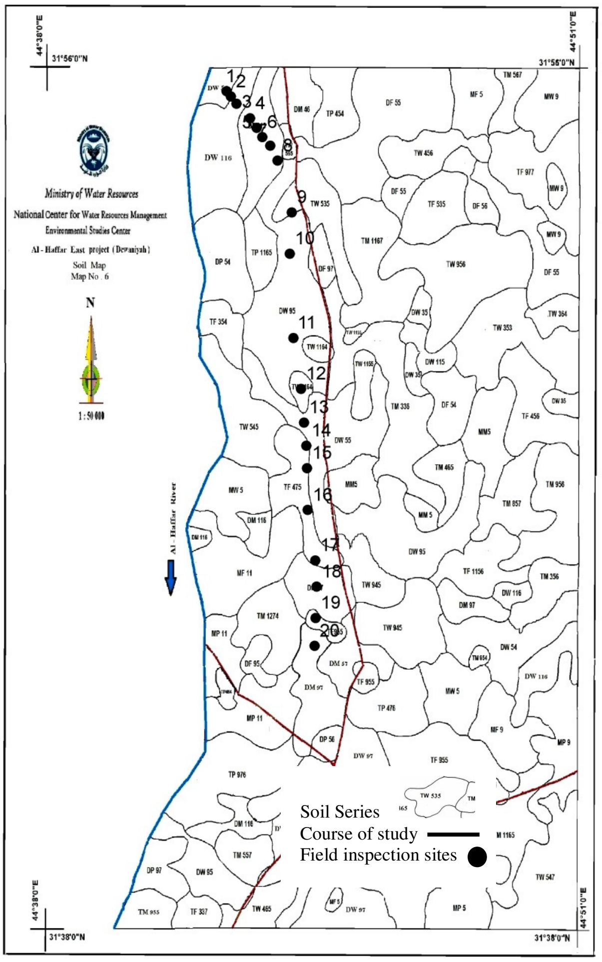


Fig. 2 : a map of the soil chains for the project, showing the course of the study and the sites of field testing

Laboratory procedures:

After the samples were obtained and brought to the laboratory, they were air dried, milled, and then sifted with a 2 mm sieve, and the following laboratory analyzes were performed:

1 -Physical analysis of PSD using hydrometer method mentioned in Richards, 1954, and then estimating the soil texture.

2 -Chemical analyzes:

- Soil pH reaction:

The reaction of soil in an extract of a soil sample with water was estimated at 1: 1 described in (Richards, 1954).

- EC conductivity:

The electrical conductivity of a soil sample extract with water was estimated 1: 1 using the Conductivity Bridge device described in (Richards, 1954).

Calcium carbonate minerals: CaCO3

Calcium carbonate minerals were estimated by calcimmeter according to (Richards, 1954).

- Gypsum:

The gypsum was estimated by sedimentation with an acetone solution, and then the electrical conductivity of the sediment formed was measured, as stated in Richards, 1954.

- Calculation of ESP by estimating the dissolved Ca, Mg, Na ions to calculate SAR and then calculating ESP according to the 1976 Abu Sharar equation.

ESP=6.28+(0.64*SAR) ....(1)

Maps drawing:

Predictive Soil Map (PSM) was done, using 10.2 GIS software and the Kriging and Inverse Distanse Weighting methods for statistical calculations.

Statistical procedures:

First: - Measuring the purity of the map:

Similarity method: It is the proposed method for finding the similarities between each of the field inspection sites and the Bidun representative of the map unit. Each of the traits (variables) were used in this method: clay, silts, sand, PH, EC, $CaCO_3$, CaSO4, ESP, and for all the studied horizons.

1- Standardizing each of the attributes using the Range Method used by Hole and Hironaka (1960) in order to standardize the units of measurement. The standardized value for the characteristic is extracted within each map unit as follows:

$$X = \frac{x - x_{min}}{x_{max} - x_{min}} \quad \text{...(2)}$$

As :

X = calibrated value.

x = the original value of the trait.

x_{max} = the highest value of the trait.

x_{min} = lowest value for the trait.

2- The percentage of each field inspection site within the map unit is measured with the baydun representing the map unit itself, using the scale of (Gower, 1971).

$$S_{ij} = 1 - \frac{\sum_{ki}^{P} |x_{ik} - x_{jk}|}{P} \quad \text{...(3)}$$

whereas:

Sij = the similarity value between the two scan sites i & j.

Xik = the value of the K-attribute for location i.

Xij = the value of the K-attribute for the location j.

P = number of variables.

Testing the purity of the map unit and the success of the survey process: The percentage of the number of field inspection sites is taken, the percentage of which is more than 75% similar to the bidun representing the prevailing taxonomic unit to the total number of field inspection sites within the soil map unit multiplied by the percentage of the area occupied by the soil map unit from the total soil map Using the equation proposed by Al-Jeraisy and Al-Moeiny, 2004.

Purity of map = ai di\Di ...(4)

As:

ai = area of the map unit i, expressed as a fraction (relative to the total area.)

di = the number of field inspection sites having a similarity of more than 75% with the bids represented by the map unit i. Di = number of total field inspection sites within the mapping unit i.

Results and Discussion

Statistical and pedological analysis:

The similarities and differences between the characteristics of the soils, depending on the ma.

Tables 1, 2 and 3 show how similar the field inspection sites are to the bidun represented within the map units. Similarity ratio of 75% or more was considered as representing the requirements for joining the Map unit. The similarity ratio less than 75% was considered defective and not similar to the prevailing taxonomic unit. The weighted purity was extracted on the basis of the area of the map units, as is the case with the usual method. This method reduced the amount of impurities, as it reached 25.67% for the Shekh Saad project, and it is within the permissible limit of 15-25%. It was also compatible with the previous studies mentioned in the traditional method.

Table 1 shows the similarity ratios between the field inspection sites and the Pedon representing the soil chain in Shekh Saad project, and it is clear that there is a difference in the similarity ratios, as the similarity percentage between the field inspection site (1) and the Pedon representative of the TW35 series was 366%, and the similarity ratios between the field inspection site (2) Al-Pedon representing the TM954 series is 86%, while the similarity ratios between the field inspection sites (3, 4, 5, 6 and 7) and Al-Pedon representing the TM865 series ranged between 75% to 85%, and the similarity ratios between field inspection sites (8 and 9) and Al-Pedon representing the series ranged from 75% to 85%. DM55 was 88% and 81%, respectively, and the similarity ratio between the field test site (10) and the bidun representing the TP965 series was 72%, and the similarity ratios between the field test site (11 and 12) and the bidun representing the TP974 series was 78% and 75%, respectively. The similarity ratios between field inspection sites (13, 14 and 15) and Bidun representing the DF95 series ranged between 85% and 89%. Whereas, the TM1154 series showed similarities between the representative baidoun and the field inspection sites (16, 17, 18, 19 and 20), and their percentage ranged between 69% to 89%, and the average similarity ratio between the testing sites and the baidoun that represented them for the Shekh Saad project was 80.51%.

Table 1 : Shows the similarity rates between field inspection sites and donuts representing soil chains in the traditional method of the Shekh Saad project

Similarity %	Sum of differences / number of traits	Absolute sum of differences	Total differences	Screening sites	Series
65.50	0.34	3.10	3.10	1	TW353
85.57	0.14	1.30	1.30	2	TM954
68.86	0.23	2.10	2.10	3	TM865
78.14	0.22	1.97	1.97	4	
84.78	0.15	1.37	1.37	5	
75.08	0.25	2.24	2.24	6	
79.51	0.20	1.84	1.84	7	
88.43	0.12	1.04	1.04	8	DM55
81.39	0.19	1.67	1.67	9	
72.37	0.28	2.49	2.49	10	TP965
77.68	0.22	2.01	2.01	11	TP974
74.91	0.25	2.26	2.26	12	
88.82	0.11	1.01	1.01	13	DF95
86.21	0.14	1.24	1.24	14	
85.41	0.15	1.31	1.31	15	
87.15	0.13	1.16	1.16	16	TM1154
88.18	0.12	1.06	1.06	17	
88.54	0.11	1.03	1.03	18	
68.84	0.31	2.80	2.80	19	
84.93	0.15	1.36	1.36	20	
80.51%					Average

In the case of relying on the Kriging method in extracting the similarity, Table 2 shows the similarity ratios between the field inspection sites and the non-representative soil chains of the Shekh Saad project based on the predictive map by the Krging method. Field test sites 1 and 2 and without representative of the series TW35366%, and the similarity ratios between field test sites 3, 4 and 5 and without representative of the TM865 series were 69%, 78% and 85%, respectively, while the similarity ratio between field test sites 6 and 7 and without DM55 series were 86% and 90% Respectively, the similarity ratios ranged between field test sites 8-20 and without representative DF9581% - 89%. The average similarity ratio between the inspection sites and the statute representing them for the Shekh Saad project was 82.61%.

Table 2 : Shows the similarity rates between field inspection sites and donuts representing soil chains drawn by Krging method for Shekh Saad project

Similarity%	Sum of differences / number of traits	Absolute sum of differences	Total differences	Screening sites	Series
65.50	0.34	3.10	3.10	1	TW353
65.66	0.34	3.09	3.09	2	
68.86	0.31	2.80	2.80	3	TM865
78.14	0.22	1.97	1.97	4	
84.78	0.15	1.37	1.37	5	
85.69	0.14	1.29	1.29	6	DM55
90.12	0.10	0.89	0.89	7	
88.25	0.12	1.06	1.06	8	DF95
81.22	0.19	1.69	1.69	9	
83.22	0.17	1.51	1.51	10	
88.61	0.11	1.03	1.03	11	
85.84	0.14	1.27	1.27	12	
88.82	0.11	1.01	1.01	13	
86.21	0.14	1.24	1.24	14	
85.41	0.15	1.31	1.31	15	
85.77	0.14	1.28	1.28	16	
86.80	0.13	1.19	1.19	17	
87.15	0.13	1.16	1.16	18	
82.61	0.17	1.57	1.57	19	
83.54	0.16	1.48	1.48	20	
82.61%					Average

When using the (IDW) Inverse Distance Weighting method in drawing a map of soil chains between Table 3, the similarity ratios between field inspection sites and the representative numbers of soil chains for the Shekh Saad project, based on the predictive map (IDW), and from the table it is also clear that there is a difference in the similarity ratios. The similarity percentage between field inspection sites 1 and the statin representing the chain is 66% TW353, and the similarity ratios between field inspection sites 2 and 3 and without representing the TM954 series were 86% and 81%, respectively, while the similarity ratios ranged between field inspection sites 4, 5, 6 and 7 and without representative of the TM865 series Between 75% and 85%, and the similarity ratios ranged from field test sites 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18, and without representative of the DF9581% and 89%. The similarity rates between field test sites 19 and 20 and the Pedon representative of the TM1154 series were 84% and 85%, respectively. The average similarity percentage between the inspection sites and the statutes representing them for the East Al Haffar project was 83.29%.

Measuring the resolution of the units of maps:

Based on Tables 4, 5 and 6, and Map 2, 3 and 4, which showed the similarity between the field inspection sites with the Bidun represented within the same series. The similarity ratio of more than 75% is used to extract the amount of purity and thus it is considered within the unit of the map, but if the percentage of similarity is less than 75%, then it is not taken and thus it is considered a defect and is not bound to the taxonomic unit, and Table (4) and the map (2) show the weighted purity for each unit of The map also shows the total weighted purity of the map at a scale of 1: 50,000 for the Shekh Saad project. The weighted purity ratios varied, as the purity of the map of soil chains in the Shekh Saad project using the traditional method was (74.33%), and the result was consistent with what was mentioned by Buringh *et al*. 1962, that the purity of the map units in the Netherlands soils is 70% or more And that 25.67% defects within the map units were consistent with what was stated in S.S. Staff, 1993 found that the surveyed defects range between 15-25% within the map units.

Table 3 : Shows the similarity rates between field inspection sites and donuts representing soil chains using the IDW method of Shekh Saad project

Similarity%	Sum of differences / number of traits	Absolute sum of differences	Total differences	Screening sites	Series
65.50	0.34	3.10	3.10	**1**	TW353
85.57	0.14	1.30	1.30	2	TM954
80.93	0.19	1.72	1.72	3	
78.14	0.22	1.97	1.97	4	TM865
84.78	0.15	1.37	1.37	5	
75.08	0.25	2.24	2.24	6	
79.51	0.20	1.84	1.84	7	
88.25	0.12	1.06	1.06	8	DF95
81.22	0.19	1.69	1.69	9	
83.22	0.17	1.51	1.51	10	
88.61	0.11	1.03	1.03	11	
85.84	0.14	1.27	1.27	12	
88.82	0.11	1.01	1.01	13	
86.21	0.14	1.24	1.24	14	
85.41	0.15	1.31	1.31	15	
85.77	0.14	1.28	1.28	16	
86.80	0.13	1.19	1.19	17	
87.15	0.13	1.16	1.16	18	
83.99	0.17	1.57	1.57	19	TM1154
84.93	0.16	1.48	1.48	20	
83.29%					**Average**

Table 4 : The measured purity of the Shekh Saad project using the traditional method

Weighted purity	Di	di	ai	total area	Area / hectare	Pedon	Series
0.00	1	0	6.47	8183.88	529.72	P1	TW353
16.87	1	1	16.87	8183.88	1380.90	P2	TM954
23.83	5	5	23.83	8183.88	1950.31	P3	TM865
8.69	2	2	8.69	8183.88	710.84	P4	DM55
0.00	1	0	5.15	8183.88	421.44	P5	TP965
13.17	2	1	26.33	8183.88	2155.13	P6	TP974
8.25	3	3	8.25	8183.88	675.33	P7	DF95
3.52	5	4	4.40	8183.88	360.22	P8	TM1154
74.33%			**100**		**8183.88**		Total

While its purity using the predictive map and the Krging method reached 82.35%, as in Table (5) and Map (4), and when using the Inverse Distance Weighting (IDW) method, its purity was (85.14%), and as in Table (6) and Map (5), Thus, the (IDW) method surpassed the traditional method and the Krging method. The reason for the lack of purity is that the soils of the study area are of high slope and a large part of it is cultivated and thus soil units are small and complex**.**

Table 5 : The measured purity of the Shekh Saad project using the Krging method

Weighted purity	Di	di	ai	total area	Area / hectare	Pedon	Series
0.00	2	0	10.73	7062.57	757.53	1+2	TW353
13.85	3	2	20.78	7062.57	1467.70	3+4+5	TM865
24.47	2	2	24.47	7062.57	1728.25	6+7	DM55
44.02	13	13	44.02	7062.57	3109.09	8---20	DF95
82.35**%**			100.00		7062.57		**Total**

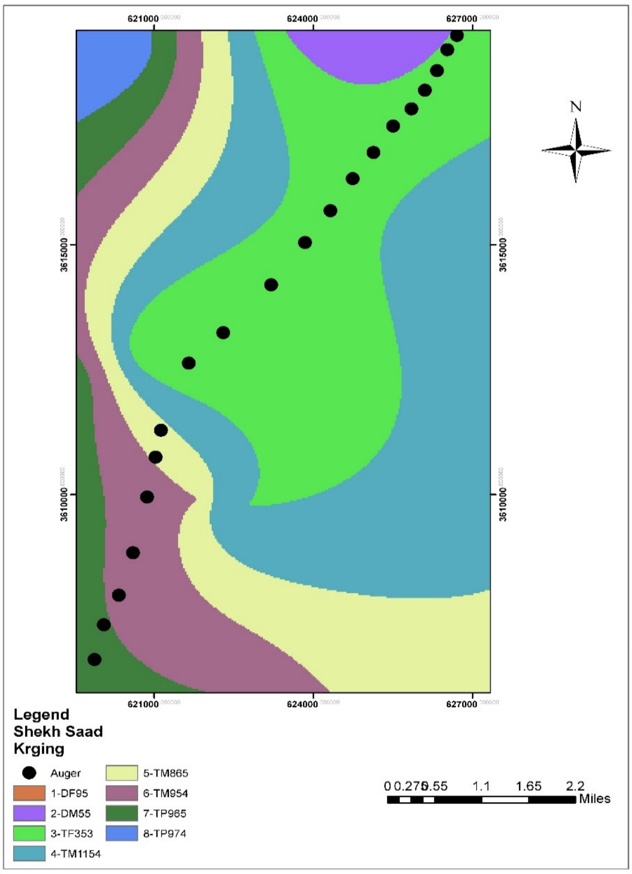


Fig. 4 : Map of the chains of the Shekh Saad project by the Krging method

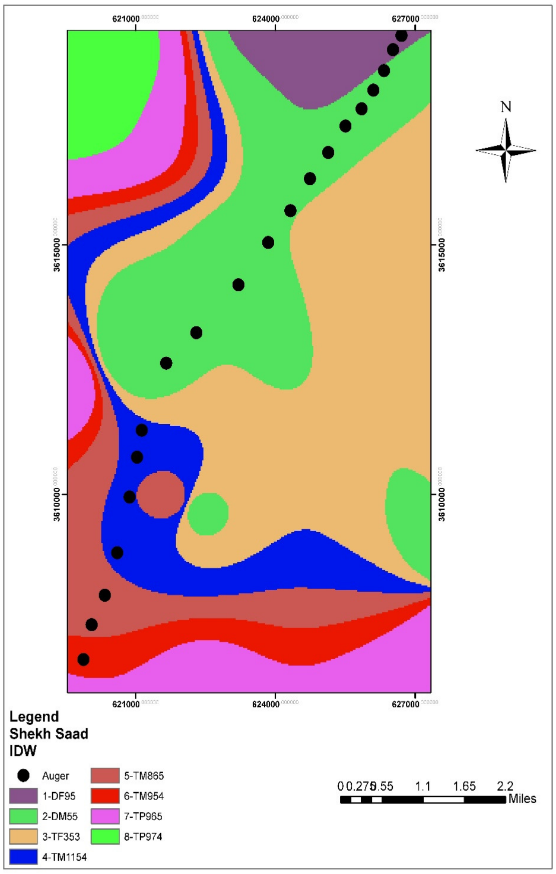


Fig. 5 : Map of the chains of the Shekh Saad project, using the IDW method

Table 6 : The measured purity of the Shekh Saad project using the IDW method

Weighted purity	Di	di	ai	total area	Area / hectare	Pedon	Series
0.00	1	0	7.11	6978.93	496.38	1	TW353
21.48	2	2	21.48	6978.93	1499.42	2+3	TM954
22.51	4	4	22.51	6978.93	1571.21	4+5+6+7	TM865
41.01	11	11	41.01	6978.93	2862.32	8--18	DF95
7.88	2	2	7.88	6978.93	549.61	19+20	TM1154
85.01			100.00		6978.93		Total

Conclusions

1- The predictive method in creating soil maps is better and more accurate than the traditional method.

2- The highest accuracy obtained is using the IDW method.

3- The IDW method was superior to Krging in mapping soil series.

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