Data Article

Groundwater quality assessment for drinking and agriculture purposes in Abhar city, Iran

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A B S T R A C T

The main objective of this study is to assess the quality of groundwater for drinking consume and agriculture purposes in abhar city. The analytical results shows higher concentration of electrical conductivity (100%), total hardness (66.7%), total dissolved solids (40%), magnesium (23%), Sulfate (13.3%) which indicates signs of deterioration as per WHO and Iranian standards for drinking consume. Agricultural index, in terms of the hardness index, 73.3% of the samples in hard water category and 73.3% in sodium content were classified as good. Therefore, the main problem in the agricultural sector was the total hardness Water was estimated. For the RSC index, all 100% of the samples were desirable. In the physicochemical parameters of drinking water, 100% of the samples were undesirable in terms of electrical conductivity.

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and 100% of the samples were desirable for sodium and chlorine parameters. Therefore, the main water problem in Abhar is related to electrical conductivity and water total hardness.

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### Specifications Table

| Subject area | Chemistry |
|--------------|-----------|
| More specific subject area | Describe narrower subject area |
| Type of data | Tables and figure |
| How data was acquired | EC, pH and chloride were analyzed using multiple parameters ion meter model Thermo Orion 5 Star. Sulfate (SO₄⁻²) was measured using a double beam UV–Vis spectrophotometer model Perkin Elmer Lambda 35 by turbidmetric, stannous chloride, and molybdo silicate, respectively. Sodium, calcium and magnesium were analyzed using flame photometer model CL-378 (Elico, India). Total hardness was determined by EDTA titrimetric method. TDS was measured gravimetrically. Agricultural indicator such as SAR, RSC, PI, KR, MH, and PS, % Na, SSP and TH were calculated using their formulas. |

| Data format | Raw, Analyzed |
|-------------|---------------|
| Experimental factors | All water samples in polyethylene bottles were stored in a dark place at room temperature until the metals analysis |
| Experimental features | Determine the content levels of physical and chemical parameters |
| Data source location | Abhar, Zanjan province, Iran |
| Data accessibility | Data are included in this article |

### Value of data

- Determination of the Agricultural and drinking water indices including SAR, %Na, SSP, MH, KR, RSC, EC, Ca²⁺, Mg²⁺, pH, TDS, TH, HCO₃⁻, Na⁺, K⁺, Cl⁻, and SO₄²⁻ in ground water was conducted in Abhar city, Iran.
- The level of EC, TDS and total hardness in the water samples indicates that maximum of them are unsuitable for drinking consume.
- Agricultural indices such as SAR and SSP indicated 100, 90% of samples in the studied area had SAR and SSP values within the excellent category respectively for irrigation purposes.
- Data of this study can help to better understand the quality of groundwater in this area.
- The present data of this study recommends that regular monitoring of groundwater is essential to avoid major environmental threat.

### 1. Data

Summary of the physical and chemical variables for the collected groundwater samples were presented in Table 1. The analytical results show higher concentration of electrical conductivity (100%), total hardness (66.7%), total dissolved solids (40%), magnesium (23%), Sulphate (13.3%) which indicates signs of deterioration as per WHO and Iranian standards for drinking consume Table 2.
As shown in Tables 3, 4, the calculated SAR, SSP, PI, MH, KR and Na% values were compared with the groundwater quality classification, where 100,90% of samples in the studied area had SAR and SSP values within the excellent category respectively for irrigation purposes.
2. Experimental design, materials and methods

2.1. Study area description

Abhar is one of the cities of Zanjan province and Abhar city center. The city with 99,285 people in 2016 is considered as the second most populated city of Zanjan province after Zanjan city. The height of Abhar city is 1540 m. The maximum relative humidity in the city is 94.4% and at least 23.3%. The average annual rainfall is 300 mm. This area is considered as a semi-cold and dry in Iran country [8] (Fig. 1).

2.2. Determination of the physico-chemical parameters concentration and agricultural indicators

In order to assess the physico-chemical parameters, a total of 30 samples taken from Abhar County (Fig. 1). Water samples were collected in a plastic container of 1-L capacity for detailed chemical analysis from all observation wells. These containers were washed thoroughly with distilled water and dried before being filled with water samples. The containers were numbered serially along with a proper record of well/sample location, date, static water level, and prior to the sampling. Groundwater samples were collected after the well was subjected to pumping for at least 5–10 min to obtain the composite sample. The pH and EC of the groundwater of the wells were measured by using HACH HQ40d and its in situ values are recorded [9–15].

| Well ID | RSC  | PI   | KR   | MH   | Na%  | SAR  | SSP |
|---------|------|------|------|------|------|------|-----|
| P1      | 0.12 | 59.16| 0.50 | 39.79| 33.60| 1.83 | 33.27|
| P2      | −0.21| 58.89| 0.33 | 54.80| 25.56| 1.03 | 25.08|
| P3      | −1.28| 72.17| 1.16 | 35.04| 53.81| 3.47 | 53.67|
| P4      | −0.2 | 55.20| 0.52 | 25.21| 34.68| 2.31 | 34.37|
| P5      | −0.33| 62.48| 0.44 | 43.76| 31.09| 1.32 | 30.77|
| P6      | 0.43 | 66.03| 0.61 | 52.00| 38.24| 1.97 | 37.80|
| P7      | −2.64| 63.63| 0.91 | 41.95| 47.72| 3.10 | 47.58|
| P8      | 0.68 | 69.60| 0.56 | 32.62| 36.17| 1.62 | 35.88|
| P9      | −0.48| 58.65| 0.43 | 37.86| 30.74| 1.44 | 30.30|
| P10     | 0.04 | 60.86| 0.47 | 48.38| 32.52| 1.56 | 31.86|
| P11     | 0.27 | 66.69| 0.59 | 53.04| 37.65| 1.82 | 37.07|
| P12     | 0.32 | 58.42| 0.49 | 31.81| 33.15| 1.86 | 32.84|
| P13     | −0.61| 51.99| 0.20 | 57.00| 17.42| 0.64 | 17.00|
| P14     | 0.43 | 65.73| 0.55 | 44.02| 35.72| 1.72 | 35.39|
| P15     | −0.08| 57.53| 0.32 | 33.01| 24.82| 1.03 | 24.37|
| P16     | −0.08| 65.13| 0.59 | 36.49| 37.45| 1.86 | 37.14|
| P17     | 1.07 | 82.87| 1.10 | 37.23| 52.76| 2.82 | 52.49|
| P18     | 0.2  | 73.28| 0.41 | 28.99| 29.41| 0.96 | 29.05|
| P19     | 0.16 | 71.82| 0.46 | 21.05| 31.84| 1.14 | 31.53|
| P20     | 0.24 | 75.40| 0.61 | 21.62| 38.20| 1.48 | 37.82|
| P21     | −1.84| 63.68| 0.82 | 33.06| 45.27| 2.86 | 45.08|
| P22     | 0.24 | 73.79| 0.44 | 25.71| 30.86| 1.04 | 30.52|
| P23     | −0.08| 72.89| 0.99 | 36.42| 49.95| 3.02 | 49.78|
| P24     | 0.12 | 66.42| 0.29 | 27.16| 23.04| 0.75 | 22.67|
| P25     | −0.08| 61.59| 0.43 | 36.88| 30.23| 1.32 | 29.82|
| P26     | −0.52| 66.23| 0.45 | 19.75| 31.50| 1.15 | 31.21|
| P27     | −0.59| 61.20| 0.35 | 22.64| 26.24| 0.95 | 25.95|
| P28     | 0.03 | 78.43| 1.05 | 36.00| 51.42| 2.68 | 51.27|
| P29     | −1.68| 65.93| 0.92 | 45.50| 48.10| 3.18 | 47.87|
| P30     | 0.24 | 74.79| 0.42 | 25.76| 29.79| 0.96 | 29.41|
| Min     | −2.64| 51.99| 0.20 | 19.75| 17.42| 0.64 | 17.00|
| Max     | 1.07 | 82.87| 1.16 | 57.00| 53.81| 3.47 | 53.67|
| Ave     | −0.20| 66.02| 0.58 | 36.15| 35.63| 1.76 | 35.30|
| SD      | 0.78 | 7.28 | 0.26 | 10.40| 9.31 | 0.81 | 9.38 |
and analyzed in the Centre for Water Resources Development and Management (CWRDM). Water samples collected in the field for chemical constituents, such as TDS, TH, Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, Na^+, Cl^- and SO_4^{2-}, were analyzed following the BIS standard. EC, pH and chloride (Cl^-) were

| Parameters | Range     | Water class  | Samples (%)  |
|------------|-----------|--------------|--------------|
|            | < 250     | Excellent    | Nil          |
| EC         | 250–750   | Good         | 53.3         |
|            | 750–2250  | Permissible  | 46.7         |
|            | > 2250    | Doubtful     | Nil          |
| SAR        | 0–10      | Excellent    | 100          |
|            | 10–18     | Good         | Nil          |
|            | 18–26     | Doubtful     | Nil          |
|            | > 26      | Unsuitable   | Nil          |
| RSC        | < 1.25    | Good         | 100          |
|            | 1.25–2.5  | Doubtful     | Nil          |
|            | > 2.5     | Unsuitable   | Nil          |
| KR         | < 1       | suitable     | 90           |
|            | 1–2       | Marginal suitable | 10   |
|            | > 2       | Unsuitable   | Nil          |
| SSP        | < 50      | Good         | 90           |
|            | > 50      | Unsuitable   | 10           |
| PI         | > 75      | Class-I      | 10           |
|            | 25–75     | Class-II     | 90           |
|            | < 25      | Class-III    | Nil          |
| MH         | < 50      | Suitable     | 86.7         |
|            | > 50      | Harmful &Unsuitable | 13.3 |
| Na%        | < 20      | Excellent    | 3.3          |
|            | 20–40     | Good         | 73.3         |
|            | 40–60     | Permissible  | 23.4         |
|            | 60–80     | Doubtful     | Nil          |
|            | > 80      | Unsuitable   | Nil          |
| T.H        | < 75      | Soft         | Nil          |
|            | 75–150    | Moderately Hard | 13.3   |
|            | 150–300   | Hard         | 73.3         |
|            | > 300     | Very Hard    | 13.4         |

Table 4
Classification of groundwater sample for irrigation use on the basic of EC, SAR, RSC, KR, SSP, PI, MH, Na%, T.H.

Fig. 1. Location of the study area in Abhar city, Zanjan province, Iran.
analyzed using multiple parameters ion meter model Thermo Orion 5 Star. Sulfate (SO₄²⁻) was measured using a double beam UV–Vis spectrophotometer model Perkin Elmer Lambda 35 by turbid-metric, stannous chloride, and molybdosilicate, respectively. Sodium (Na⁺), calcium (Ca²⁺) and magnesium (Mg²⁺) were analyzed using flame photometer model CL-378 (Elico, India). Total hardness was determined by EDTA titrimetric method [1,16–18]. TDS was measured gravimetrically and Agricultural indicator such as SAR, RSC, PI, KR, and MH, % Na, SSP and TH were calculated by their formulas presented in Table 5.

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Transparency document. Supporting information

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Table 5
Summary of water quality indices in present study [1].

| Indices                          | Formula                                      |
|---------------------------------|----------------------------------------------|
| Residual sodium carbonate (RSC) | RSC= (CO₃²⁻ + HCO₃⁻) + (Ca²⁺ + Mg²⁺)        |
| Permeability index (PI)         | PI = Na+K/HCO₃⁻ × 100                       |
| Kelly’s ratio (KR)              | KR = Na/Ca²⁺Mg²⁺                           |
| Magnesium hazard(MH)            | MH = Mg/Ca²⁺Na⁺ × 100                       |
| Sodium percentage (Na %)        | Na⁺/ = (Na+K)/(Ca²⁺Mg²⁺ + Na⁺K) × 100       |
| Sodium adsorption ratio (SAR)   | SAR = Na¹⁰⁰/Ca²⁺Mg²⁺                          |
| Soluble sodium percentage (SSP) | SSP = Na¹⁰⁰/Ca²⁺Mg²⁺ + Na⁺ × 100             |
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