The Use GIS To Assess The Environmental Impact Of Sewage Waste On Groundwater

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***Abstract*— The study aimed to use geographic information systems to create and upload digital maps to study the environmental management of the pollution of groundwater wells as a result of black wells in the municipality of Souq al-Jumaa, Shurfat Al Malaha area.**

The study showed the exposure of groundwater in the Shurfat Al Malaha area to pollution resulting from sewage water and its unsuitability for use, as the study area lacks sewage services, which led to the population's use of black wells, which led to the arrival of sewage water to the groundwater, carrying with it many Chemical pollutants (nitrates - biological oxygen requirement - chemical oxygen requirement). It also showed the ability of GIS to study water and its characteristics, produce accurate maps, assess the general situation of groundwater, and create geographical databases.

***Keywords*—black wells, environmental pollution, groundwater, geographic information systems.**

I. Introduction

The water problem is one of the most prominent problems that has increased in severity in recent times, especially in the Arab countries, and by virtue of Libya's location within the dry and semi-arid region, groundwater is the main source For water, it constitutes 98% of the exploited water resources.[1]

It is no longer a secret to anyone that there are environmental problems that threaten the underground water stock and the percentage of the individual getting his share of it, as well as the danger caused by sewage - whether domestic, industrial or rainwater with many environmental problems that directly affect the quality of the environment. [2]

In this research, the study was applied to the municipality of Souq al-Jumaa - Shurfat Al Malaha locality, using geographic information systems (GIS), where the locality of Shurfat Al Malaha is one of the areas that suffer from an imbalance in the water.

The importance of GIS applications in land use comes because it is an effective and modern way to deal with a huge amount of data and Information by linking or collecting a set of different data in different layers that can be dealt with automatically, and benefit. Therefore, GIS technology was used in the study through spatial analysis in evaluating and identifying groundwater wells, and preparing a database on the local environment of Shurfat Al Malaha locality.

II. Research problem

The study will address the problem of groundwater pollution, as the rapid increase in population and random urban expansion without expanding the development of the sewage network in the eastern region of the municipality of Souq al-Jumaa, which represents 33.8% [3] of the entire municipality area and the study area "Shurfat Al Malaha locality" is 22% of the total area.[3] It does not have a sewage network, which prompted the residents to find alternative solutions, namely, the use of black wells, even though these alternatives cause damage and corruption in the quality of water and soil and cause an imbalance in its ecosystem. The main objective of this research is to use geographic information systems to assess and monitor the suitability of groundwater for human use, as well as to provide a special model for groundwater based on its physical, chemical and bacteriological characteristics.

Where the applications of GIS were carried out according to data collected from several sources, and the aquifer was evaluated for a number of underground wells distributed over the entire study area, and accordingly, the subject of the study can be summarized in the following questions:

i) What is the spatial distribution of groundwater pollution?

ii) What are the depths of the underground wells that the pollution reached?

iii) Which areas have the most concentration of pollution?

III. Field and laboratory work

A. Study area

The study area (Shurfat Al Malaha locality) is located within the locality of Souq al-Jumaa municipality on the eastern side of the municipality, bordered on the north by the Mitiga base, on the south by the Al-Fath district, on the east by the Tajoura municipal council, and on the west by the Oqba bin Nafeh and Al-Gharrat localities, with an estimated area of 2665.6 square kilometers and extending between longitudes 13°16 '0"E -13°18'30"E)) and two latitudes (32°54'0"N-32°52'30"N) as in the map shown in Figure (1).[3]

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Fig. 1. Aerial image of the study area.

B. *Groundwater wells and black wells*

A group of subterranean wells and black wells were randomly distributed so that they are distributed over the entire study area with a number of 19 wells. The locations of these wells were determined using a Leica GPS1200 surveying device to determine the x- and y coordinates for each of these wells, as well as their depths as in the table (1)

TABLE I: COORDINATES OF UNDERGROUND WELLS & BLACK WELLS

No	Coordinates of underground wells			The coordinates of the black wells	
	E	N	depth	E	N
1	13.28189	13.28189	4.4	13.28152	32.88948
2	13.28359	13.28359	2.77	13.28357	32.88862
3	13.28007	13.28007	2.08	13.28006	32.88381
4	13.28572	13.28572	3.47	13.28572	32.88453
5	13.27786	13.27786	3.71	13.27785	32.88586
6	13.28727	13.28727	5.77	13.28745	32.88664
7	13.29137	13.29137	6.22	13.29124	32.88576
8	13.29179	13.29179	4.51	13.29152	32.88307
9	13.29149	13.29149	4.68	13.29154	32.88239
10	13.29085	13.29085	3.08	13.29078	32.8896
11	13.28035	13.28035	2.95	13.2804	32.89143
12	13.27546	13.27546	7.69	13.27577	32.8876
13	13.27614	13.27614	2.97	13.27599	32.88461
14	13.29922	13.29922	6.96	13.29904	32.88669
15	13.29705	13.29705	7.22	13.29687	32.88448
16	13.30557	13.30557	6.89	13.30555	32.88088
17	13.28395	13.28395	3.02	13.2838	32.89171
18	13.27783	13.27783	5.15	13.27772	32.88954
19	13.27292	13.27292	9.26	13.27308	32.89071

C. *Laboratory analyzes performed:*

2 samples were taken from each well for 19 wells, which are as follows:-

A sample in a half-liter bottle to be used in chemical analyzes to determine the concentration of chemical elements to be used in determining the BOD and COD and to determine the concentration of NO3.

These samples were transferred to laboratories under a temperature of about 20 degrees Celsius, where the necessary analyzes were carried out in the form of batches. The following results were obtained as in Table (2).

TABLE II: RESULTS OF LABORATORY TESTS FOR SAMPLES

No	Lab tests		
	COD mg/l	**BOD mg/l**	**NO_3 mg/l**
1	21.09	12.05	87.6
2	10.94	6.25	118
3	8.66	4.95	8.3
4	38.5	22	9.2
5	56.5	32.29	3.9
6	8.06	4.61	75.3
7	9.83	5.62	181.3
8	20	11.43	187.7
9	7.74	4.42	109
10	6.81	3.89	52.9
11	8.07	4.61	68.8
12	7.61	4.35	83.4
13	9.25	5.29	161.7
14	11.3	6.46	222.1
15	7.9	4.51	190.4
16	10.4	5.94	79.7
17	12.8	7.31	35.3
18	6.37	3.64	2.1
19	8.71	4.98	158

IV. DATA ANALYSIS

The data was analyzed using the Arc Map program and taking advantage of the tools that help in the analysis.

The (Spline) method was used in the analysis processes, due to its high efficiency when used to plot groundwater levels, rainwater quantities and pollutant concentrations. [4]

A. *Groundwater Depth Analysis*

The depth of the groundwater is one of the important variables because it determines the thickness of the materials that the water will pass through during its filtration downward and before it reaches the groundwater.

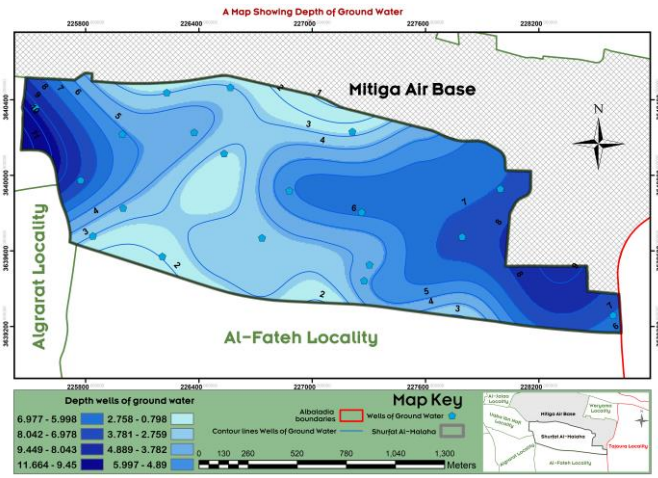

Fig. 2. Contour map of the depth of underground wells.

B. *Analysis of the concentration of chemical elements*

It is important to measure the concentration of chemical elements such as nitrate, BOD and COD because it is evidence of groundwater contamination that may come from black wells, and comparing these concentrations with the permissible ones according to the Libyan assay for drinking water 1992 AD.

1- Nitrate concentration (NO3):

Through the table (2) we note that the number of 4 wells can be considered unpolluted (3/4/5/18), while well No. (17) It is very close to about (35.3) milligrams / liter of the permissible concentration while the rest of the wells are of high concentration, as the concentration in the two wells (15/14) reached more than 4 times the permissible concentration , which is (45 mg / l), which makes The water of these wells is not suitable for drinking and indicates the contamination of the groundwater of this area with the water of black wells.

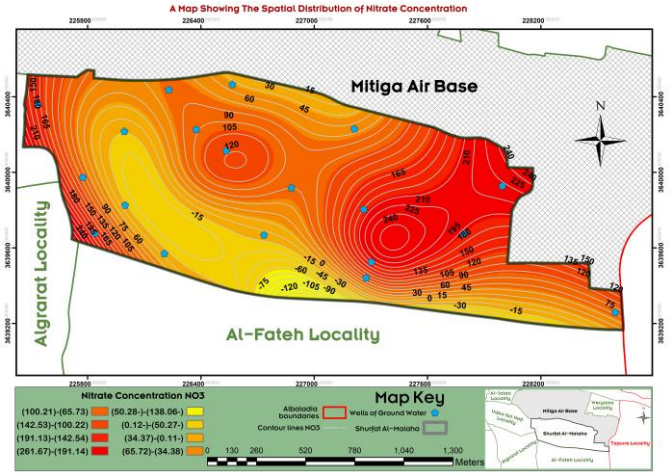

Fig. 3. Spatial distribution of nitrate concentration in well water.

2- BOD concentration:

Through the table (2), we note that the concentrations are different and varied, as the concentration was low in the wells (10/18). While the highest concentration was in well No. (4/ 5) which is considered a very high percentage that exceeds the permissible, which is (6 mg / l).

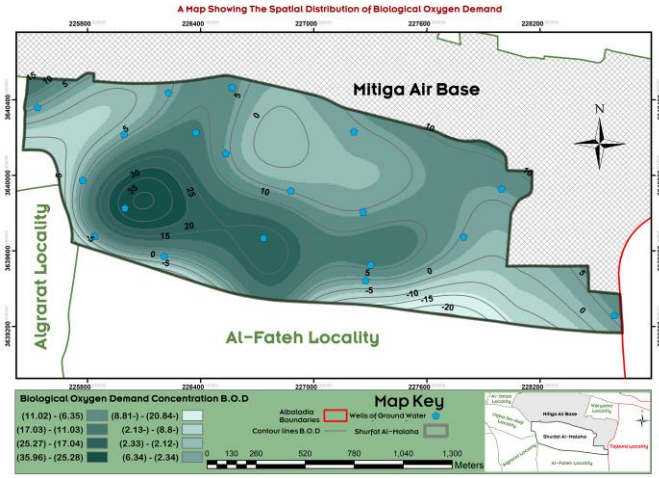

Fig. 4. Spatial distribution of BOD concentration in well water.

3- Concentration of (COD):

It is also considered one of the important indicators that indicate the contamination of groundwater with organic matter, which may be the source of black wells, and from table (2) it can be noted that the number of 11 wells out of 19 wells remarkably close to the degree of pollution permissible limit, which is 10 mg / l.

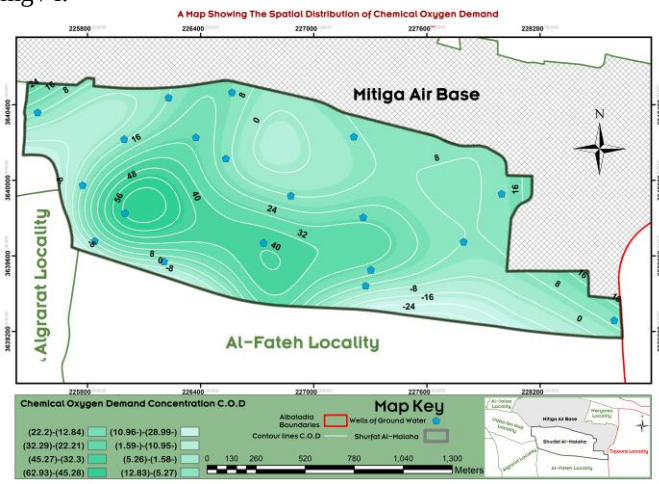

Fig. 5. Spatial distribution of COD concentration in well water.

V. EXTRACTING, PRESENTING AND DISCUSSING DATA:

GIS technology provides an effective tool in analyzing and evaluating the degree of groundwater pollution; Therefore, this technique is important for decision makers in reclaiming groundwater quality.

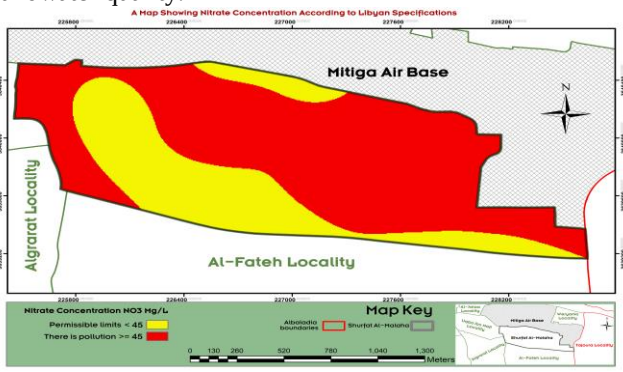

Fig. 6. No_3 concentration according to Libyan

specification

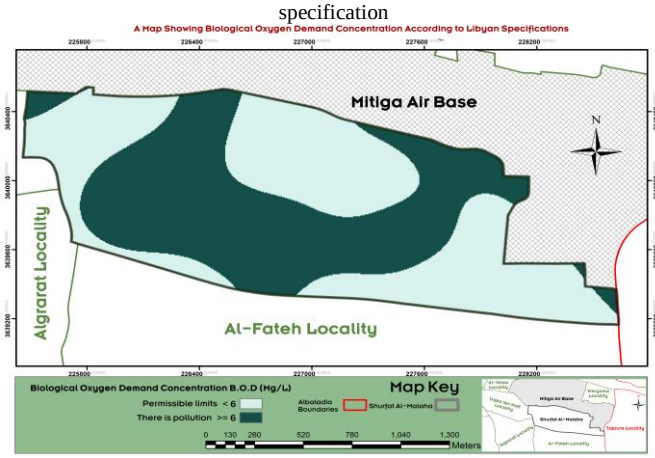

Fig. 7. BOD concentration according to Libyan specification

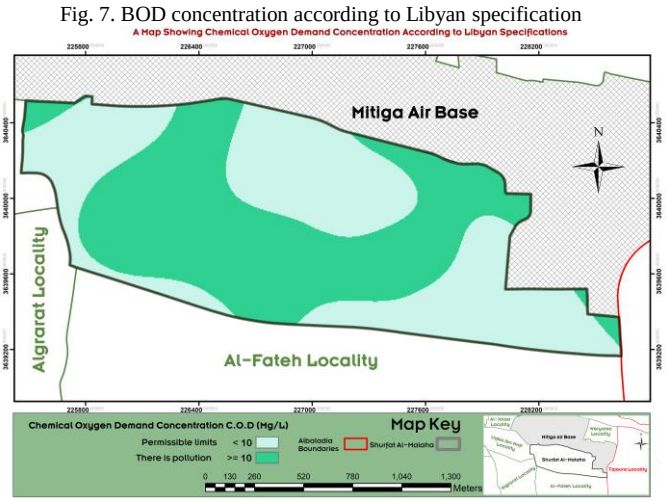

Fig. 8. COD concentration according to Libyan specification

VI. Conclusion

The study showed a set of results through achieving the objectives of this study, as follows:-

1. The ability of geographic information systems to study, evaluate and analyze the characteristics of the water situation, produce accurate maps that show pollution rates, and establish geographical databases for the chemical properties of drinking water in the study area.

2. The groundwater in this area has been contaminated by black well water, which is widely spread in the study area, where it was observed that the concentration of some elements that represent the pollution resulting from sewage water, the concentration of both the BOD and the COD as well as the presence of a high concentration of nitrates NO3, where the permissible limit has been exceeded. making it unfit for use and issuing a warning an environmental catastrophe threatens the health of the population.

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