Hydrochemical data on groundwater quality for drinking and irrigation use around Dangila town, Northwest Ethiopia

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\textbf{A B S T R A C T}

The groundwater of volcanic aquifers, dissected by various structures and affected by several volcanic eruption events, varies in quality. A large number of rural people depend on shallow aquifers tapped by shallow hand wells and springs. On the other hand, the urban population is dependant on deep aquifers using drilled boreholes. The location of springs, shallow hand-dug wells and boreholes inside or close to farmlands, and the advancement of irrigation water use from groundwater by the government entail the assessment of groundwater quality. Therefore, the focus of the present study is to determine the quality and suitability of groundwater around Dangila Town, Northwest Ethiopia, for drinking and irrigation uses. The water quality assessment was conducted by collecting groundwater samples from 14 shallow hand-dug wells, 4 springs, and 7 deep boreholes then analysing for different physical and chemical parameters. A total of 25 selected groundwater samples from shallow and deep aquifers were analysed in a laboratory for physical and chemical parameters. The physical parameters measured both in the field and the laboratory included pH, elec-
trical conductivity (EC) and total dissolved solids (TDS). The chemical parameters analysed in the laboratory comprised cations of calcium (Ca$^{2+}$), magnesium (Mg$^{2+}$), sodium (Na$^+$), potassium (K$^+$), Iron (Fe), manganese (Mn$^{2+}$) and anions of bicarbonate (HCO$_3^-$), sulfate (SO$_4^{2-}$), carbonate (CO$_3^{2-}$), chlorine (Cl$^-$), nitrate (NO$_3^-$), fluoride (F$^-$), and boron (B). Based on the laboratory results, the variation in groundwater facies, and major cation and anion sources were determined.

Furthermore, the groundwater quality for human consumption was assessed and sodium adsorption ratio (SAR), Na%, and the residual sodium carbonate (RSC) values, which are crucial to determine the overall groundwater quality for irrigational uses, were calculated. Detailed interpretations of the data have been presented in the paper entitled “Hydrogeological framework of the volcanic aquifers and groundwater quality in Dangila Town and the surrounding area, Northwest Ethiopia” [1]. The presented dataset demonstrates the necessity of water quality assessments that would be helpful to water sectors, government, and policymakers for sustainable groundwater management.

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### Specifications Table

| Subject                  | Earth and planetary sciences |
|--------------------------|-----------------------------|
| Specific subject area    | Hydrogeochemistry            |
| Type of data             | Tables, Figures             |
| How data were acquired   | The lightweight, portable, and multi-parameter measuring instrument (Hanna HI 991,301, USA) was used to measure pH, electrical conductivity (EC), and total dissolved solids (TDS) values. The atomic absorption spectrometry (novAA 400P, Germany) integrated with ASPECT LS software was used to measure the concentration of cations, and the colourimetry instrument (palintest photometer 7100, UK) was used to measure the concentration of anions. Raw, Analysed |
| Data format              | The new plastic bottles were rinsed with the sample water, and groundwater samples were collected, stored in a cool place, and transported to the laboratory within a day. The samples from shallow hand wells and springs were taken after pouring water for a few minutes, whereas samples from deep boreholes were taken in the middle of the continuous pumping test. Before laboratory analysis, water samples were filtered with a 45-micron filter to remove the suspended particles. |
| Parameters for data Collection | A total of 14 shallow hand-dug wells, two deep boreholes, and four spring water samples were collected during the dry season (February to April) 2015 and 2017 while the remaining five deep boreholes groundwater samples were collected during their pumping tests. The physical water parameters comprising pH, EC, TDS were measured in the field during sample collection. The chemical groundwater parameters comprising cations (Ca$^{2+}$, Mg$^{2+}$, Na$^+$, K$^+$, Mn$^{2+}$, Fe) and anions (Cl$^-$, SO$_4^{2-}$, HCO$_3^-$, CO$_3^{2-}$, NO$_3^-$, F$^-$, B) were measured in the laboratory. |
| Description of data Collection | Data area boundaries from world geodetic systems 84 (WGS84) are; longitude: 36.70 to 37.00 °E and latitudes: 11.07 to 11.41 °Naround Dangila Town, Northwest Ethiopia. |
| Data source location     | Data are included in this article |
| Data accessibility       | Mulugeta C. Fenta, Zelalem L. Anteneh, János Szanyi, David Walker; Hydrogeological framework of the volcanic aquifers and groundwater quality in Dangila Town and the surrounding area, Northwest Ethiopia. Groundwater for sustainable development [1]. |
| Related research article |                                |
Value of the Data

- Hydrochemical data presented in this article will enable the society to understand the groundwater quality of the area as it is the primary source for the provision of freshwater supply.
- The various groundwater datasets will be beneficial to develop effective strategies to strengthen the Dangila Town and surrounding rural area drinking and small-scale irrigation water supply.
- The water sector, government, policymakers, and scientific community can make use of these data to comprehend the hydrochemical characteristics of volcanic aquifers of the area and to plan sustainable groundwater management systems.
- The raw and analysed data will serve as a benchmark for further research and studies as the region lacks hydrochemistry data sources. Moreover, it can be useful for further insights on heterogeneous hydrochemical volcanic aquifers to create groundwater numerical models.

1. Data Description

This dataset of Dangila Town and its surrounding area of Northwest Ethiopia comprises of one Figure and 7 Tables. Table 1, Table 2, and Table 3 consist of groundwater physical and chemical parameters used to assess groundwater quality for drinking and irrigation use from boreholes, shallow hand-dug wells, and springs, respectively. Table 4 contains the quality of groundwater samples for drinking purposes based on the WHO 2011 drinking water quality index [2]. Table 5 consists of the different water facies of the area, whereas Table 6 comprises the formulas used to calculate the SAR, Na%, and RSC values of groundwater samples. Table 7 consists of the calculated SAR, Na%, and RSC values of all groundwater samples. All datasets in the tables contain either water sample laboratory analysis data or the calculated results and statistical values of minimum, maximum, mean, and standard deviation for each groundwater scheme.

2. Experimental design, materials, and methods

2.1. Study area description

The collection of physicochemical data from groundwater samples was conducted at Dangila town and its surrounding area located in Dangila district, known in Ethiopia as a woreda, in northwest Ethiopia (Fig. 1). It is situated at the southwest of Lake Tana, which is the source of the Blue Nile river. It is mainly covered by Quaternary volcanic rocks with an annual rainfall of 1640 mm (measured since 1988 at the National Meteorological Agency (NMA) weather station at Dangila town), of which 91% falls from May to October. It has a moist subtropical climate with a median annual daily maximum temperature of 25 °C and a minimum of 9 °C [6]. The groundwater sampling was aimed to assess the quality of both shallow and deep aquifer systems of the area using existing springs, shallow hand-dug wells, and deep boreholes. The sampling sites were chosen to cover the area within the town and its surrounding rural villages.

A total of 25 groundwater samples were collected from deep boreholes (7 samples), shallow hand-dug wells (14 samples), and springs (4 samples) with plastic bottles rinsed by sample water ahead of sampling. The samples were poured into the plastic bottles after pumping out water for 10 min to remove the stagnant water from shallow hand-dug wells. The borehole samples were collected in the middle of constant rate pumping tests that lasted for 24, 36, 48, or 72 h depending on the plan of the test. The spring water samples were sampled at the point of spring discharge continuously from the ground.
Table 1
Hydrochemical and physical data of volcanic aquifers sampled from boreholes. The values of TDS, cations, and anions are given in (mg/L), whereas the EC is (μS/cm).

| Borehole ID | pH | EC  | TDS  | Ca^{2+} | Mg^{2+} | Na^{+} | K^{+} | Mn^{2+} | Fe   | Cl^{-} | SO_{4}^{2-} | HCO_{3}^{-} | CO_{3}^{2-} | NO_{3}^{-} | F  | B   |
|-------------|----|-----|------|---------|---------|--------|-------|---------|------|-------|-------------|--------------|------------|-----------|----|----|
| BH1         | 6.83 | 245 | 159.25 | 35.34 | 6.03   | 15.54  | 15.1  | 0.022   | 0.08 | 1.9   | 1           | 175          | 0          | 1         | 0.63 | 0.057 |
| BH2         | 7.84 | 262 | 150   | 23.8   | 5.35   | 25     | 0.9   | 0.022   | BDL  | BDL   | 0           | 16          | 1.6        | 170.6     | 14.4 | 0   |
| BH3         | 8.67 | 290 | 188.5 | 27.94  | 6.921  | 13.6   | 10.32 | 0.005   | BDL  | BDL   | 145         | 15          | 1.5        | 0.34      | 0.06 |
| BH4         | 8.4  | 295 | 204   | 36     | 5.35   | 25     | 0.9   | BDL     | BDL   | 0     | 16          | 170.6       | 14.4       | 4.8       | 0   |
| BH5         | 8.51 | 204 | 124   | 19.5   | 30.9   | 2.6    | BDL   | 2       | 1.3   | 90    | 0           | 0           | 0         | 1.1       | 0   |
| BH6         | 7.44 | 313 | 203   | 8.4    | 2.8    | 25.4   | 7.63  | BDL     | BDL   | 2.2   | 0.8         | 93          | 0         | 1.23      | 0   |
| BH7         | 8.81 | 335 | 214   | 0.97   | 4.51   | 34.5   | 1.86  | BDL     | 0.01  | 2.5   | 0.5         | 97.6        | 0         | 1.44      | 0.64 |
| Min         | 6.83 | 204 | 124   | 0.97   | 1.95   | 13.6   | 0.90  | 0       | 0     | 0     | 0.5         | 90          | 0         | 0.13      | 0   |
| Max         | 8.81 | 335 | 214   | 36.00  | 6.92   | 39.00  | 15.10 | 0.02    | 0.08  | 2.5   | 8           | 175         | 15        | 4.8       | 1.1 |
| Mean        | 8.07 | 277.71 | 177.54 | 20.06   | 4.64   | 26.15  | 5.73  | 0.01    | 0.013 | 1.47  | 2.14         | 130.03      | 4.2        | 1.44      | 0.2 |
| SD          | 0.73 | 44.21 | 33.56 | 14.20   | 1.75   | 9.32   | 5.43  | 0.01    | 0.023 | 0.93  | 2.66         | 36.51       | 7.18       | 1.60      | 0.4 |

* BDL represents below detectable limit for manganese and iron using flame AAS instrument with 0.0015 mg/L and 0.005 mg/L values respectively. These low detection limits of flame AAS instrument values are based on PerkinElmer’s work that determined elemental standards in dilute aqueous solution with a 98% confidence level [3].
| Shallow well ID | pH   | EC  | TDS  | Ca²⁺ | Mg²⁺ | Na⁺   | K⁺   | Mn²⁺ | Fe    | Cl⁻   | SO₄²⁻ | HCO₃⁻ | CO₂⁻ | NO₃⁻ | F   | B   |
|----------------|------|-----|------|------|------|-------|------|------|-------|-------|-------|-------|------|------|-----|-----|
| SW1            | 6.12 | 260 | 169  | 24.62| 2.116| 2.78  | 2.94 | 0.016| 0.01  | 4.2   | 0.8   | 85    | 0    | 3    | 0.66| 0.06|
| SW2            | 6.07 | 480 | 312  | 25.1 | 2.14 | 3.56  | 3.12 | 0.006| BDL   | 0.8   | 0.5   | 75    | 0    | 11   | 0.35| 0.06|
| SW3            | 5.62 | 70  | 45.5 | 6.09 | 1.98 | 1.69  | 1.39 | 0.029| BDL   | 6.7   | 0.8   | 15    | 0    | 1    | 0.34| 0.05|
| SW4            | 5.37 | 90  | 58.5 | 23.41| 1.89 | 7.45  | 3.92 | 0.029| BDL   | 2.1   | 0.8   | 95    | 0    | 3    | 0.48| 0.04|
| SW5            | 6.14 | 160 | 104  | 19.81| 2.288| 3.14  | 6.52 | 0.02 | BDL   | 12.5  | 0.7   | 60    | 0    | 3    | 0.4  | 0.05|
| SW6            | 6.4  | 140 | 91   | 25.55| 2.23 | 2.45  | 1.9  | 0.005| BDL   | 1.6   | 1.5   | 75    | 0    | 15   | 0.44| 0.06|
| SW7            | 5.53 | 171.9 | 87  | 12.5 | 2.28 | 0.08  | 0.15 | BDL  | 0.01  | 2.7   | 1.5   | 48.8  | 0    | 4.85 | 0.21| 0   |
| SW8            | 6.31 | 264.4 | 135 | 18.07| 2.94 | 2.54  | 2.29 | BDL  | 1.65  | 0.7   | 1.6   | 97.3  | 0    | 1.22 | 0.56| 0   |
| SW9            | 6.17 | 174 | 88   | 17.4 | 2.81 | 4.6   | 1.54 | BDL  | BDL   | 1.3   | 6.2   | 60.2  | 0    | 1.48 | 0.4 | 0   |
| SW10           | 5.83 | 130.7 | 66  | 14.6 | 2.37 | 1.73  | 0.42 | BDL  | 0.2   | 0.5   | 1.1   | 52    | 0    | 4.37 | 0.22| 0   |
| SW11           | 6.88 | 334.9 | 172 | 19.4 | 3.4  | 0.08  | 1.74 | BDL  | 0.01  | 3.7   | 1.1   | 85.2  | 0    | 2.9  | 0.31| 0   |
| SW12           | 5.76 | 200.4 | 102 | 18.4 | 3.44 | 0.08  | 2.13 | BDL  | 0.01  | 1.3   | 0.84  | 90.4  | 0    | 3.2  | 0.32| 0   |
| SW13           | 5.69 | 196.8 | 100 | 18.7 | 3.12 | 0.1   | 1.14 | BDL  | 4.3   | 1.7   | 1.4   | 86.1  | 0    | 2.37 | 0.28| 0   |
| SW14           | 5.99 | 309.4 | 159 | 27.1 | 3.18 | 0.19  | 9.06 | BDL  | 0.7   | 2.7   | 1.2   | 125.4 | 0    | 4.12 | 0.25| 0   |
| Min            | 5.37 | 70  | 45.5 | 6.09 | 1.89 | 0.08  | 0.15 | 0.00 | 0      | 0.5   | 0.5   | 15    | 0    | 1    | 0.21| 0   |
| Max            | 6.88 | 480 | 312  | 27.10| 3.44 | 7.45  | 9.06 | 0.03 | 4.3    | 12.5  | 6.2   | 125.4 | 0    | 15   | 0.66| 0.06|
| Mean           | 5.99 | 213.04 | 120.64 | 19.34| 2.58 | 2.18  | 2.73 | 0.01 | 0.49   | 3.04  | 1.43  | 75.03 | 0    | 4.32 | 0.37| 0.02|
| SD             | 0.40 | 108.99 | 67.88 | 5.74 | 0.54 | 2.13  | 2.42 | 0.01 | 1.19   | 3.19  | 1.41  | 26.69 | 0    | 3.92 | 0.13| 0.03|

BDL* represents below detectable limit for manganese and iron using flame AAS instrument with 0.0015 mg/L and 0.005 mg/L values respectively [3].
| Springs ID | pH    | EC   | TDS  | Ca$^{2+}$ | Mg$^{2+}$ | Na$^+$ | K$^+$ | Mn$^{2+}$ | Fe    | Cl$^-$ | SO$_4^{2-}$ | HCO$_3^-$ | CO$_3^{2-}$ | NO$_3^-$ | F$^-$ | B   |
|------------|-------|------|------|-----------|-----------|--------|-------|-----------|-------|--------|-------------|------------|------------|----------|-------|-----|
| SP1        | 5.64  | 75   | 48.75| 18.55     | 1.99      | 2.09   | 2.35  | 0.002     | BDL   | 0.8    | 5           | 50         | 0          | 6.82     | 0.65  | 0.06|
| SP2        | 5.53  | 40   | 97   | 3.58      | 1.8       | 1.67   | 1.45  | 0.012     | BDL   | 1.7    | 0.8         | 15.5       | 0          | 0.8      | 0.82  | 0.3 |
| SP3        | 6     | 189.6| 26   | 3.87      | 0.8       | 1.24   | BDL   | 0.01      | 1.2    | 11     | 912         | 0          | 2.5       | 0.37     | 0     |     |
| SP4        | 5.31  | 48.67| 24   | 14.1      | 2.42      | 0.08   | 5.13  | BDL       | 0.01   | 0.8    | 2.4         | 50.2       | 0          | 2.34     | 0.8   | 0   |
| Min        | 5.31  | 40   | 24   | 3.58      | 1.80      | 0.08   | 1.24  | 0.00      | 0.00   | 0.80   | 0.01        | 0.01       | 0.01       | 0.43     | 1.91  | 30.96|
| Max        | 6.00  | 189.6| 97   | 23.30     | 3.87      | 2.09   | 5.13  | 0.01      | 0.01   | 1.70   | 5.00        | 91.2       | 0          | 6.82     | 0.82  | 0.3 |
| Mean       | 5.62  | 88.32| 48.94| 14.88     | 2.52      | 1.16   | 2.54  | 0.00      | 0.00   | 0.113  | 2.33        | 51.73      | 0          | 3.12     | 0.66  | 0.09|
| SD         | 0.29  | 69.14| 33.95| 8.42      | 0.94      | 0.90   | 1.79  | 0.01      | 0.00   | 0.43   | 1.91        | 30.96      | 0          | 2.59     | 0.21  | 0.14|

BDL$^*$ represents below detectable limit for manganese and iron using flame AAS instrument with 0.0015 mg/L and 0.005 mg/L values respectively [3].

Table 3
Hydrochemical and physical data of volcanic aquifers sampled from Springs. The values of TDS, cations, and anions are given in (mg/L), whereas the EC is (μS/cm). .
Table 4
Quality of groundwater samples from the study area for drinking purposes based on the WHO 2011 drinking water quality index [2]. The values of TDS, cations, and anions are given in (mg/L), whereas the EC is (μS/cm).

| Water quality parameter | Measured ranges of samples | WHO (2011) maximum allowable limit | Samples above allowable limit |
|-------------------------|----------------------------|-----------------------------------|------------------------------|
|                         | Boreholes | Shallow wells | Springs | Boreholes | Shallow wells | Springs | Boreholes | Shallow wells | Springs | Boreholes | Shallow wells | Springs |
| pH                      | 6.83–8.81 | 5.37–6.88 | 5.31–6.00 | 6.5–8.5 | Nil |
| EC                      | 204–335 | 70–480 | 40–189.60 | 1000 μS/cm | Nil |
| TDS                     | 124–214 | 45.50–312 | 24–97 | 500 mg/L | Nil |
| Ca^{2+}                 | 0.97–36 | 6.09–27.1 | 3.58–23.3 | 75 mg/L | Nil |
| Mg^{2+}                 | 1.95–6.92 | 1.89–3.44 | 1.80–3.87 | 50 mg/L | Nil |
| Na^+                    | 13.60–39 | 0.08–7.45 | 0.08–2.09 | 200 mg/L | Nil |
| Fe                      | BDL-0.08 | BDL-4.3 | BDL-0.01 | 0.4 mg/L | 2 shallow well samples |
| HCO$_3$                 | 90–175 | 15–125.4 | 15.50–91.20 | 120 mg/L | 4 borehole and one shallow well samples |
| SO$_4^{2-}$             | 0.5–8 | 0.5–6.2 | 0.80–5 | 250 mg/L | Nil |
| Cl$^-$                  | 0–2.5 | 0.5–12.5 | 0.80–1.70 | 250 mg/L | Nil |
| NO$_3$                 | 0.13–4.8 | 1–15 | 0.80–6.82 | 50 mg/L | Nil |
| F$^-$                   | 0–1.1 | 0.21–0.66 | 0.37–0.82 | 1.5 mg/L | Nil |

BDL$^*$ represents below detectable limit for iron using flame AAS instrument with 0.005 mg/L value [3].
The different groundwater facies of the area.

| No. | Water scheme | Sample quantity | Water facies type |
|-----|--------------|-----------------|------------------|
| 1.  | SP           | 1               | Ca-HCO₃          |
|     | SW           | 7               |                  |
| 2.  | SP           | 3               | Ca-Mg-HCO₃       |
|     | SW           | 5               |                  |
| 3.  | BH           | 2               | Ca-Na-HCO₃       |
| 4.  | BH           | 3               | Na-Ca-HCO₃       |
| 5.  | BH           | 1               | Ca-Na-Mg-HCO₃    |
| 6.  | BH           | 1               | Na-HCO₃          |
| 7.  | SW           | 1               | Ca-Mg-HCO₃-Cl    |
| 8.  | SW           | 1               | Ca-HCO₃-Cl       |

The formulas used to calculate groundwater parameters for irrigation use.

| Indices                      | Formula                                                                 |
|------------------------------|-------------------------------------------------------------------------|
| Sodium adsorption ratio (SAR) | $\text{SAR} = \frac{\text{Na}^+}{\sqrt{\text{Ca}^{2+} + \text{Mg}^{2+}}}$ based on Suarez et al., [4]. |
| Sodium percentage (Na%)       | $\text{Na}^\% = \frac{\text{Na}^+}{\text{Na}^+ + \text{Ca}^{2+} + \text{Mg}^{2+}} \times 100$ based on the United States Salinity Laboratory Staff [5]. |
| Residual sodium carbonate (RSC) | $\text{RSC} = (\text{HCO}_3^- + \text{CO}_3^{2-}) : (\text{Ca}^{2+} + \text{Mg}^{2+})$. |

Where Na⁺, Ca²⁺, Mg²⁺, K⁺, HCO₃⁻, and CO₃²⁻ are in meq/L.

The samples were separately labelled with sample identification (ID) and water schemes, such as BH1 to represent borehole groundwater sample no. 1, and stored at 10 °C temperature before analysis for different physicochemical parameters. The pH, electrical conductivity (EC), and total dissolved solids (TDS) were analysed in the field using a pH/EC/TDS multi-parameter measuring instrument (Hanna HI 991,301, USA). The device is characterised by having simultaneous pH, EC/TDS, and temperature measurements on a large three-line liquid crystal display (LCD). During the measurement of EC/TDS, the probe was placed in the sample water to be tested, and plastic beaker containers were used to minimise any electromagnetic interference. The value of EC, TDS, and temperature was taken after the temperature sensor reaches thermal equilibrium. The metre was regularly calibrated for pH by immersion of the probe in pure water with a neutral pH of 7.0 before pH measurements.

The atomic absorption spectroscopy (AAS) (novAA 400P, Germany) was used to analyse the cation concentration of the groundwater samples. The cation concentrations were determined using a flame technology system in the laboratory that has a typical characteristic feature of precision, fast speed analysis, automated dilution, and reliable quality monitoring, all with uncomplicated handling with the aid of Autosampler. The groundwater samples to be analysed for cations concentrations (Ca²⁺, Mg²⁺, Na⁺, K⁺, Mn²⁺, and Fe) using AAS in the laboratory were placed on Autosampler in their standard solutions forms. The atomisation process, the nebuliser delivers the liquid sample at a controlled rate, creates a fine aerosol that mixes with fuel and oxidant for a starter into the flame. The nebuliser uses the combustion flames to atomise and introduce the sample into the light path. The photomultiplier tube of AAS as the detector determines the intensity of photons of the analytical line exiting the monochromator. The decrease in intensity of the light is the process of atomic absorption, and AAS measures the change in intensity. A computer data system converts this change in intensity of light into an absorbence. The Software package (ASPECT LS) offers both routine operation and several developments and optimisation facilities. It allows comprehensive control, monitoring, and recording of all processes run in the spectrometer and its accessories.

The analysis of anions in the laboratory was conducted by Palintest instrument (Photometer 7100, UK), which uses the colourimetric method. The photometer is fully integrated with the whole range of Palintest water tests and uses light to measure colour changes in water samples.
Table 7
The calculated values of SAR, Na%, and RSC of groundwater samples from boreholes, shallow hand-dug wells, and springs.

| Boreholes ID | SAR   | Na%   | RSC   | Shallow hand-dug wells ID | SAR   | Na%   | RSC   | Springs ID | SAR   | Na%   | RSC   |
|--------------|-------|-------|-------|---------------------------|-------|-------|-------|------------|-------|-------|-------|
| BH1          | 0.636 | 20.35 | 0.608 | SW1                       | 0.144 | 7.563 | -0.010| SP1        | 0.123 | 7.329 | -0.270 |
| BH2          | 1.902 | 50.93 | 0.687 | SW2                       | 0.183 | 9.310 | -0.199| SP2        | 0.180 | 16.642| -0.073 |
| BH3          | 0.597 | 20.98 | 0.913 | SW3                       | 0.152 | 12.764| -0.221| SP3        | 0.040 | 2.248 | 0.014 |
| BH4          | 1.028 | 32.49 | 1.039 | SW4                       | 0.398 | 18.538| 0.233 | SP4        | 0.005 | 0.335 | -0.080 |
| BH5          | 2.467 | 67.57 | 0.915 | SW5                       | 0.178 | 9.227 | -0.193| Min        | 0.005 | 0.335 | -0.27 |
| BH6          | 1.939 | 56.67 | 0.875 | SW6                       | 0.125 | 6.604 | -0.229| Max        | 0.180 | 16.642| 0.014 |
| BH7          | 3.277 | 76.26 | 1.180 | SW7                       | 0.005 | 0.425 | -0.012| Mean       | 0.087 | 6.639 | -0.102 |
| Min          | 0.60  | 20.35 | 0.61  | SW8                       | 0.146 | 8.416 | 0.451 | SD         | 0.079 | 7.29  | 0.120 |
| Max          | 3.28  | 76.26 | 1.18  | SW9                       | 0.270 | 14.943| -0.113|            |       |       |       |
| Mean         | 1.69  | 46.47 | 0.89  | SW10                      | 0.111 | 7.454 | -0.071|--          |       |       |       |
| SD           | 1.00  | 22.30 | 0.20  | SW11                      | 0.004 | 0.269 | 0.148 |            |       |       |       |
|              |       |       |       | SW12                      | 0.004 | 0.276 | 0.280 |            |       |       |       |
|              |       |       |       | SW13                      | 0.006 | 0.356 | 0.221 |            |       |       |       |
|              |       |       |       | SW14                      | 0.009 | 0.446 | 0.441 |            |       |       |       |
| Min          | 0.004 | 0.27  | -0.229|--            |       |       |       |            |       |       |       |
| Max          | 0.398 | 18.54 | 0.451|--            |       |       |       |            |       |       |       |
| Mean         | 0.124 | 6.90  | 0.052 |            |       |       |       |            |       |       |       |
| SD           | 0.116 | 5.97  | 0.242 |            |       |       |       |            |       |       |       |
treated with a reagent. The colourimeter is used to photoelectrically measure the amount of coloured light absorbed by a coloured sample in reference to a colourless sample (a standard deionised sample). The concentrations of Cl\(^-\), SO\(_4\)\(^{2-}\), HCO\(_3\)\(^-\), CO\(_3\)\(^{2-}\), NO\(_3\)\(^-\), F\(^-\) and B were measured using the colourimetric method, and alternatively, the concentrations of HCO\(_3\)\(^-\) and CO\(_3\)\(^{2-}\) were determined by titration with HCl. The laboratory analyses to determine the concentration of cations and anions of groundwater samples were conducted based on APHA (2005) standard methods [7]. The values of cation and anion concentrations that can impact human health are below the maximum allowable limits of WHO 2011 drinking water quality standards [2].

The groundwater of the area has five main types of water facies (Table 5) as Ca-HCO\(_3\) and Ca-Mg-HCO\(_3\) in shallow aquifers, and Na-Ca-HCO\(_3\), Ca-Na-HCO\(_3\) and Na-HCO\(_3\) water facies in the deep aquifer system. The Piper diagram plot and the details of different water facies are described by Fenta et al. [1]. There are also Ca-HCO\(_3\)-Cl and Ca-Mg-HCO\(_3\)-Cl types of water facies in shallow hand-dug wells and Ca-Na-Mg-HCO\(_3\) type water facies in boreholes. The presence of a significant amount of chloride in a few shallow hand-dug wells is related to anthropogenic pollution, whereas the increasing tendency in the concentration of Ca\(^{2+}\), Mg\(^{2+}\), and Na\(^+\) with depth lead to Ca-Na-Mg-HCO\(_3\) type of water facies. The existence of these types of water facies might be due to the intermixing of shallow and deep groundwater systems. The work by Fenta et al. [1] stated rock-water interactions involving silicate weathering, cation exchange, and carbonation are the main hydrochemical processes that control the primary composition of the groundwater chemistry.

The three commonly used factors in assessing the suitability of groundwater for irrigation use are SAR, Na\%, and RSC. SAR is the measure of possible sodium hazard for irrigation water by United States Salinity Laboratory Staff (1954) [5], and Na\% is a vital parameter that helps to categorise water suitability for irrigation purposes [8]. The excess amount of SAR, Na\%, and RSC will affect water and air movement in soils and later affect plant growth. The three values of each water sample are calculated using the formulas listed in Table 6, and the calculated values are presented in Table 7.
Based on the calculated values, all water samples have low SAR values (< 10), which categorises all samples as excellent for irrigation use. The calculated Na% values of shallow hand-dug wells and spring samples are < 20 that classifies the shallow groundwater as excellent for irrigational purposes. The calculated Na% values of boreholes vary from 20 to 40 (3 boreholes), 40–60 (2 boreholes), and 60–80 (2 boreholes), which classifies the different deep aquifers as good, permissible and doubtful respectively for irrigational use. The RSC values of all water schemes are < 1.25, which makes it suitable for agricultural use. The other related groundwater physical parameter, the electrical conductivity, has < 750 μs/cm value, which is low to medium category based on US regional laboratory staff test [5].

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have, influenced the work reported in this article.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105877.

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