A preliminary ecological analysis of spring water in Al-Shanafiyah District, Al-Qadisiyah Province, Southern Iraq

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Abstract

This research was conducted to assess the quality of spring water in the Al-Shanafiyah area of the Diwaniyah Province for a period of four months from September to December 30, when 3 samples were taken at average rates from Al-Qaim, Mashaher, and Obaid. The result showed that pH is natural and used for drinking and irrigation According to all samples and their most recent arrival (7.2-7.9), the standard limit for drinking water was noted (6.5-8.5). From turbidity effects in Al-Qaim spring water stays within its full limit per month, the standard limit for drinking water should be 5 NTU, but in the Obaid, spring water was allowed, except in November (10.1) NTU and December (11.2) NTU, to exceed the permissible limit, and readings exceeded normal Limits of pure drinking water, as shown in the Mashaher spring water, range (10.5-17.07) NTU results showed that the cataract was more saline special. The results showed a high degree of stiffness, except for the Al-Qaim spring. Alkaline Cataract readings still stay within the upper limit, despite their simplicity Increased levels and more than 200 mg/l of sulfate readings It should be observed to increase in all samples and to hit (1761-2351.5) mg/liter for all months, hence chloride readings confirm that this is the appropriate limit, remember the normal limit It should not exceed (600) mg/liter.

Keywords. springs water, groundwater, Al-Shanafiyah, parameters.

1. Introduction

Given the importance of water in all areas of life, attention has recently shifted to the exploitation of water springs due to the increase in population and the urgent need for water due to the shortage of rainwater and the scarcity of surface water. It is necessary to take care of these springs and protect them from pollution and drought and sustain them for future generations.

Springs are locations for the emergence of underground water On the surface of the Earth, sometimes forming a stream, pond, or wetland[1]. The importance of water in drinking, agriculture, industry, and urban development is involved in the process of preserving freshwater resources, one of the common problems in countries around the world, and requires setting up programs to monitor those water sources from pollution [2]. Groundwater is one of the most important parts of water resources, as it constitutes 71.7% of the drinking water in the world. Groundwater includes well and spring water, which originates mainly from rainwater and irrigation water that is drained into the ground and stored under its surface in non-porous layers to form reservoirs of water. Sub-surface area [3]. Water has a great and important role
in the revival and development of many societies of various living creatures. Since the dawn of civilization, people have been interested in water because it is the main artery of life on earth. An important basis in making life in all its forms and a guarantee for its continuity[4]. Given the increase in population growth rates, the expansion in resources, and the development of agricultural and industrial development, water has become an important place among natural resources, the scarcity of water and the problems related to its quality have significantly affected the ability of countries to ensure the supply of water to meet the future economic and environmental needs of the population at a time when it has become Water resources are scarce, and all this was accompanied by the increasing growth around this water source and the dependence mainly on agriculture without industry and the unregulated use of irrigation has exacerbated the problem. Estimates confirm that 80% of water use in the Middle East is for irrigation purposes [5].In Iraq, there is a large number of springs, as well water, which has increased in use in recent decades due to the increase in the agricultural area, the scarcity of surface water sources, and the lack of freshwater discharges to the country.[6]And due to the limited water supply in Iraq and the Arab world in general, the use of groundwater has become one of the important means to face the water deficit [7].A crucial step towards these objectives Checking and assessment of the changes in the efficiency of groundwater. Extensive analysis was carried out On tracking surface water[8].

The quality of water, which includes its physical, chemical, and biological properties, is one of the basic aspects in determining the validity of water. Many countries of the world have tended to set specific standards for water to evaluate and classify it, as the development in the fields of industry and agriculture and the increase in population numbers led to the deterioration of water sources suitable for consumption Human Rights and Reducing Opportunities for Providing Water Conforming to Standard Specifications [9].The groundwater contains several salts, which are mostly calcium and magnesium salts, and maybe in high concentrations to make this water hard due to its exposure to soluble substances in geological formations in addition to the salts transported in it[10], [11].Groundwater is considered one of the preferred sources of water due to the lack of need to treat it in most cases and the fact that its temperature and relative density are constant throughout the year almost as this helped to provide cheap water as the main source for drinking or other uses [12], [13].The purpose of the research is to know and study monthly changes in some of the physical and chemical properties of spring water quality, as well as to study monthly changes in the concentration of certain heavy elements. Measuring the biological diversity index of some of the dominant populations in the study area, as well as evaluating the suitability of this water for drinking, animal drinking and irrigation.

2. Description of the study area

Al-Shanafiyah district is located in the southwest of the Qadisiyah GovernorateThe city of Shanafiyah was established in 1832 ADAnd away from the governorate center about (72) from (the district center) The percentage of cultivated lands was approximately 40% of the rest of the fallow lands.In addition to what this aspect is famous for is the cultivation of corn, millet, and sesame, in addition to the cultivation of vegetables such as cucumbers, melons, watermelon, and other vegetables. (38)The Shanafiyah district is famous for cultivating rice, wheat, and barley in the winter. The sources of this city’s water are the main rivers (the Shanafiyah River, the Qadisiyah River, the Haffar Stream) in addition to the presence of many artesian wells around (29 wells) and natural springs scattered in different areas of the district, which amount to (24 springs),In this current study, three sampling sites were chosen as follows
a. **Site 1**  
Al-Qaim spring This spring is located in the Al-Asra region, about 14 km from the center of the Shanafiyah district. It is located at about 31° 35′ 22.36 ″ N 44° 32′ 33.02 ″ E. The depth of these springs is about 1 meter and extends the source water from these springs to a distance of 7 km. As it is characterized by biodiversity in this region and the advantage of the presence of plants, including the reed plant *phragmites australis*, also *Tamarixaphylla* and Also, the palm *Phoenix dactylifera* is found in its vicinity. There are also some aquatic animals such as *Acanthopagruslatus*, As shown in Figure (1) to illustrate the location of the Al-Qaim water spring.

![Figure (1) to illustrate the water spring of Al-Qaim in Al-Shanafiyah](image1)

b. **Site 2.**  
Mashaher Spring is located in the Khusuf region, As it is about 12 km from the center of El-Shanafiyah, its depth ranges from 90 cm and its length is 5 meters. The advantage of the presence of plants, including the reed plant *phragmites australis*, *Tamarixaphylla* and *Alhagigraecorum*. But it lacks biodiversity due to its geographical location in the desert. The water of this spring is used to wash sand for building and construction materials. As in Figure (2), shows Mashaher water spring.

![Figure (2) to show Mashaher water spring](image2)
c. Site 3. Obaid springs are located in the village of Saar Al-Awda, about 23 km away from the center of Al-Shinafiya, and are characterized by the presence of plants reeds *Phragmites australis* and *Tamarixaphylla*, palms *Phoenix dactylifera*, and *Alhagigraecorum*, and some animals such as cattle, and sheep. The residents of the region depend on these springs for drinking, domestic use, plant watering, and animal watering. As Figure (3) shows the Obaid water spring.

3. Methodology

Then this study took samples from the water springs from (Al-Qaim spring, Mashaher springs, Obaid spring), which are located in the Shanafiyah desert and about 20 km away from the Shanafiyah center, so 30 samples were taken at the rate of 3 water samples for each spring per month for 4 months by clean bottles. And a sterile prepared in advance where physical and chemical field tests were carried out.

- Water samples were collected for physical and chemical examinations and heavy element examinations by three replications. Each sample was taken from the water surface using 5-liter polyethylene containers, then washed with dilute hydrochloric acid (10%), then washed with distilled water, and then with re-distilled water[14].
- Water samples were collected using transparent and opaque (250) ml glass bottles (Winkler bottles) to estimate the dissolved oxygen DO and the biochemical oxygen requirement for $BOD_5$.

4. Physical examinations

a. Temperature. The air and water temperature was measured by a graded mercury thermometer from (0 - 100) C.

b. Electrical conductivity. The electrical conductivity was measured by the electrical conductivity meter (Cond7110) of German origin, after calibrating it with standard solutions, and the results were expressed in microsiemens/cm.
c. **Turbidity.** The turbidity meter (2020wi) was used by LaMotte of American origin after calibrating it with standard solutions to measure turbidity, and the results were expressed in the (NTU) unit.

d. **Total dissolved solids (T.D.S).** The method described by the American Public Health Association [15] was followed by filtering 100 ml of the sample through 0.45 m filter paper, then evaporating the filtrate in an oven at a temperature of (103-105) °C to estimate the value of dissolved solids and expressing the results in units of mg/liter.

e. **Total suspended solids (T.S.S).** It was measured by following the method described by the American Public Health Association[15] by filtering 100 ml of the sample through the filter paper 0.45 μm with a known weight, then the paper was dried at a temperature (103-105 m) to estimate the value of suspended solids, and the results were expressed in units of mg/liter.

5. **Chemical examinations**

a. **pH.** The pH was measured by a pH meter model (SD300pH) of the company (lovi bond) of German origin after calibrating it with standard buffering solutions.

b. **Dissolved oxygen.** The Winkler method (modulating Azide), described by the American Public Health Association, was followed to determine the amount of dissolved oxygen after field stabilization and then washed with a solution of sodium thiosulfate (0.025 M), and the results were expressed mg/liter.

c. **Biochemical oxygen demand (BOD).** The biochemical oxygen requirement was measured according to the following[15] As follows

- **Samples that do not need dilution.** The opaque and uncleaned Winkler bottles were incubated for 5 days at 20 °C. Then the dissolved oxygen was measured and the difference with the primary dissolved oxygen DO represents the BOD value in mg/liter. [16]

  \[ \text{BOD5 mg/L}= \text{Dissolve oxygen initial} \text{– Dissolve oxygen (after 5 days incubation)} \]

- **Samples needing dilution**
  As the sample was diluted with oxygen-saturated water, then two Winkler bottles were filled, one of them transparent, in which the oxygen was fixed directly in the field to estimate the primary dissolved oxygen, D1 and the other opaque and unfixed and placed in the incubator for 5 days at a temperature of 20 °C after which the final dissolved oxygen was estimated D2. The results were expressed in mg / L

  \[ \text{BOD5}= \frac{D1-D2}{P} \]

  As:

  D1: the dissolved oxygen of the diluted sample immediately after the dilution in mg / L.
  D2: the dissolved oxygen of the sample was diluted after incubation for 5 days at a temperature of 20 mm in mg / L.
  P: dilution factor

d. **Total alkalinity.** The method described by [17] in estimating the alkalinity of water samples was followed by correction of 100 ml of the sample with a standard solution of sulfuric acid (N 0.02) and the orange methylation was used as a guide and the results were expressed in units of mg; CaCO3 / L.
e. **Total hardness.** Total hardness was estimated by following the method mentioned in [15] by correcting 50 ml of the diluted sample with Na2EDTA standard solution (0.01 M) after adding 1 ml of buffer solution and using Eriochrome Black T dye as a guide and expressing the results in units. CaCO3 mg/liter.

f. **Calcium hardness.** Calcium hardness was determined by following the method mentioned in [15] by correcting 50 ml of the sample with a standard Na2EDTA solution (0.01 M) after adding 2 ml of NaOH solution (IN) to raise the pH value to (12-13) and the use of the murexide dye as evidence and the results were expressed in units of mg CaCO3/liter.

g. **Magnesium.** Irradiated the method mentioned in [15] to calculate the magnesium concentration, according to the following equation:

\[
\text{Mg} / \text{L} = \left[\text{total hardness (as mg CaCO}_3/\text{L}) - \text{calcium hardness (as mg CaCO}_3/\text{L})\right] \times 0.243
\]

and the result is expressed in units of CaCO3 mg/L.

h. **Sodium and Potassium.** Sodium and Potassium were determined using the Flame photometer model 375 Elica CL, and the results were expressed in units of mg/L [15].

i. **Chloride.** Followed by the correction method with silver nitrate mentioned in (2005, APHA, to estimate the concentration of potassium in a bank of potassium spores to 100 ml of the lozenge, then d with a solution of standard silver nitrate (141N 0,0) until the brown color appears. Results in units of milligrams/L as in the following

\[
\text{CL}^- \text{mg/L} = \frac{(A - B) \times N \times 35450}{\text{ml of sample}}
\]

A: The standard volume of silver nitrate used to correct the sample (ml).
B: The standard volume of silver nitrate used to correct distilled water (ml).
N: The genius of a nitrate solution

j. **Sulfate.** Sulfates The Turbiditmetric Method described by the American Public Health Association [15] was followed for estimating sulfates by adding 20 ml of the Buffer solution A to (100) ml of the sample with mixing, then add a spoonful of barium chloride crystals (BaCl2 crystal), after which the absorbance is measured over a wavelength of 420 nm by the spectrophotometer model UVmini-1240 -, and express the results in units -mg/liter

k. **Phosphates.** Follow the stannous chloride method described by the American Public Health Association [15] to measure the phosphate concentration by adding 4 ml of ammonium molybdate solution and 10 drops of tin chloride solution to 100 ml of the sample and then measure the absorbance on Wavelength 690 nm by the spectrophotometer model UVmini-1240, company (SHIMADZU), origin (Japan)- and the results are expressed in μg/L units

6. **Results and discussion**

Note through the results obtained from this research that the pH values were within the permissible limits for drinking and watering in all eyes and all the studied months, reaching between (7.2-7.9) and that the permissible limits are (6.5-8.5). About turbidity, which is one of the important criteria, and its cause is
the presence of suspended substances such as clay, silts, organic materials with fine particles and microorganisms, it is noted from Table (1) the water of spring the Al-Qaim has noticed in al-Qaim spring that turbidity was within the permissible limits (NTU 5). As for the conductivity, which expresses the ability of water to carry electric current and depends on the concentration of dissolved ions in the water, the acids, bases, and inorganic salts dissolved in the water are good conductors of the electric current, and through the tables (1,2,3) we note that these springs are very high salinity, especially a spring For Mashaher, the conductivity values were very high, as the water with conductivity 2250 is classified as very salty water for irrigation, which indicates that this water cannot be used for drinking and it is not recommended to use it for watering because it adds salts for breeding, so it reduces the fertility of the soil as many plants do not tolerate this High salinity, therefore, its productivity is low, as This rise indicates the natural level of salinity variation, as the groundwater salinity increases with the direction of its movement from the feeding areas to the drainage areas[18]. Regarding the concentration of salinity or total dissolved salts, which is an essential factor in assessing water suitability for irrigation, it can be said that water is not suitable for agricultural purposes. It is noted that it is high in all samples, and this is related to the presence of all dissolved salts formed as a result of natural factors or as a result of their addition from some treatments such as fertilizers, Which are added to the soil or as a result of organic waste added directly or indirectly [19]. As for hardness, it is the total concentration of calcium and magnesium ions in the water, and when there are other salts, they enter it. From the tables (1,2,3), it is noticed that the high hardness in the water of these springs is noticed, except for the spring of al-Qaim, where the hardness was somewhat acceptable.

The reason for its elevation is its association with other ions such as calcium, which is also high in all the results that the presence of calcium is related to the nature of the soils in which this water is present in addition to several other ions such as magnesium, iron, aluminum, and manganese. The hardness of the water is related to the geological character of the land through which the water runs or passes, and since the calcium ions, sulfates and chlorides are high, it is expected that hardness will be high in these waters. . As for the alkalinity, water can form a strong acid at a certain pH, meaning that it has a close relationship with the water's pH and depends on many ions such as carbonates, bicarbonate, and phosphates., which are widely distributed in most natural waters, reach from several hundred to a thousand milligrams per liter. Because they have limited solubility in the water, there are limited quantities in surface waters, except for the waters of affluent areas, and their concentration increases in groundwater or increases due to the disposal of liquid wastes—containing sulfates such as fertilizer plants and others. Through the results, we notice a significant increase in the percentage of sulfates in all eyes and in all the studied months, where it was in huge quantities, ranging between (1330-2861) mg/liter. The presence of sulfates in these quantities leads to the occurrence of severe diarrhea. When drinking water containing these quantities of sulfates, knowing that the permissible limits for drinking are 200 mg/liter, and when used for irrigation, its value should be approximately 400 mg/liter. Sulfates are among the substances that cause salinity and give an unwanted salt taste, so this water is considered. In all springs, it is not suitable for drinking or watering in terms of the presence of sulfates. About chlorides, which are among the essential negative ions present in natural water, we note from the results in all the studied springs, Where it is noticed in all months and all samples exceeded the permissible limit, as it ranged between (690-1094) mg/liter, noting that the permissible limits are 600 mg/liter. As for the vital oxygen requirement (BOD),all results were within the permissible limits, and that these limits are three, and this measurement depends on determining the amount of dissolved oxygen consumed by microorganisms in the
decomposition of organic materials during a specific period at a degree of 20 C5. From the above results, it is recommended not to use this water for drinking until after it has been treated. As for watering, it is possible to irrigate only salt-tolerant plants. It is also recommended to use this water for recreation because of its minerals in large quantities.

Table No. (1) shows the physical and chemical tests of the Al-Qaim spring

| Parameters       | September | October | November | December |
|------------------|-----------|---------|----------|----------|
| pH               | 7.2       | 7.09    | 7.03     | 7.7      |
| T.D.S Mg/L       | 2820      | 2760    | 3685.5   | 3679.6   |
| E.C µS/CM        | 4.50      | 4.55    | 4.01     | 4.57     |
| Turb. (NTU)      | 1.07      | 1.5     | 4.7      | 4.2      |
| B.O.D5 (Mg/L)    | 1.3       | 1.7     | 2.3      | 2.5      |
| Total Alk (Mg/L) | 206       | 211     | 154      | 160      |
| TH (Mg/L)        | 1567      | 1594    | 1940     | 1958     |
| Ca²⁺ (Mg/L)      | 384       | 346     | 396      | 387      |
| Mg²⁺ (Mg/L)      | 175       | 160     | 194      | 239      |
| PO₄³⁻ (Mg/L)     | 0.1430    | 0.1543  | 0.1578   | 0.1467   |
| SO₄²⁻ (Mg/L)     | 1761      | 1330    | 1789     | 1690     |
| Cl⁻ (Mg/L)       | 690       | 768     | 980      | 804      |

Table. (2) shows the physical and chemical examinations of the Mashaher spring

| Parameters       | September | October | November | December |
|------------------|-----------|---------|----------|----------|
| pH               | 7.90      | 7.98    | 7.82     | 7.96     |
| T.D.S (Mg/L)     | 4820      | 4760    | 4685.5   | 5679.6   |
| E.C(µS/ CM)      | 5.64      | 5.90    | 6.08     | 5.76     |
| Turb.(NTU)       | 17.07     | 10.5    | 16.1     | 15.2     |
| B.O.D₅ (Mg/L)    | 12.3      | 11.7    | 7.3      | 12.5     |
| T. Alk. (Mg/L)   | 204       | 186     | 196      | 205      |
| TH (Mg/L)        | 2567      | 2594    | 2940     | 2958     |
| Ca²⁺ (Mg/L)      | 480       | 441     | 496      | 487      |
| Mg²⁺ (Mg/L)      | 275       | 260     | 294      | 293      |
| PO₄³⁻ (Mg/L)     | 0.1730    | 0.1643  | 0.1478   | 0.1767   |
Table. (3) shows the physical and chemical tests of the Obaid Spring

| Parameters                  | September | October | November | December |
|-----------------------------|-----------|---------|----------|----------|
| pH                          | 7.77      | 7.87    | 7.60     | 7.56     |
| T.D.S Mg/L                  | 3820      | 3760    | 3685.5   | 3673.6   |
| E.C μS/CM                   | 4.48      | 4.98    | 4.65     | 5.90     |
| Tur NTU                     | 5.07      | 4.5     | 10.1     | 11.2     |
| B.O.D₅ Mg/L                 | 1.2       | 1.5     | 2.1      | 2.8      |
| Total alkalinity Mg/L       | 133       | 121     | 144      | 170      |
| Total hardness Mg/L         | 1687      | 1896    | 1965     | 1920     |
| Ca²⁺ Mg/L                   | 367       | 380     | 386      | 395      |
| Mg²⁺ Mg/L                   | 257       | 208     | 192      | 244      |
| PO₄³⁻ Mg/L                  | 0.1630    | 0.1693  | 0.1778   | 0.1767   |
| SO₄²⁻ Mg/L                  | 2861      | 2630    | 2589     | 2790     |
| Cl⁻ Mg/L                    | 790       | 788     | 830      | 803      |

7. The viability of water springs

The validity of groundwater for human consumption, irrigation, or industrial purposes is related to its physical and chemical properties. This validity can be determined by comparing the analyzes of water samples with global determinants.

8. The validity of spring water for human consumption (drinking water)
Through the results of physical and chemical tests measured for comparison with the World Health Organization (WHO, 2007), as well as Iraqi standards for drinking water (IQS, 2009) it was found that this water is not suitable for drinking for humans in Table (4).

Table (4) standards for drinking water (WHO 2007, IQS2009)

| Parameter (ppm) | IQS standard 2009 | WHO 2007 |
|----------------|------------------|---------|
| pH             | 6.5 – 8.5        | 6.5 – 8.5 |
| Ca+²           | 150              | 75      |
| Mg+²           | 100              | 125     |
| Na+            | 200              | 200     |
| Cl             | 350              | 250     |
| SO4²⁻         | 400              | 250     |
| TDS            | 1000             | 1000    |

9. The validity of spring water for animal consumption. Depending on the classification made by the scientist (Altoviski, 1962) it was found that this water is suitable for animal consumption according to Table (5)

Table (5) Standards of water validity for animal consumption (Altoviski, 1962).

| Element (ppm) | Very good water | Good water | Permit | Can be use | Threshold |
|---------------|-----------------|------------|--------|------------|-----------|
| TDS           | 3000            | 5000       | 7000   | 10000      | 15000     |
| TH            | 1500            | 3200       | 4000   | 4700       | 54000     |
| Na            | 800             | 1500       | 2000   | 2500       | 4000      |
| Ca            | 350             | 700        | 800    | 900        | 1000      |
| Mg            | 150             | 350        | 500    | 600        | 700       |
| Cl            | 900             | 2000       | 3000   | 4000       | 6000      |
| SO4²⁻         | 1000            | 2500       | 3000   | 4000       | 6000      |

10. The validity of using water for irrigation purposes. The use of water for irrigation purposes depends on the hydrochemical variables and dissolved salts (TDS) and the percentage of sodium ion (Na%) and the percentage of sodium adsorption. (From comparing the results from the (Train, 1979,) classification in Table (6), we find that the water of the study area can be used for irrigation of plants with high salt tolerance and that its use requires experience.

Table (6) shows the validity of previously using water for irrigation purposes

Classification (Train,1979).

| TDS (ppm) | The use of water for irrigation does not cause harmful effects. |
|-----------|----------------------------------------------------------------|
11. Conclusion

During the evaluation of the quality of the spring water in Shanafiyah, it was found that it is not suitable for drinking and not suitable for human consumption due to exceeding the permissible values during the analysis of the results. This water can be used for animal consumption. Regarding the validity of water for irrigation, this water must be irrigated to plants that tolerate salinity because it is these spring water with high salinity in it and you need experience in its use.

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