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Contour and Digital Terrain Models of Marshes Soil Properties by Using Geographic Information System (GIS)

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Abstract

Considering the huge amount of information, it becomes so difficult to deal with and understand only in condition they were organized, classified and saved as data base that can deal with automatically and to make use of it without interfering with its meaning and significance. Here comes the need to invent new methods and systems to save such information and deal with. An example of such systems is management information system and Geographic Information System.

Marshes are water areas in the south of Iraq and cover about (35000) Km^2 of the total area of Iraq. And because of it's strategically and economical importance in addition to tourism this study seemed to be important. In this research the information were gathered from the soil reports of the National Centre for Construction Laboratories for different parts of Marshes area in addition to Laboratory reports done by Consultation Bureaus and the researcher made tests for three parts of Marshes area. More than ten tests were carried out for each area and the results of such tests were statistically studied, analysed and measure to know level of confidence.

One of the most important Engineering properties, bearing capacity of soil, in addition to the amount of acidity and alkality (pH) of the soil. These data were treated and analysed by using geographic information system to produce contour maps, after that local analysis was done for data to come up with digital terrain models in a three dimensional figure to manifest earth surface. By these abilities, a digital data base was made for these properties that can be generalization for all soil properties and for all parts of Iraq, which enables to do the recyclization and treatment and analysis easily in making the designing and planning of any engineering project.

Keywords: Contour Digital Terrain Models , Marshes Soil, Global Positioning System(GPS), Geographic Information System(GIS).

INTRODUCTION

The area of the marshes is known as the southern part of the sedimentary plain, which is characterized by the existence of large marshes, which occupies areas in the form of a triangle head down to the city of Basrah, the base to the north represented by the line linking the cities of Maysan and Dhi Qar. Marshes are water areas in the south of Iraq and cover about (35000) Km^2 of the total area of Iraq. And because of its strategically and economical importance in addition to tourism, this study seemed to be important In this paper, some soil properties were studied , engineering properties (bearing capacity of soil) and pH values. These data were processed and analysed using GIS [3] [4], Where we note that the study covered the largest part and the basis of the map and there are some areas were not included in the study because of the lack of sufficient information to do so. [7] In this study, the map of the marshes of Iraq for 2008 issued by the General Authority for Surveying was adopted on a scale of 1: 250000 as shown in Figure (1). If the data to be used are not already in digital form, that is, in a form the computer can recognize, various techniques can capture the information. Maps can be digitized by hand-tracing with a computer mouse on the screen or on a digitizing tablet to collect the coordinates of features. Electronic scanners can also convert maps to digits. Coordinates from Global Positioning System (GPS) receivers can also be uploaded into a GIS. . [1][2]

A GIS can be used to emphasize the spatial relationships among the objects being mapped. While a computer-aided mapping system may represent a road simply as a line, a GIS may also recognize that road as the boundary between wetland and urban development between two census statistical areas. [1][2]

Data capture putting the information into the system involves identifying the objects on the map, their absolute location on the Earth's surface, and their spatial relationships. Software tools that automatically extract features from satellite images or aerial photographs are gradually replacing what has

traditionally been a time-consuming capture process. Objects are identified in a series of attribute tables the information part of a GIS. Spatial relationships, such as whether features intersect or whether they are adjacent, are the key to all GIS-based analysis. [5][6]

A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analyses new variables. For example, using GIS technology, it is possible to combine agricultural records with hydrographic data to determine which streams will carry certain levels of fertilizer runoff. Agricultural records can indicate how much pesticide has been applied to a parcel of land. By locating these parcels and intersecting them with streams, the GIS can be used to predict the amount of nutrient runoff in each stream. Then as streams converge, the total loads can be calculated downstream where the stream enters a lake. [1][2]

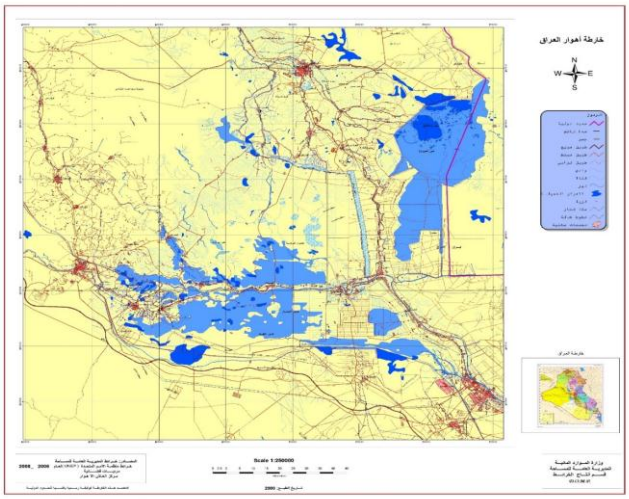

Figure 1. Marshes in Iraq on a scale of 1: 250000.

LINKING INFORMATION FROM DIFFERENT SOURCES:

If information on the soil properties of an area can be linked to aerial photos of the region, with some tabular data on soil, geology, and trends of inclination, it is possible to determine which land will be most bearable. The geographic information system, which can use information from various sources in its many forms, can assist in conducting this analysis. The primary data source needs are limited to different data locations, the place can be indicated in the three axes (X, Y, and Z) to reflect latitude, latitude and altitude, or other systems. Any variable element, which can be identified, can be used in the GIS. Many of the data-based computers, which could be covered by GIS, were produced by private enterprises. Various types of data can be covered by GIS.

DATA MODELLING

Modelling is an act of simulating reality, by constructing a model that enables us to understand a specific situation, or predict future outcomes from an activity. This model is a set of steps and rules, including spatial rules, for GIS. For example, it is difficult to link land maps with the amount of rainwater at a given point, such as airports, television stations and schools. GIS can be used to define properties in two or three dimensions, for surface, sub-surface and atmospheric aspects of specific information points. Such maps can be made of the soil properties of a region. The soil information was then taken from the selected areas and coordinates were determined by GPS. Also, in the same system, this information was inserted as columns in the Excel program where the first column of the zone name and the second and third columns of coordinates (N, E). The fourth column (Z) represents the values of bearing capacity of soil and acidity and alkaline levels as shown in Tables (1) and (2), respectively. These maps can then be produced using the GIS program as illustrated in Figures (2) and (3) which demonstrate the bearing capacity of soil pressure and basal and acid values of marshland as contour maps.

Table 1 The values of the coordinates for points of varying bearing capacity

Z(Elevation)	N(Northing)	E(Easting)	Areas
70.122	3419177.233	713703.765	Al-halfiaya
94.230	3495984.245	703683.654	Al-majer Al-khaber
67.550	3428320.456	666558.623	Al-Fhood
81.560	3449205.453	654928.123	Al-Aslah
63.880	3410108.987	747406.803	Al Sadir
55.654	3429243.876	723460.192	Al-Hoyer
41.998	3426152.987	677764.370	Al-Hammar
67.990	3424540.900	733893.179	Qurna
62.80	3429459.321	731676.274	Talha
72.20	3484598.334	633424.654	Al-Doaia
67.210	3504670.234	718540.987	Al-khala
71.230	3475130.980	702527.120	Al Fartos
63.780	3488778.908	730742.230	Bani Malik
63.890	3416682.990	652062.130	Kirma Bani Saeed

Table 2. Coordinates for points of varying pH values of soils

Z(Elevation)	N(Northing)	E(Easting)	Areas
9.120	3419177.675	713703.870	Al-halfiaya
7.410	3495984.990	703683.667	Al-majer Al-khaber
7.550	3489356.768	719918.880	Al-Fhood
7.560	3428320.880	666558.990	Al-Aslah
8.100	3449205.000	654928.078	Al Sadir
8.300	3410108.122	747406.753	Al-Hoyer
8.600	3429243.232	723460.332	Al-Hammar
9.200	3426152.739	677764.431	Qurna
9.400	3424540.007	733893.003	Talha
9.320	3429459.100	731676.023	Al-Doaia
8.500	3484598.002	633424.430	Al-khala
7.800	3504670.120	718540.013	Al Fartos
8.800	3475130.001	702527.124	Bani Malik
8.300	3488778.005	730742.005	Kirma Bani Saeed
7.700	34166820.521	652062.105	Al-halfiaya

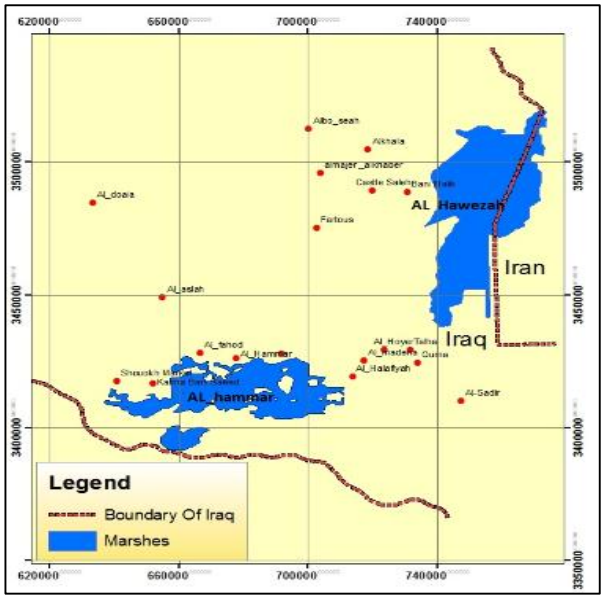

Figure 2. The map of Marshes in Iraq in GIS program.

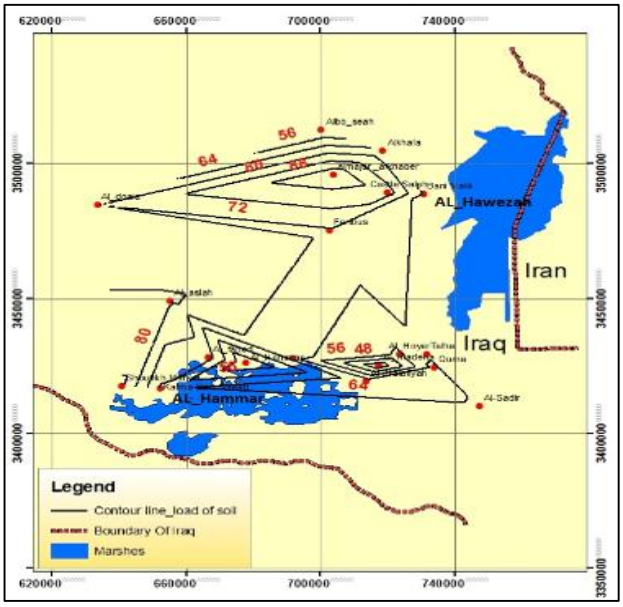

Figure 3. Contour map showing the values of bearing capacity in marshes soil

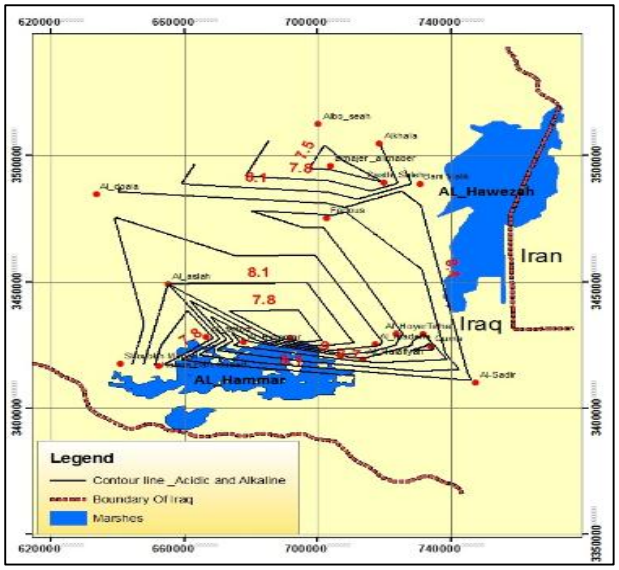

Figure 4. Contour map showing the values of pH in marshes soil

BUILDING A DIGITAL TERRAIN MODEL FOR SOIL PROPERTIES (DTM)

Using GIS spatial analysis, digital elevation models can be derived from these contour maps to illustrate the shape of the Earth's surface in three dimensions, as in Figures (5).

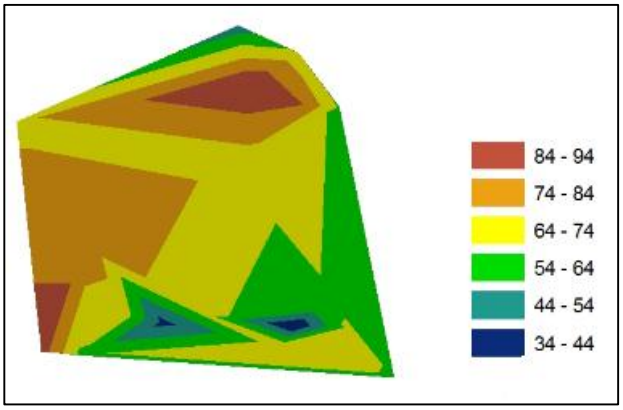

Figure 5. Digital Terrain Model for bearing (DTM).

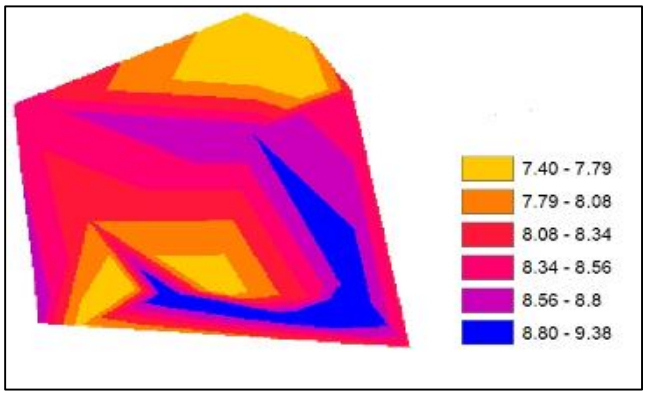

Figure 6. Digital Terrain Model for pH of marshes soil (DTM).

RESULTS AND DISCUSSIONS

- The soil of the marshes is of inhomogeneous soil so it is necessary to carry out soil investigations for all projects that will be established in the future and all areas near the marshes.
- Maps prepared by geographic information systems programs and the drawing of contour lines on areas that have not been sampled by knowing the value of the contour line that passes through this area helps us to know the values of bearing capacity of soil and the values of acidity of soil.
- The bearing capacity for soil of the marshes ranged from (35-95) kN / m^2.
- We have been able to get a three-dimensional shape and this form helps us to clarify the work well and know the nature of the distribution of these data on the soil and we can know the area covered by each of these properties where each colour is part of the property of soils.

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