

THE USE OF GIS CLOUD TECHNOLOGY IN ENVIRONMENT RISK MANAGEMENT

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المخلص

هدفت الدراسة إلى استخدام نظم المعلومات الجغرافية والتقنية السحابية في إنشاء ورفع خرائط رقمية لدراسة الإدارة البيئية لتلوث آبار المياه الجوفية نتيجة الآبار السوداء في بلدية سوق الجمعة منطقة شرفة الملاحة ومشاركة وتوعية المجتمع بحجم التلوث عن طريق نشر الخرائط باستخدام تقنية الحوسبة السحابية.

أظهرت الدراسة أن استخدام التقنية السحابية في دراسات المياه يساعد على توعية وإدراك المجتمع لحجم التلوث، مما يؤدي إلى خلق روح التعاون والمشاركة الإيجابية في محاولة تقليص المشكلة، علاوة على ذلك فإن خدمة التقنية السحابية تعمل على حفظ البيانات من التلف والمحافظة عليها وسهولة الوصول إليها.

ABSTRACT

The study aims to use Geographical Information Systems (GIS) and Cloud Technology to create and upload digital maps to study the environmental management of groundwater well pollution as a result of using septic tanks in the municipality of Souq al-Jumaa, Shurfat Al Malaha area, and to share and educate the community about the extent of the pollution by publishing maps using cloud computing technology.

The study shows that the use of cloud technology in water studies helps to raise awareness among the community about the extent of pollution, which leads to the creation of a spirit of cooperation and positive participation in an attempt to reduce the problem.

KEYWORDS: groundwater, septic tanks, environmental pollution, groundwater, spatial analysis, geographical information systems, cloud technology

INTRODUCTION

There were many disasters that faced many countries of the world. It drew the attention of those interested, as they found it difficult to obtain important data to get the right way to prevent these disasters and took a long time, and with the development of modern technologies available on the web and the steady increase in Internet speeds available to users, many Information institutions need to make their applications available for use through the internet in what is known as cloud computing.

From this point of view, GIS technologies also play a role, as the trend towards GIS Cloud. [1].

This technology provided its users with additional advanced advantages represented in saving expenses and making information services available to a larger segment of the beneficiaries, as all GIS tools, images and databases that you need are organized on the Internet, and it also provides the beneficiary and information institutions with the ability to store, process and transmit information and share it from anywhere and at any time without committing to use the personal computer as a tool for storage, processing, information transfer and sharing, but all these procedures are accomplished through

external servers available on the Internet cloud while ensuring the security of this information and preserving it from the abuses of hackers or viruses and GIS Cloud technology is one of the technologies that provides this feature to its subscribers, and it is a combination of running software and GIS service on the cloud and accessing GIS capabilities using the Internet. [2] (GIS Cloud) is the first website that relies entirely on electronic cloud technology "remote storage" that fully supports the advantages of GIS through the web, as it provides a professional visual environment, analyzes and clarifies geographical information.

RESEARCH PROBLEM

The study will address the problem of groundwater pollution, as the rapid increase of 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% of the entire municipality area. Shurfat Al Malaha locality covers about 22% of the total area of the municipality, with an estimated area of 2665.6 square kilometers (Figure (1)), and its coordinates are:

Longitudes: 13°16'0"E, 13°18'30"E

Latitudes: 32°54'0"N, 32°52'30"N

It does not have a sewage network system, which prompted the residents to find other solutions, most of them use septic tanks as alternative solution, which cause a damage of the quality of water and soil and cause an imbalance in their ecosystem [3].

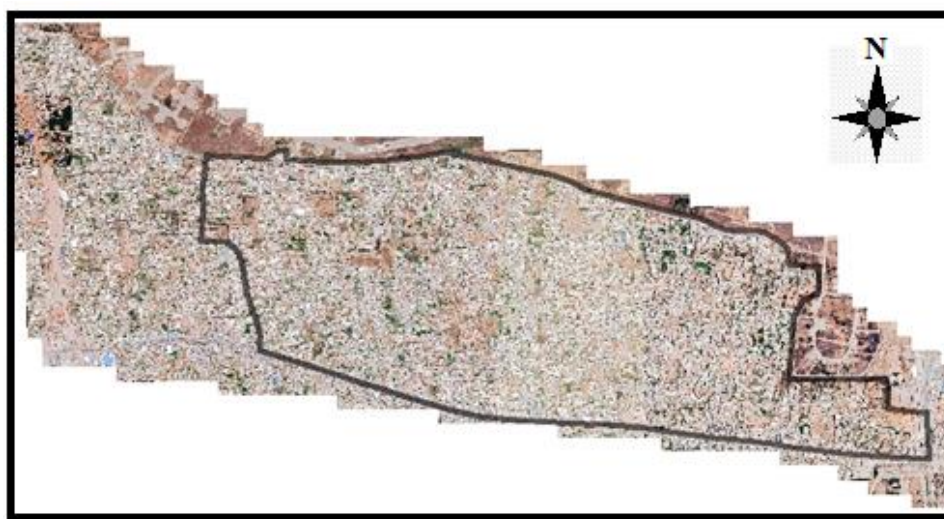


Figure 1: The study area " Shurfat Al Malaha "

These tanks are built without observing the lowest environmental safety conditions in terms of insulators, safety distance, direction and location of the septic tank from the water well. Also, the horizontal and vertical urban expansion in the region increases the number of septic tanks, and increasing the wastewater that infiltrate to the groundwater, which led to the pollution of groundwater. This critical case calls for shedding light on the reality of this pollution, and public opinion on the extent of water pollution, in order to reach conclusions, recommendations and proposals to alleviate the problems arising from it and deal with them properly.

The GIS Cloud Technology has been adopted to create and upload digital maps to study environmental management.

GIS CLOUD TECHNOLOGY

GIS website, produced by (ESRI), which is one of the leading companies in the information systems software industry, the site is completely based on electronic cloud technology “remote storage” fully supports the advantages of GIS through the web, providing a visual environment professional, analyzing, and clarifying the geographic information [4].

The objectives of the GIS cloud are to simplify the exchange of geographic information between the user and the service provider anywhere, and to analyze data regardless of the place [5].

DATA COLLECTION AND ENTRY INTO ARCGIS

All the necessary data related to the subject of this study were obtained from the Planning Office in the Municipal Council of Souq al-Jumaa.

Map Reference

The base map used in the study was obtained from Terra Incognita, and georeferencing was performed on the local coordinates "ELD 1979 Libya 7".

Water Wells

Groundwater wells distributed randomly over the entire study area. Water samples were taken from 19 wells located in this area. The coordinates of these wells were determined using a "Leica GPS1200" surveying device, also, their depths were observed.

These samples were analyzed chemically to determine the concentration of chemical elements like the Biological Oxygen Demanding (BOD), Chemical Oxygen Demanding (COD), and the concentration of Nitrate (NO₃) (Table 1). All the data obtained was entered into the ArcGIS program, and the wells were clarified as shown in (Figure 2).

Table 1: the results of laboratory tests for samples

| No. | NO ₃ (mg/L) | BOD (mg/L) | COD (mg/L) | E coli (cfu/ml) | (cfu/ml)Coliform |
|-----|---------------------------|---------------|---------------|--------------------|------------------|
| 1 | 87.6 | 12.05 | 21.09 | not detected | 20 |
| 2 | 118 | 6.25 | 10.94 | no detected | TNTC |
| 3 | 8.3 | 4.95 | 8.66 | not detected | not detected |
| 4 | 9.2 | 22 | 38.5 | not detected | 17 |
| 5 | 3.9 | 32.29 | 56.5 | not detected | TNTC |
| 6 | 75.3 | 4.61 | 8.06 | not detected | 15 |
| 7 | 181.3 | 5.62 | 9.83 | not detected | TNTC |
| 8 | 187.7 | 11.43 | 20 | not detected | TNTC |
| 9 | 109 | 4.42 | 7.74 | not detected | TNTC |
| 10 | 52.9 | 3.89 | 6.81 | 40 | TNTC |
| 11 | 68.8 | 4.61 | 8.07 | not detected | 100 |
| 12 | 83.4 | 4.35 | 7.61 | not detected | 80 |
| 13 | 161.7 | 5.29 | 9.25 | not detected | TNTC |
| 14 | 222.1 | 6.46 | 11.3 | not detected | TNTC |
| 15 | 190.4 | 4.51 | 7.9 | not detected | TNTC |
| 16 | 79.7 | 5.94 | 10.4 | not detected | not detected |
| 17 | 35.3 | 7.31 | 12.8 | not detected | not detected |
| 18 | 2.1 | 3.64 | 6.37 | not detected | not detected |
| 19 | 158 | 4.98 | 8.71 | not detected | TNTC |

Note: TNTC is an acronym for (Too Numerous to Count).

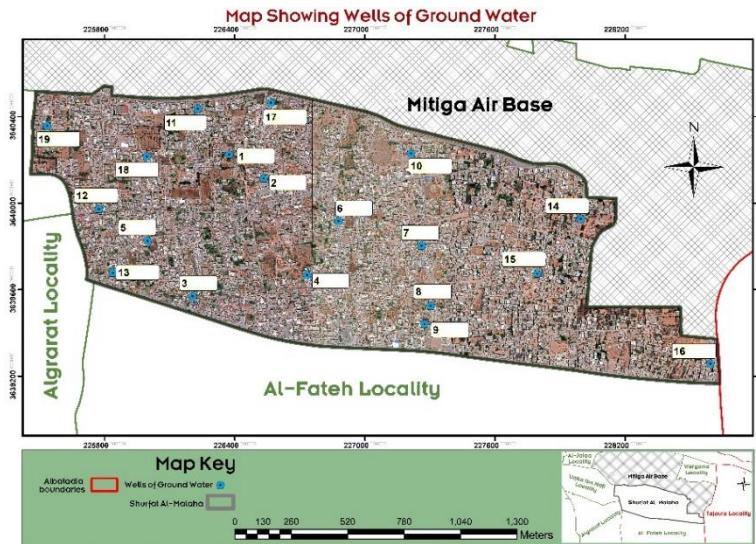


Figure 2: The wells locations from which samples were taken

DATA ANALYSIS

The data has been analyzed using the ArcMap program to produce a thematic map, and to deduce maps that allows to know the missing values from the measured values. The Spline format was used in the analysis processes, due to its high efficiency when used to plot groundwater levels, rainwater quantities and pollutant concentrations. This method draws a flexible predictive surface that passes over all the values of the samples, and it is able to predict the values of less and more than the values of the samples, but does not ignore them.

Groundwater Depth Analysis:

The depth of the groundwater is one of the important variables because it gives some indication about the depth of polluted water reached and the degree of pollution that effect the groundwater on that depth. To the level of groundwater will increase, and therefore its arrival with less impact and damage.

The Concentration of Chemical Elements and Microbial Contamination:

It is important to measure the concentration of chemical elements such as nitrate, BOD and COD because it is an evidence of groundwater contamination that may come from septic tanks. Biological analysis should be carried out to check if there is any kind of bacteria that is also considered pollutants in groundwater, the most important of this bacteria is the colon bacteria, specifically *Escherichia Coli*, as well as the bacteria (Coliform group bacteria)

PUBLISHING ON CLOUD TECHNOLOGY:

Publishing on the web using cloud technology needs to follow some procedures

Register on the GIS Cloud:

Registration on the GIS Cloud website is the first step you need to do through www.giscloud.com and creating an account by clicking on “Free Signup” and then entering the information of the registrant where it allows you to modify your personal information Login information and how to manage it.

Loading the Data:

The process of uploading data to the GIS Cloud Server is the most important stage in the project, because it depends on data in certain extension formats that can be uploaded

to the GIS Cloud Server [6]. Spatial data and image files related to the study were uploaded with the aim of spreading awareness, and sharing the community their participation about this problem.

The layers that should be uploaded were: a map of the administrative boundaries of the study area, samples of water wells with all their data represented in their depths (Figure 3) and chemical analysis, as well as a map of the spatial distribution of nitrate concentration (Figure 4, 5), BOD, and COD and their comparison with the permissible limits of the Libyan specification.

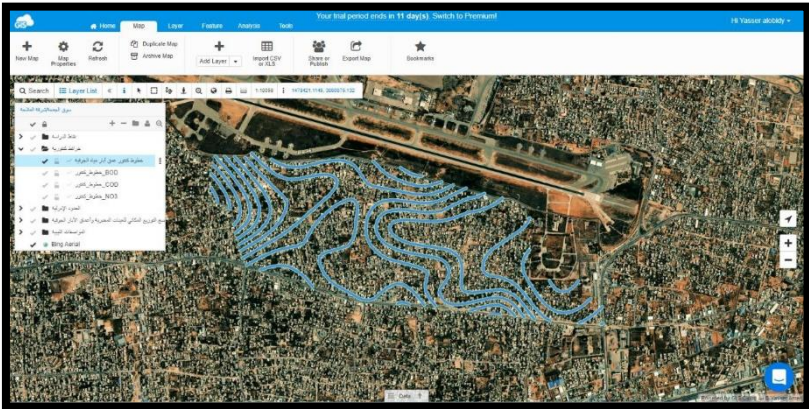


Figure 3: A contour map of the water wells’ depth in the study area

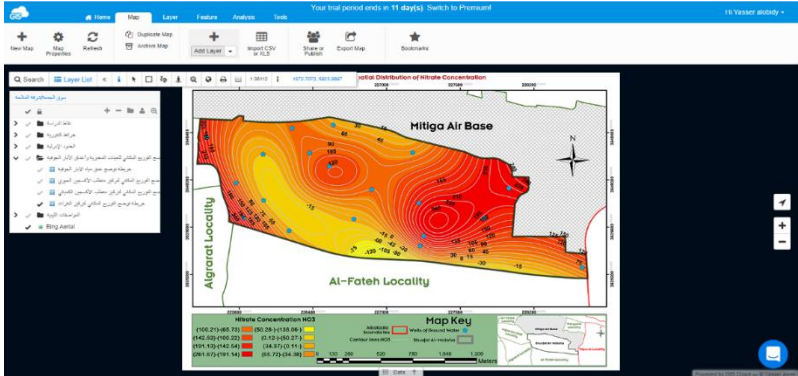


Figure 4: The spatial distribution of Nitrate concentration in well water located in the study area

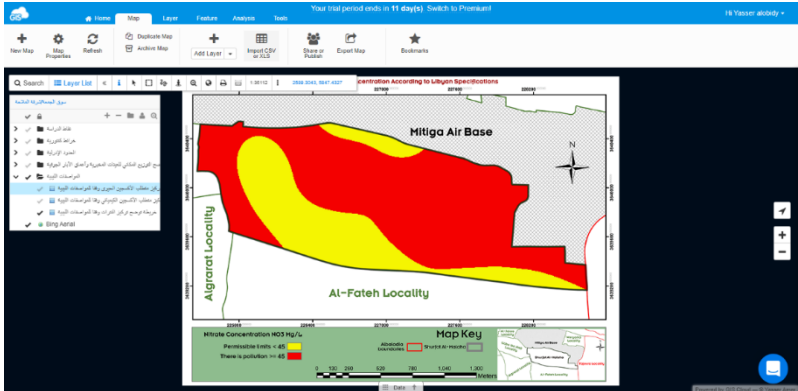


Figure (5) The concentration of nitrates according to Libyan specifications

With this technology, the volume of water pollution in the municipality of Souq al-Jumaa - the locality of Shurfat Al Malaha can be seen by everybody. Moreover, the users and

researchers allow to create, edit, modify, update, process and analyze geospatial and linear data. Thus, they can urge officials, especially those in the field of environment, local government and planning, to support the municipal council to solve the existing pollution problem.

CONCLUSION

The rapid increase in population and the random urban expansion without the expansion of the sewage network led the population to build septic tanks to drain their wastewater. Sewage water is considered one of the most important facts that causes groundwater pollution, making it one of the most serious problems that threaten people and their daily life.

The study aimed to use cloud computing to publish, preserve, and easily access maps. From the results achieved during this study, it is clear that: -

1. Uploading digital maps to cloud computing technology saves data from damage and helps to access them easily.
2. The process of creating an account on the GIS Cloud site and uploading the characteristics and chemical analyzes of groundwater works to raise awareness among the community and their awareness of the extent of the water problem in the study area.
3. The groundwater in this area has been contaminated by the contents of septic tanks, which are widely spread in the study area. It was observed that the concentration of some elements causes pollution resulting from sewage water. The concentration of both the biological oxygen requirement BOD and the chemical oxygen requirement COD exceeded the allowable limits in many wells (6, 10 mg/L, Libyan specifications 2015), which means an organic pollution, and a high concentration of nitrate NO_3 spread out in the area of study. Also, there is a large bacterial contamination of both E coli and coliform bacteria. The presence of this pollution led to a change in the properties of groundwater in the study area, up to well depths of 9 meters, and this gives a warning that threatens the health of the population.

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