Data Article

Dataset on the assessment of water quality of ground water in Kalingarayan Canal, Erode district, Tamil Nadu, India

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\textbf{A R T I C L E   I N F O}

Article history:
Received 1 July 2020
Revised 24 July 2020
Accepted 27 July 2020
Available online 1 August 2020

Keywords:
Water quality index
Ground water
Kalingarayan canal
Physico chemical parameters

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

This data article aimed to investigate the quality of ground water in Kalingarayan Canal for the analysis of pollution level, Tamil Nadu. In order to understand the pollution status of the canal, nine ground water samples (GW1- GW9) were collected from the downstream side of the canal during the period between January 2014 – December 2016. Nine stations were selected along the Kalingarayan Canal, and ground water samples were collected on a monthly basis from these stations. The parameters like pH, electrical conductivity (EC), total dissolved solids (TDS), chlorides, total hardness (TH) nitrates, sulphates, sodium, calcium and magnesium were analyzed to observe the current status of the groundwater quality. Also, the groundwater quality is expressed in terms of Water Quality index (WQI). The APHA method was applied to determine the physico chemical parameters of the water samples. From the investigation, WQI reflects a low quality of groundwater in sampling stations Kolathupalayam (GW3) and Perumparai (GW6) which is mainly contaminated with nitrate and the water is found to be very hard in nature. Also, it was observed that calcium and magnesium content in groundwater is very high at certain stations. Most of the groundwater from this place cannot be used for any kind of

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https://doi.org/10.1016/j.dib.2020.106112
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Specifications table

| Subject               | Environmental Engineering     |
|-----------------------|--------------------------------|
| Specific subject area | Water Quality                 |
| Type of data          | Table Figure                  |
| How data were acquired| All experiments were done using titrimetric testing for temporary and permanent hardness, calcium, magnesium and chloride. System testing also included pH (WTW model) and electrical conductivity (ESI model). The analysis of sulfate anions and cations was done by spectrophotometry (DR5000; Hach) in water. The total hardness and TDS were determined by the EDTA titrimetric method and gravimetry, respectively. |
| Data format           | Raw Analyzed                  |
| Parameters for data collection | All water samples were collected in polyethylene bottles and stored in an ice-jacket placed at a 4°C room temperature |
| Description of data collection | Water Quality Index and Physico chemical parameters of Kalingarayan Canal |
| Data source location  | City/Town/Region: Erode District, Tamilnadu |
| Data accessibility    | With the article              |
| Related research article | T. Mohanakavitha and T. Meenambal, Assessment of water quality index for the groundwater in downstream side of the Kalingarayan canal, erode district, Tamilnadu state, India, Pollution Research, 32(2), 2013, pp. 245-249. [1] |

Value of the data

- The data provided in this article reflect the analysis of pollution level of the Kalingarayan Canal.
- Determination of the levels of the physical and chemical parameters of pH, electrical conductivity (EC), total dissolved solids (TDS), chlorides, total hardness (TH), nitrates, sulphates, sodium, calcium and magnesium were analyzed to observe the current status of the ground water quality of the Kalingarayan Canal country in India.
- Water quality index (WQI) is one of the most effective tools to communicate information about the quality of water to the citizens concerned and policy makers. Hence it becomes important to assess and manage the ground water quality.
- This data will be useful to the society, since groundwater is one of the most important source of drinking water. It is also useful to reach the socio-economic objectives like income, production and quality of life. This information provided can be extended to other canals for analysis of groundwater quality.
- The data can potentially make an impact on society. As there is a rapid growth in industrialization, the water body along the river gets polluted. This data provides the level of pollution and its environmental impact interns of short and long term. Also, It can be useful in the context of regional planning.
- The result of analysis of the data shows that the water in this area is not desirable for industrial processes and human consumption without proper treatment.
The ground water is contaminated mainly with nitrate. The water is very hard in nature at certain locations due to high concentration of calcium and magnesium content in groundwater during the three years, indicating that most of the ground water locations were not suitable for irrigation purposes.

1. Data description

The construction work of Kalingarayan Canal was carried out during the period 1271 AD–1283 AD. The canal starts with a Kalingarayan dam on River Bhavani, near Bhavani and flows through Erode before terminating near Kodumudi. It is designed in a circuital way with as many twists and turns as possible. The canal is in the curvilinear path to cover more land area for irrigation. The length of the canal is 92 km passing entirely through the Erode district, Tamil Nadu as per the survey conducted. The mean sea level (MSL) where the canal begins is 534 feet and ends at 412 feet. The Kalingarayan Canal is situated on the western bank of the river Cauvery at 77° 40'E to 77° 48'E longitude and 11° 16'N to 11° 26'N with an area of 7621 Sq. km. Based on the latest population census in Erode district (2011), its population was 521,900. There are number of tannery and textile industries located across the river which spoils the quality of river by discharging its effluent into the river water, which turnspoils the ground water quality in the surrounding areas. The data contain analysis of pollution level of group water samples [2–5]. Nine ground water samples (GW1–GW9) were collected from the downstream side of the canal during the period between January 2014 – December 2016 and ground water samples were collected on a monthly basis from these stations. The parameters like pH, electrical conductivity (EC), total dissolved solids (TDS), chlorides (Cl), total hardness (TH), nitrates (NO₃⁻), sulphates (SO₄²⁻), sodium(Na), calcium(Ca) and magnesium(mg) were analyzed to observe the current status of the groundwater quality. Also, the groundwater quality is expressed in terms of Water Quality index (WQI). The APHA method was applied to determine the physico chemical parameters of the water samples. The data set pertaining to pH, EC, and physico chemical parameters, are shown in Table 2–10. The details of groundwater sampling in nine different locations in the Kalingarayan Canal (Table 1, Fig. 1).

2. Experimental design, materials and methods

2.1. Materials and methods

Ground water samples were collected from open wells at nine different locations in the surrounding irrigation fields over a period of three years from 2014 to 2016 once in a month. The groundwater samples were collected throughout the year (at the time of flow, i.e during monsoon season, since the river is mostly fed by the southwest monsoon [4] and at the time of non-flow of water, i.e during the summer season in the canal). The bottles were washed with detergent and dilute nitric acid before sampling. Finally, the de-ionized water was used to rinse the sampling bottles and the dried in sunlight. Samples were collected in plastic bottles from each sampling point. The groundwater samples were coded as GW. The details of groundwater sampling in nine different locations in the Kalingarayan Canal (Table 1, Fig. 1). The reason behind this is that the effluents are discharged into the canal during the flow period. But during non-flow period, it is not possible to discharge the effluents into the canal and it is discharged into the ground. This pollutes the groundwater. The basic water quality parameters were analyzed using the analytical methods are shown in Table 13 [6–9]. The parametric values are compared year wise for individual sampling station (flow and non-flow period) and the values are shown in Tables 2 to 10 respectively. In this sampling station all the parameters are within the permissible limit of that of the drinking water range except nitrate. In this region also, water is contaminated with nitrate during the non-flow period of the canal. This indicates that the
Table 1. Location of ground water samples in Kalingarayan Canal.

| S. No. | Latitude       | Longitude        | Sample Code | Distance From the Canal (m) | Sampling Location                  |
|--------|----------------|------------------|-------------|----------------------------|-----------------------------------|
| 1      | 11°26′26.37″N  | 77°40′41.27″E    | GW1         | 90                         | Panjalingapuram towards north direction |
| 2      | 11°23′12.49″N  | 77°41′43.73″E    | GW2         | 170                        | Kolathupalayam I towards south direction |
| 3      | 11°23′14.52″N  | 77°41′45.09″E    | GW3         | 30                         | Kolathupalayam II towards north direction |
| 4      | 11°21′50.78″N  | 77°42′46.87″E    | GW4         | 100                        | Unjalur I towards north-east direction |
| 5      | 11°21′51.86″N  | 77°42′49.24″E    | GW5         | 150                        | UnjalurII (hospital) towards north-east direction |
| 6      | 11°21′50.21″N  | 77°43′20.56″E    | GW6         | 50                         | Perumparai towards north-east direction |
| 7      | 11°21′32.69″N  | 77°44′13.54″E    | GW7         | 85                         | Vadakupudupalayam I towards north direction |
| 8      | 11°21′33.29″N  | 77°44′16.51″E    | GW8         | 200                        | Vadakupudupalayam II towards north direction |
| 9      | 11°19′42.82″N  | 77°45′9.44″E     | GW9         | 150                        | Sallikadu towards north direction |

Table 2. Physico-chemical parameters of groundwater sample at GW1 a distance of 90m away from the canal.

| Parameters    | At the time of flow(Year) | At the time of non-flow(Year) |
|---------------|---------------------------|-------------------------------|
|               | 2014 | 2015 | 2016 | SD    | 2014  | 2015 | 2016 | SD   |
| pH            | 6.40 | 6.80 | 6.66 | 0.20  | 7.40  | 7.90 | 7.80 | 0.26 |
| EC(μS/cm)     | 906  | 956  | 1094 | 97.37 | 1001  | 1076 | 1263 | 134.93 |
| TDS(mg/L)     | 580  | 612  | 700  | 62.13 | 640   | 688  | 808  | 86.53 |
| Chloride (mg/L) | 269  | 289  | 338  | 35.28 | 306   | 324  | 376  | 36.24 |
| Sulphate (mg/L) | 59   | 63   | 85   | 13.94 | 76    | 80   | 102  | 14.00 |
| Sodium (mg/L) | 95   | 102  | 113  | 8.86  | 108   | 114  | 125  | 8.51 |
| Calcium (mg/L) | 97   | 104  | 101  | 3.54  | 106   | 112  | 110  | 3.09 |
| Magnesium(mg/L) | 33   | 35   | 51   | 9.81  | 30    | 35   | 57   | 14.53 |
| Hardness (mg/L) | 377  | 405  | 462  | 43.54 | 389   | 424  | 511  | 62.59 |
| Nitrate (mg/L) | 22.8 | 27.4 | 25.7 | 2.33  | 25.4  | 26.9 | 28.2 | 1.40 |

A dilution of contaminants in the groundwater makes water, insufficient for dilution of these contaminants. By using an ion exchange denitrification process, excess nitrates can be removed easily.

3. Analytical Procedures

Water quality index (WQI) is a mathematical formula used in the assessment of overall quality of water by using the values of different water quality parameters. WQI is one of the most successful methods and it gives information on the quality of water. WQI was calculated using the World Health Organization standards [10] and Indian Standards [11] in the following steps. Water quality index method for groundwater quality assessment is widely used around the world for assessment & management of groundwater [12–15]. The WQI calculation was car-
Fig. 1. Locations of the monitoring stations in Kalingarayan Canal (Modified from Divahar et al. [3]).

Table 3.
Physico-chemical parameters of groundwater sample at GW2 a distance of 170m away from the canal.

| Parameters      | At the time of flow(Year) | At the time of non-flow(Year) |
|-----------------|----------------------------|-----------------------------|
|                 | 2014          | 2015          | 2016          | SD          | 2014          | 2015          | 2016          | SD          |
| pH              | 6.40          | 6.80          | 6.70          | 0.21        | 7.60          | 8.10          | 7.93          | 0.25        |
| EC(μS/cm)       | 1071          | 1138          | 1263          | 97.45       | 1206          | 1347          | 1469          | 131.61      |
| TDS(mg/L)       | 686           | 728           | 809           | 62.52       | 772           | 862           | 940           | 84.07       |
| Chloride (mg/L) | 412           | 440           | 487           | 37.90       | 463           | 492           | 541           | 39.32       |
| Sulphate (mg/L) | 98            | 106           | 126           | 14.48       | 117           | 124           | 146           | 15.02       |
| Sodium (mg/L)   | 27            | 30            | 41            | 7.60        | 36            | 38            | 51            | 8.03        |
| Calcium (mg/L)  | 86            | 92            | 91            | 3.12        | 94            | 100           | 98            | 3.09        |
| Magnesium (mg/L)| 27            | 30            | 44            | 9.19        | 29            | 31            | 45            | 8.83        |
| Hardness (mg/L) | 327           | 354           | 407           | 40.92       | 356           | 378           | 431           | 38.39       |
| Nitrate (mg/L)  | 28.2          | 32.2          | 31.1          | 2.07        | 34.3          | 36.4          | 37.2          | 1.50        |

ried out using a weighted arithmetic index as shown below. The WQI calculations include three successive steps. Each of the 10 parameters has been assigned a weight \(w_i\) according to its relative importance in the overall quality of water for drinking purposes. The maximum weight of 5 has been assigned to the parameter nitrate due to its major importance in water quality assessment. Magnesium which is given the minimum weight of 1 as magnesium by itself may not be harmful.

The first step is “assigning weight” each of the 10 parameters has been assigned a weight \(w_i\) according to its relative importance in the overall quality of drinking water. The second
step is the “relative weight calculation” calculated by following equation

$$W_i = \frac{w_i}{\sum_{j=1}^{n} w_j}$$

The third step is “quality rating (qi)” calculated by following equation

$$q_i = \frac{C_i}{S_i} \times 100$$

where, $C_i$ is the concentration of each parameter in each water sample, $S_i$ is the WHO standard value for each parameter. Finally, the $W_i$ and $q_i$ are used to calculate the $SI_i$ for each parameters.
Table 7.
Physico-chemical parameters of groundwater sample at GW6 a distance of 50m away from the canal.

| Parameters               | At the time of flow (Year) | At the time of non-flow (Year) |
|--------------------------|-----------------------------|-------------------------------|
|                          | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 |
| pH                       | 7.40 | 7.80 | 7.71 | 0.21 | 8.10 | 8.60 | 8.45 | 0.26 |
| EC(μS/cm)                | 3256 | 3464 | 3383 | 104.84 | 3586 | 3814 | 3821 | 133.70 |
| TDS(mg/L)                | 2084 | 2217 | 2165 | 67.62 | 2295 | 2441 | 2446 | 85.77 |
| Chloride (mg/L)          | 770  | 820  | 808  | 26.02 | 842  | 895  | 884  | 27.97 |
| Sulphate (mg/L)          | 742  | 786  | 776  | 23.07 | 812  | 863  | 850  | 26.50 |
| Sodium (mg/L)            | 296  | 315  | 316  | 11.15 | 339  | 361  | 361  | 12.70 |
| Calcium (mg/L)           | 199  | 212  | 208  | 6.60  | 213  | 227  | 223  | 7.18  |
| Magnesium (mg/L)         | 66   | 71   | 98   | 17.27 | 73   | 77   | 107  | 18.76 |
| Hardness (mg/L)          | 770  | 822  | 921  | 76.60 | 831  | 884  | 997  | 84.73 |
| Nitrate (mg/L)           | 31.4 | 36.1 | 34.3 | 2.37  | 37.0 | 39.4 | 39.9 | 1.55  |

Table 8.
Physico-chemical parameters of groundwater sample at GW7- a distance of 85m away from the canal.

| Parameters               | At the time of flow (Year) | At the time of non-flow (Year) |
|--------------------------|-----------------------------|-------------------------------|
|                          | 2014 | 2015 | 2016 | SD | 2014 | 2015 | 2016 | SD |
| pH                       | 7.00 | 7.50 | 7.57 | 0.31 | 7.50 | 7.90 | 8.28 | 0.39 |
| EC(μS/cm)                | 1092 | 1166 | 1505 | 220.21 | 1379 | 1467 | 1571 | 96.11 |
| TDS(mg/L)                | 699  | 747  | 963  | 140.63 | 883  | 939  | 1005 | 61.07 |
| Chloride (mg/L)          | 272  | 290  | 391  | 64.37 | 343  | 364  | 406  | 31.91 |
| Sulphate (mg/L)          | 82   | 86   | 91   | 4.56  | 135  | 144  | 94  | 26.42 |
| Sodium (mg/L)            | 131  | 140  | 189  | 31.21 | 166  | 176  | 196  | 15.22 |
| Calcium (mg/L)           | 144  | 154  | 224  | 43.76 | 157  | 167  | 233  | 41.01 |
| Magnesium (mg/L)         | 36   | 39   | 98   | 35.08 | 39   | 42   | 108  | 38.94 |
| Hardness (mg/L)          | 508  | 544  | 963  | 253.06 | 554  | 590  | 1024 | 261.41 |
| Nitrate (mg/L)           | 42.4 | 44.1 | 45.3 | 1.46  | 54.3 | 57.8 | 57.2 | 1.87  |

Table 9.
Physico-chemical parameters of groundwater sample at GW8 a distance of 200m away from the canal.

| Parameters               | At the time of flow (Year) | At the time of non-flow (Year) |
|--------------------------|-----------------------------|-------------------------------|
|                          | 2014 | 2015 | 2016 | SD  | 2014 | 2015 | 2016 | SD  |
| pH                       | 6.50 | 6.90 | 7.04 | 0.28 | 6.90 | 7.40 | 7.65 | 0.38 |
| EC(μS/cm)                | 918  | 1035 | 1354 | 225.66 | 1113 | 1197 | 1358 | 124.50 |
| TDS(mg/L)                | 587  | 662  | 866  | 144.38 | 712  | 766  | 869  | 79.76 |
| Chloride (mg/L)          | 239  | 277  | 402  | 85.45 | 269  | 284  | 396  | 69.34 |
| Sulphate (mg/L)          | 91   | 98   | 115  | 12.23 | 136  | 148  | 113  | 17.79 |
| Sodium (mg/L)            | 79   | 86   | 102  | 12.01 | 102  | 112  | 101  | 6.18  |
| Calcium (mg/L)           | 124  | 132  | 168  | 23.55 | 135  | 145  | 166  | 15.55 |
| Magnesium (mg/L)         | 31   | 33   | 62   | 17.58 | 33   | 36   | 61   | 15.60 |
| Hardness (mg/L)          | 436  | 467  | 676  | 130.60 | 474  | 509  | 665  | 101.91 |
| Nitrate (mg/L)           | 41.5 | 42.7 | 44.4 | 1.46  | 47.6 | 50.3 | 50.2 | 1.53  |

and then the WQI calculated from the following equation:

\[ S_{li} = W_i \times q_i \]

\[ WQI = \sum W_i q_i \]

where \( S_{li} \) is the sub index of each parameter.

Where both the summations are taken from \( i = 1 \) to \( i = 10 \) (the total no. of parameters considered).

WQI of ground water at each sampling point is shown in Table 12, Fig. 1. Table 11 deals with classification of drinking water quality. It was observed that 35% of groundwater samples
Table 10.
Physico-chemical parameters of groundwater sample at GW9 a distance of 150m away from the canal.

| Parameters       | At the time of flow (Year) | At the time of non-flow (Year) |
|------------------|---------------------------|-----------------------------|
|                  | 2014 | 2015 | 2016 | SD  | 2014 | 2015 | 2016 | SD  |
| pH               | 6.50 | 6.80 | 6.91 | 0.21 | 7.00 | 7.50 | 7.50 | 0.29 |
| EC(μS/cm)        | 965  | 1078 | 1435 | 245.33 | 1150 | 1192 | 1427 | 149.29 |
| TDS(mg/L)        | 618  | 690  | 919  | 157.18 | 736  | 763  | 913  | 95.36 |
| Chloride (mg/L)  | 265  | 306  | 431  | 86.53 | 293  | 311  | 444  | 82.42 |
| Sulphate (mg/L)  | 94   | 101  | 173  | 43.73 | 125  | 133  | 125  | 4.53  |
| Sodium (mg/L)    | 107  | 114  | 129  | 11.08 | 127  | 135  | 131  | 4.01  |
| Calcium (mg/L)   | 98   | 104  | 118  | 9.99  | 105  | 112  | 131  | 13.18 |
| Magnesium (mg/L) | 26   | 28   | 48   | 12.17 | 28   | 30   | 53   | 14.07 |
| Hardness (mg/L)  | 352  | 377  | 490  | 73.76 | 378  | 402  | 545  | 90.18 |
| Nitrate (mg/L)   | 36.8 | 38.1 | 39.7 | 1.45  | 42.3 | 45.1 | 45.2 | 1.65  |

Table 11.
Water quality classification based on WQI value.

| WQI Value | Water Quality     |
|-----------|-------------------|
| ≤50       | Excellent         |
| 50-100    | Good Water        |
| 100-200   | Poor Water        |
| 200-300   | Very Poor Water   |
| >300      | Water Unsuitable For Drinking |

Table 12.
Quality of ground water based on WQI values.

| Sample Code | 2014 | 2015 | 2016 |
|-------------|------|------|------|
|             | WQI values | Quality | WQI values | Quality | WQI values | Quality |
| GW1         | 113  | Poor | 121  | Poor | 130  | Poor |
| GW2         | 121  | Poor | 130  | Poor | 138  | Poor |
| GW3         | 325  | Unsuitable for drinking | 346  | Unsuitable for drinking | 343  | Unsuitable for drinking |
| GW4         | 143  | Poor | 153  | Poor | 197  | Poor |
| GW5         | 150  | Poor | 160  | Poor | 202  | Very Poor |
| GW6         | 312  | Unsuitable for drinking | 329  | Unsuitable for drinking | 327  | Unsuitable for drinking |
| GW7         | 143  | Poor | 152  | Poor | 318  | Unsuitable for drinking |
| GW8         | 124  | Poor | 132  | Poor | 155  | Poor |
| GW9         | 112  | Poor | 120  | Poor | 138  | Poor |

are unsuitable for drinking and another 35% of samples are very poor water and remaining 30% of the samples are of poor category throughout the study period (2014, 2015 and 2016). The percentage of water samples under the ‘unsuitable for drinking’ category gradually increases. This indicates that the groundwater pollution in this region increases from 2014 to 2016. In the year 2015 and 2016, none of the samples fell under the good category which shows that all the groundwater samples have undergone some kind of pollution threats. In 2016, water samples that came under the category of very poor’ are 15.7%, while it is only 1.85% in the year 2015. So, the groundwater was contaminated more in the year 2016. Table 12 shows the quality of groundwater in each location with respect to Water Quality Index values during the study period. Fig. 2. shows the variation in the WQI values throughout the study period. During the study period, sampling stations GW3 and GW6 reach the maximum value while comparing with other sampling stations. So, the ground water withdrawn from these two wells could not be used for any purpose. In addition to that the sampling stations GW3 is located 30 m away from the canal and GW6 is located at 50 m away from the canal. The value of WQI increases
Table 13.
Analytical methods of Water quality parameters.

| S. No. | Parameters   | Method            | Instrumentation          |
|--------|--------------|-------------------|--------------------------|
| 1      | pH           | Potentiometer     | Digital pH meter         |
| 2      | EC           | Digital conductivity meter |
| 3      | TDS          | Digital conductivity meter |
| 4      | Total hardness | EDTA complex   | Titration               |
| 5      | Chloride     | Argentometry      |                          |
| 6      | BOD          | Winkler’s method  |                          |
| 7      | COD          | Open refluxion    | COD digester            |
| 8      | Sodium       | Flame             | Flame Photometer        |
| 9      | Magnesium    | Emission          |                          |
| 10     | Calcium      |                   |                          |
| 11     | Phosphate    | Molybdenum-blue complex | UV –Vis Spectrophotometer |
| 12     | Sulphate     | Turbidimetric method |                     |
| 13     | Nitrate      | Phenol disulphonic acid |                     |

Fig. 2. Variation in groundwater quality based on WQI.

with time in all the sampling stations. This gives a warning that the pollution of groundwater in that region must be prevented. The information obtained through this work may be used to improve the management practices and developing better water pollution control strategies for Kalingarayan Canal.

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.

Acknowledgments

Our Hearty thanks to the Editor-in-chief and an anonymous reviewer for his valuable suggestions to improve on the quality of the manuscript.
Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2020.106112.

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