Data Article

Dataset for mapping groundwater contaminant risk using the DRASTIC model for a case study in Ethiopia

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A R T I C L E  I N F O

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A B S T R A C T

This paper contains the data that helps in mapping groundwater contaminant risk (nitrate and phosphate) using the DRASTIC model for a case study in Ethiopia. The data contains a total of 9 parameters, each having data points ranging from 10 to 33 (196 records in total). About 52% of the data points from 7 parameters (depth to water table, aquifer media, soil, types of vadose, transmissivity, aquifer thickness, and hydraulic conductivity) allows the model to predict contaminant risk levels in the groundwater. About 48% of the data points from direct records of 2 variables (nitrate and phosphate) help to validate model predictions and spatial mapping of contaminant risk levels. A brief description of the model development can be found by Alamne, Assefa, Belay and Hussein [1]. This data helps to associate and develop relations between contaminant risk with aquifer characteristics, soil, and water table. A principal component analysis can be performed to identify essential parameters in the prediction of groundwater contaminant risk levels. In addition, the dataset can be used as a baseline or reference point for trend analysis on contaminant risk with the addition of a new dataset.

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Specifications Table

| Subject                      | Environmental Science |
|------------------------------|-----------------------|
| Specific subject area        | Hydrology and water quality |
| Type of data                 | Table, Figure         |
| How the data were acquired   | The data comprises primary and secondary data. Water samples were collected from many groundwater wells for the primary data and analyzed in the Laboratory for nitrate and phosphate concentration. In addition, the secondary data were obtained from Amhara Design and Supervision Works Enterprise (ADSWE) and Amhara Water Works and Drill Enterprise (AWWDE). |
| Data format                  | Raw and Analysed      |
| Description of data collection | A one-liter polyethylene bottle was used for sample collection and samples were analyzed for nitrate and phosphate concentration using a spectrophotometric method |
| Data source location         | Bahir Dar, Amhara, Ethiopia. Geographical extent ranges from 37° 18' to 37°30' E longitude and 11°44' to 11°34' N latitude. |
| Data accessibility           | The data is available within this article and in the dryad database: [1] https://doi.org/10.5061/dryad.w0v4b8v7 |
| Related research article     | Alamne, S.B., Assefa, T.T., Belay, S.A. et al. Mapping groundwater nitrate contaminant risk using the modified DRASTIC model: a case study in Ethiopia. Environ Syst Res 11, 8 (2022). [2] https://doi.org/10.1186/s40068-022-00253-9 |

Value of the Data

- The data provides detailed information on various attributes used to predict contaminant risk and validate it with actual phenomena.
- Information on this data article will help the researcher to develop a relationship between contaminant risk level (nitrate and phosphate) and predictor variables to understand essential variables for contaminant risk and apply the relationship to a broader region.
- The data can be used as a baseline for contaminant level trend analysis with the addition of a new dataset in the same region.
- The data can be used to map spatial contaminant levels in the same region and to inform decision-makers about conservation management or exploring other alternatives.

1. Data Description

This paper contains data for the prediction and validation of contaminant risk (nitrate and phosphate) in the northern part of Ethiopia considering several parameters (Table 1). The parameters which were considered essential for contaminant risk prediction include; aquifer characteristics (aquifer media, aquifer thickness, types of vadose, transmissivity, and hydraulic conductivity), soil, and depth to the water table. These data were collected from Amhara Design and Supervision Work Enterprises (ADSWE) and Amhara Water Works and Drill Enterprise (AWWD). Parameter ratings for the model input can be prepared based on Aller [2] and Secunda, Collin and Melloul [3], which range from 1 to 10. Nitrate and phosphate concentration are considered the major water quality indicators. The nitrate and phosphate concentration data were determined in a water quality laboratory using samples collected from groundwater wells. Nitrate and phosphate data help to validate model prediction and spatial mapping of contaminant risk levels.
Table 1
Data types and sources.

| Variables                  | Unit of measurement | Data points | Data sources and Descriptions                                                                 |
|----------------------------|---------------------|-------------|------------------------------------------------------------------------------------------------|
| Nitrate (NO₃)              | mg/l                | 28          | These are primary data in which samples were collected from groundwater wells using a one-liter polyethylene and analysed in laboratory to obtain concentration level. |
| Phosphate (PO₄)            | mg/l                | 24          |                                                                                                  |
| Depth to the water table   | M                   | 31          | These data are obtained from the Amhara Water Work and Drill Enterprise, and describes aquifer characteristics and depth to water table. |
| Aquifer thickness          | m                   | 10          |                                                                                                  |
| Aquifer media              | -                   | 17          |                                                                                                  |
| Types of vadose            | -                   | 16          |                                                                                                  |
| Transmittivity             | m²/d                | 10          |                                                                                                  |
| Hydraulic conductivity     | m/d                 | 10          |                                                                                                  |
| Soil texture               | %                   | 33          | These data is obtained from the Amhara Design and Supervision Works Enterprise, and describes silt, clay, and sand contents.               |

2. Experimental Design, Materials and Methods

2.1. Nitrate (NO₃) and Phosphate (PO₄) Contaminants

Groundwater samples were collected as primary data from a total of 28 wells for nitrate (NO₃) and 24 wells for phosphate (PO₄). A one-liter polyethylene bottle was used for sample collection and samples were analyzed for contaminant concentration using a spectrophotometric method, Al-Rawabdeh, Al-Ansari, Al-Taani, Al-Khateeb and Knutsson [4], at Amhara Design and Supervision Enterprise laboratory. Nitrate concentration in the wells ranges from less than 1 to 46 mg/l, whereas, phosphate concentration ranges from less than 1 to 8 mg/l (Fig. 1). The two contaminant concentrations, NO₃ and PO₄, were used to validate contaminant risk prediction from the DRASTIC model.

![Fig. 1. Nitrate (NO₃) and phosphate (PO₄) data versus elevation of groundwater wells location.](image-url)
2.2. Depth to Water Table

The depth to groundwater table from a total of 31 wells was collected from Amhara Water Work and Drill Enterprise. Depth to the water table in the wells ranges from 0 to 43 m from the surface (Fig. 2) and depicts the depth of material in which the contaminant travels.

2.3. Aquifer Media and Types of Vadose

Aquifer media refers to an unconsolidated rock or lithology of a saturated zone [5]. Types of vadose refer to the geological information of the unsaturated or discontinuously saturated zone above the water table and are used to compute the impacts of vadose. Geological information on aquifer media and types of vadose were obtained from a total of 17 and 16 wells, respectively, from Amhara Water Work and Drill Enterprise.

2.4. Transmissivity, Hydraulic Conductivity, and Aquifer Thickness

Transmissivity refers to the quantity of water that the aquifer can transmit horizontally, whereas, hydraulic conductivity refers to the ease with which water can move through the aquifer. Aquifer thickness refers to the thickness of a hydro-geologically defined aquifer in which the pore spaces are filled with water. Hydraulic conductivity can be computed as a quotient of transmissivity and aquifer thickness. The aquifer thickness in the wells ranges from 14 to 76 m. Transmissivity, hydraulic conductivity, and hydraulic conductivity data were obtained from a total of 10 wells from Amhara Water Work and Drill Enterprise. Transmissivity in wells ranges from 5 to 70 m²/d, whereas, hydraulic conductivity ranges from less than 1 to about 5.5 m/d (Fig. 3).

2.5. Soil

The soil media refers to the top weathered unsaturated zone with significant biological activities [2]. Infiltration rate depends on soil media, hence affecting contaminant transport to groundwater. Soil texture data were collected from a total of 33 groundwater wells.
**Fig. 3.** Transmissivity and hydraulic conductivity versus elevation of groundwater wells location.

**Ethics Statement**

No data were collected from modern human populations or individuals with known relatives.

**CRediT Author Statement**

Tewodros T. Assefa: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

**Declaration of Competing Interest**

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Data Availability**

Dataset for mapping groundwater contaminant risk using the DRASTIC model for a case study in Ethiopia (Original data) (Dryad).

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