Data Article

Water quality assessment for groundwater around a municipal waste dumpsite

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A B S T R A C T

The dataset for this article contains geostatistical analysis of the level to which groundwater quality around a municipal waste dumpsite located in Oke-Afa, Oshodi/Isolo area of Lagos state, southwestern has been compromised for drinking. Groundwater samples were collected from eight hand-dug wells and two borehole wells around or near the dumpsite. The pH, turbidity, salinity, conductivity, total hydrocarbon, total dissolved solids (TDS), dissolved oxygen, chloride, Sulphate (SO₄), Nitrate (NO₃) and Phosphate (PO₄) were determined for the water samples and compared with World Health Organization (WHO) drinking water standard. Notably, the turbidity, TDS, chloride and conductivity of some of the samples were above the WHO acceptable limits. Also, high quantities of heavy metals such as Aluminum and Barium were also present as shown from the data. The dataset can provide insights into the health implications of the contaminants especially when the mean concentration levels of the contaminants are above the recommended WHO drinking water standard.

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Value of the data

- The data could be used to determine the level of chemical contamination dumpsites, volcanic erupted areas, chemical wastes sites, oil spillage sites and others areas of interest.
- The data could be helpful for concerned authorities and policy makers in water quality management.
- Findings can be extended to other metal or non-metal elements not considered in this article.
- The data could be used in auditing water quality.

1. Data

The data contains geostatistical and geochemical analysis of groundwater samples collected from eight (8) hand-dug wells and some borehole wells around or near the dumpsite. The dumpsites are located in Oshodi/Isolo area of Lagos State, South-western Nigeria. The parameters investigated are:

| Parameters       | W1    | W2    | W3    | W4    | W5    | W6    | W7    | W8    | W9    | W10   |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| pH               | 6.55  | 5.15  | 6.35  | 6.26  | 6.59  | 6.17  | 6.26  | 6.25  | 6.89  | 6.17  |
| DO mg/l          | 4.4   | 4.2   | 4.3   | 4.1   | 4.2   | 4.0   | 4.3   | 4.1   | 4.0   | 4.2   |
| CC mg/l          | 92    | 108   | 116   | 44    | 200   | 84    | 168   | 88    | 344   |
| THC mg/l         | 200   | 140   | 236   | 240   | 228   | 188   | 120   | 164   | 652   |
| Salinity mg/l    | 0.18  | 0.22  | 0.23  | 0.09  | 0.40  | 0.17  | 0.08  | 0.34  | 0.18  | 0.69  |
| SO₄ mg/l         | 0.07  | 0.09  | 1.21  | 1.27  | 1.01  | 0.06  | 0.08  | 0.05  | 2.09  | 2.12  |
| NO₃ mg/l         | 1.20  | 2.30  | 2.50  | 2.60  | 1.90  | 2.20  | 1.76  | 1.24  | 3.50  | 2.90  |
| PO₄ mg/l         | 0.09  | 0.06  | 1.20  | 0.10  | 0.70  | 0.05  | 2.10  | 1.70  | 3.20  | 3.00  |
| Conduct mS/cm    | 952   | 454   | 954   | 1014  | 1151  | 994   | 1007  | 1120  | 1643  | 1123  |
| TDS mg/l         | 480   | 211   | 388   | 249   | 573   | 496   | 504   | 561   | 822   | 399   |
| Turbidity (NTU)  | 4.5   | 2.7   | 2.9   | 1.5   | 3.2   | 6.9   | 2.2   | 2.9   | 6.9   | 6.5   |
| Temp (°C)        | 28.2  | 27.9  | 28.3  | 28.4  | 28.4  | 28.3  | 28.2  | 29.9  | 29.2  | 27.2  |
| SWL m            | 8     | N/A   | 6     | 8.6   | 13    | 5     | 6     | N/A   | 2     | 4     |

W represents the sample (well and borehole), N.A means Not applicable, W2 and W8 are boreholes.
pH, dissolved oxygen (DO), chlorine content (CC), total hardness content (THC), salinity, sulphate ($SO_4$), Nitrate ($NO_3$), Phosphate ($PO_4$), conductivity, total dissolved solids (TDS), turbidity, temperature and static water level (SWL). The static water level is not applicable to the two borehole wells. The results of the physio-chemical characteristic of the studied area are presented in Table 1. Results of the heavy metal analysis are presented in Table 2. The detailed descriptive statistics are presented in Table 3. Different measures of central tendency were compared with the WHO recommended limit and this is presented in Table 4.

2. Experimental design, methods and materials

Several data analysis has been carried out on the physio-chemical, geochemical and geostatistical assessment of quality of groundwater [1–16].

2.1. Study area and sample collection

The data was collected from the areas located around the dumpsite. The dumpsite is an extensive one which has been in existence in Oke-afa, Oshodi/Isolo Area of Lagos State for more than two decades. The detailed GPS coordinates elevation and distance from the dumpsite is presented in Table 5 while the map and GPS elevation map of the studied area can be seen in Figs. 1 and 2 respectively. The boreholes and hand dug wells around this dumpsite had been contaminated by the leachates from the dumpsite.

Lagos is a sedimentary area located within the western Nigeria coastal zone, a zone of coastal creeks and lagoons developed by barrier beaches associated with sand deposition [17]. The subsurface geology reveals two basic lithologies, clay and sand deposits. These deposits may be inter-bedded in places with sandy clay or clayey sand and occasional with vegetable remains and peat. Basically, the geological setting of the study area reveals that it lies solely within the extensive Dahomey basin, the basin extending almost from Accra to Lagos. The coastal belt varies from about 8 km near the republic of Benin border to 24 km towards the eastern end of the Lagos lagoon [18].

| Table 2 |
|---|
| Results for the heavy metals analysed on the 10 water samples (Acme Lab Canada). |

| Analyte | Dilution | Al | As | Au | B | Ba | Be | Br | Ca | Cd | Ce |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | ppb | ppb | ppb | ppb | ppb | ppb | Ppb | ppm | Ppb | Ppb | ppb |
| MDL | 1 | 1 | 0.5 | 0.05 | 5 | 0.05 | 0.05 | 5 | 0.05 | 0.05 | 0.01 |
| WHO (ppb) | 200 | 50 | – | 300 | 2000 | – | 25 | – | 5 | – |

| SOLA 1 Water | 1 | < 0.5 | 0.14 | 343 | 29.05 | < 0.05 | 370 | 63.05 | 0.06 | < 0.01 |
| SOLA 2 Water | 1 | 25 | 0.7 | < 0.05 | 90 | 42.46 | 0.09 | 482 | 36.21 | 0.28 | 0.13 |
| SOLA 3 Water | 1 | 13 | 0.9 | < 0.05 | 177 | 33.15 | < 0.05 | 700 | 80.74 | 0.06 | 0.06 |
| SOLA 4 Water | 1 | 10 | 0.5 | < 0.05 | 117 | 38.28 | < 0.05 | 278 | 93.94 | 0.10 | 0.05 |
| SOLA 5 Water | 1 | 1641 | 1.4 | < 0.05 | 20 | 203.4 | 0.33 | 371 | 48.84 | 0.23 | 95.07 |
| SOLA 6 Water | 1 | 13 | 1.0 | < 0.05 | 149 | 32.92 | < 0.05 | 266 | 61.60 | < 0.05 | 0.35 |
| SOLA 7 Water | 1 | 89 | 0.8 | < 0.05 | 172 | 33.08 | 0.07 | 138 | 39.70 | < 0.05 | 0.22 |
| SOLA 8 Water | 1 | 26 | 1.1 | < 0.05 | 61 | 127.5 | 0.08 | 890 | 48.95 | 0.14 | 14.93 |
| SOLA 9 Water | 1 | 7 | 1.4 | < 0.05 | 1438 | 76.14 | < 0.05 | 269 | 56.78 | < 0.05 | 0.78 |
| SOLA 10 Water | 1 | 18 | 4.2 | < 0.05 | 2063 | 116.8 | < 0.05 | 3547 | 82.20 | < 0.05 | 0.25 |

Al – Aluminium, As – Arsenic, Au – Gold, B – Boron, Ba – Barium, Br – Bromide, Be – Beryllium, Ca – Calcium, Cd – Cadmium, Ce – Cerium, MDL – MAXIMUM DETECTION LIMIT.
Table 3
The descriptive statistics of the parameters of the data.

| Parameters | Mean | Standard error | Median | Standard deviation | Variance | Kurtosis | Skewness | Range | Min | Max | Sum |
|------------|------|----------------|--------|--------------------|----------|----------|----------|-------|-----|-----|-----|
| pH         | 6.26 | 0.14           | 6.26   | 0.45               | 0.21     | 4.54     | – 1.61   | 1.74  | 5.15| 6.89| 62.64|
| DO mg/l    | 4.18 | 0.04           | 4.20   | 0.13               | 0.02     | – 0.75   | 0.09     | 0.40  | 4.00| 4.40| 41.80|
| CC mg/l    | 128.40 | 28.60       | 100    | 90.44              | 8179.38  | 3.20     | 1.68     | 304   | 40  | 344| 1284|
| THC mg/l   | 259.60 | 51.20       | 214    | 161.90             | 26209.60 | 3.67     | 1.94     | 532   | 120| 652| 2696|
| Salinity mg/l | 0.26 | 0.06           | 0.20   | 0.18               | 0.03     | 3.19     | 1.68     | 0.61  | 0.08| 0.69| 2.58|
| SO4 mg/l   | 0.81 | 0.27           | 0.55   | 0.85               | 0.72     | – 1.31   | 0.58     | 2.07  | 0.05| 2.12| 8.05|
| NO3 mg/l   | 2.21 | 0.23           | 2.25   | 0.72               | 0.52     | – 0.24   | 0.19     | 2.30  | 1.20| 3.50| 22.10|
| PO4 mg/l   | 1.22 | 0.39           | 0.95   | 1.23               | 1.51     | – 1.19   | 0.60     | 3.15  | 0.05| 3.22| 12.2|
| Conduct mS/cm | 104.12 | 91.39        | 1010.50 | 288.99             | 83513.50 | 3.50     | 0.09     | 1189  | 454| 1643| 10412|
| TDS mg/l   | 468.30 | 55.01        | 488    | 173.97             | 30264.90 | 1.05     | 0.47     | 611   | 211| 822| 4683|
| Turbidity (NTU) | 4.02 | 0.65           | 3.05   | 2.04               | 4.17     | – 1.41   | 0.58     | 5.40  | 1.50| 6.90| 40.20|
| Temp (°C)  | 28.40 | 0.23           | 28.3   | 0.72               | 0.52     | 1.80     | 0.75     | 2.70  | 27.2| 29.2| 284|

Table 4
Comparison of the central tendency estimates with the WHO recommended limits.

| Parameters | WHO limit (2008) | Mean | Median | 5% Trimmed mean | HuME | TBW | HaME | AW |
|------------|------------------|------|--------|-----------------|------|-----|------|----|
| pH         | 6.5–8            | 6.26 | 6.26   | 6.29            | 6.28 | 6.27| 6.30 | 6.27|
| DO mg/l    | –                | 4.18 | 4.20   | 4.17            | 4.19 | 4.18| 4.18 | 4.18|
| CC mg/l    | 250              | 128.40 | 100    | 121.33          | 107.10 | 97.73| 102.21 | 97.95|
| THC mg/l   | 500              | 259.60 | 214    | 245.56          | 209.54 | 191.66| 194.57 | 191.66|
| Salinity mg/l | –               | 0.26 | 0.20   | 0.24            | 0.21 | 0.20| 0.20 | 0.20|
| SO4 mg/l   | 500              | 0.81 | 0.55   | 0.77            | 0.65 | 0.62| 0.69 | 0.63|
| NO3 mg/l   | 5               | 2.21 | 2.25   | 2.19            | 2.21 | 2.19| 2.21 | 2.19|
| PO4 mg/l   | 0.06             | 1.22 | 0.95   | 1.18            | 1.04 | 1.08| 1.12 | 1.08|
| Conduct mS/cm | 500              | 104.12 | 1010.50 | 1040.39         | 1038.82 | 1036.73| 1038.27 | 1036.69|
| TDS mg/l   | 600              | 468.30 | 488    | 462.94          | 469.29 | 452.74| 461.95 | 450.01|
| Turbidity (NTU) | 4.0              | 4.02 | 3.05   | 4               | 3.58 | 3.47| 3.71 | 3.48|
| Temp (°C)  | 28               | 28.40 | 28.3   | 28.38           | 28.30 | 28.29| 28.28 | 28.30|

HuME is the Huber’s M-Estimator, TBW is the Tukey’s bi-weight, HaME is the Hampel’s M-Estimator, AW is the Andrew’s wave.

Table 5
GPS Readings and elevation from the 10 hand dug wells and boreholes.

| Samples | Latitude | Longitude | Distance from dumpsite (m) | Elevation (m) | Water table (m) |
|---------|----------|-----------|----------------------------|---------------|-----------------|
| W1      | N06.52889| E003.31986| 10                         | 13.0          | 8               |
| W2      | N06.31471| E003.13073| 4                          | 17            | N/A             |
| W3      | N06.52916| E003.31974| 15                         | 18.3          | 6               |
| W4      | N06.52955| E003.31991| 30                         | 8.6           | 8.6             |
| W5      | N06.52954| E003.32027| 40                         | 12.3          | 13              |
| W6      | N06.52988| E003.32026| 35                         | 15.1          | 5               |
| W7      | N06.52998| E003.31994| 25                         | 20.1          | 6               |
| W8      | N06.31512| E003.19057| 250                        | 18            | N/A             |
| W9      | N06.31523| E003.19005| 55                         | 5             | 2               |
| W10     | N06.3521 | E003.19014| 300                        | 30            | 4               |
2.2. Samples preparation

The samples were collected during the dry season when the demand for water is high due to the hot weather. The residents have both hand dug wells and boreholes but patronize commercial water for drinking purposes. The samples were collected and taken to laboratory for procedural analysis. The pH, conductivity and total dissolved solid (TDS) were measured with pH-conductivity-TDS meter (COMBO HI model 98130). Dissolved oxygen (DO) was measured using DO-meter (HACH model). Anions like sulphate (SO$_4$), phosphate (PO$_4$), and nitrates (NO$_3$) were determined using ultraviolet (UV)-Visible Spectrophotometer (Camspec model). Turbid metric method was used for sulphate determination; Vanado-Molybdo-Phosphoric acid method was used for phosphate determination, while salicylate method was used for nitrate determination. The Cl$^-$ concentration was determined by Mohr’s method, while hydrocarbonate was determined by titration against 0.01 M of H$_2$SO$_4$ using mixed indicator (Bromocresol green-Methyl red solution). The heavy metals in the water samples were analyzed using inductively coupled plasma mass spectrometry (ICPMS) in ACME Laboratory, Canada.
Normality tests are conducted to determine if the observed values are drawn from the normal distribution since the sample size is small. The result is presented in Table 6.

| Variables         | Kolmogorov–Smirnov | Shapiro–Wilk |
|-------------------|---------------------|--------------|
|                   | Statistic | Df | Sig. | Statistic | Df | Sig. |
| pH                | 0.318     | 10 | 0.005 | 0.820     | 10 | 0.025 |
| DO mg/l           | 0.160     | 10 | 0.200 | 0.942     | 10 | 0.575 |
| CC mg/l           | 0.255     | 10 | 0.065 | 0.834     | 10 | 0.038 |
| THC mg/l          | 0.348     | 10 | 0.001 | 0.759     | 10 | 0.005 |
| Salinity mg/l     | 0.261     | 10 | 0.051 | 0.833     | 10 | 0.036 |
| SO₄²⁻ mg/l        | 0.300     | 10 | 0.011 | 0.805     | 10 | 0.017 |
| NO₃ mg/l          | 0.112     | 10 | 0.200 | 0.971     | 10 | 0.898 |
| PO₄³⁻ mg/l        | 0.219     | 10 | 0.192 | 0.860     | 10 | 0.077 |
| Conduct mS/cm     | 0.279     | 10 | 0.027 | 0.851     | 10 | 0.059 |
| TDS mg/l          | 0.174     | 10 | 0.200 | 0.946     | 10 | 0.627 |
| Turbidity (NTU)   | 0.256     | 10 | 0.062 | 0.855     | 10 | 0.067 |
| Temp (°C)         | 0.300     | 10 | 0.011 | 0.893     | 10 | 0.182 |

Df is the degrees of freedom, Sig is the statistical significance measured as p-value.

| Variables         | pH | DO | CC | THC | Salinity | SO₄²⁻ | NO₃ | PO₄³⁻ | Conduct | TDS | Turbidity | Temp |
|-------------------|----|----|----|-----|----------|-------|-----|-------|---------|-----|------------|------|
| pH                | 1  | −0.073| −0.018| 0.519| −0.023| 0.419| 0.100| 0.394| 0.874| 0.764| 0.309| 0.372|
| DO                | 1  | 0.038| −0.422| 0.026| −0.256| −0.489| −0.163| −0.427| −0.319| −0.407| −0.421|
| CC                | 1  | 0.277| 0.999| 0.449| 0.128| 0.419| 0.119| 0.013| 0.351| −0.325|
| THC               | 1  | 0.281| 0.853| 0.787| 0.690| 0.772| 0.569| 0.650| 0.074|
| Salinity          | 1  | 0.451| 0.134| 0.422| 0.121| 0.121| 0.353| −0.320|
| SO₄²⁻             | 1  | 0.827| 0.614| 0.607| 0.232| 0.370| −0.181|
| NO₃               | 1  | 0.464| 0.396| 0.112| 0.428| −0.221|
| PO₄³⁻             | 1  | 0.674| 0.571| 0.392| 0.115|
| Conduct           | 1  | 0.854| 0.486| 0.444|
| TDS               | 1  | 0.519| 0.558|
| Turbidity (NTU)   | 1  | −0.121|
| Temp              | 1  |      |

| Variables         | pH | DO | CC | THC | Salinity | SO₄²⁻ | NO₃ | PO₄³⁻ | Conduct | TDS | Turbidity | Temp |
|-------------------|----|----|----|-----|----------|-------|-----|-------|---------|-----|------------|------|
| pH                | 1  | 0.134| −0.067| 0.445| −0.056| 0.238| 0.000| 0.360| 0.427| 0.573| 0.187| 0.495|
| DO                | 1  | 0.136| −0.285| 0.084| 0.062| −0.446| −0.031| −0.495| −0.303| −0.343| −0.563|
| CC                | 1  | 0.248| 0.997| 0.188| 0.042| 0.200| 0.248| 0.042| 0.274| 0.073|
| THC               | 1  | 0.280| 0.806| 0.745| 0.418| 0.564| 0.079| 0.421| 0.208|
| Salinity          | 1  | 0.225| 0.097| 0.243| 0.298| 0.073| 0.291| −0.040|
| SO₄²⁻             | 1  | 0.867| 0.503| 0.442| −0.164| 0.073| −0.153|
| NO₃               | 1  | 0.370| 0.382| −0.188| 0.189| 0.189| 0.018|
| PO₄³⁻             | 1  | 0.697| 0.479| 0.116| 0.183|
| Conduct           | 1  | 0.697| 0.323| 0.526|
| TDS               | 1  | 0.476| 0.581|
| Turbidity (NTU)   | 1  | 0.037|
| Temp              | 1  |      |

2.3. Normality tests

Normality tests are conducted to determine if the observed values are drawn from the normal distribution since the sample size is small. The result is presented in Table 6.
### Table 9
Correlation matrix (Kendall).

| Variables | pH  | DO   | THC  | Salinity | SO₄  | NO₃  | PO₄  | Conduct | TDS  | Turbid | Temp |
|-----------|-----|------|------|----------|------|------|------|---------|------|--------|------|
| pH        | 1   | 0.122| –0.068| 0.296    | –0.046| 0.159| –0.023| 0.205   | 0.250| 0.477  | 0.163| 0.376 |
| DO        | 1   | 0.072| 0.263| 0.048    | –0.119| –0.358| –0.024| –0.238  | –0.148| –0.244 | –0.359|
| THC       | 1   | 0.200| 0.989| 0.156    | 0.067| 0.156| 0.156| 0.022   | 0.205| –0.046|      |
| Salinity  | 1   | 0.225| 0.689| 0.600    | 0.333| 0.422| 0.022| 0.341   | 0.184|        |      |
| SO₄       | 1   | 0.180| 0.090| 0.180    | 0.180| 0.045| 0.230| –0.023  | 0.002| 0.092  |      |
| NO₃       | 1   | 0.809| 0.178| 0.289    | –0.111| 0.114| 0.000|        |      |        |      |
| PO₄       | 1   | 0.168| –0.046| 0.289    | –0.111| 0.114| 0.000|        |      |        |      |
| Conduct   | 1   | 0.200| 0.989| 0.156    | 0.067| 0.156| 0.156| 0.022   | 0.205| –0.046|      |
| TDS       | 1   | 0.386| 0.414| 0.000    |      |      |      |        |      |        |      |
| Turbid    | 1   | 0.000|      |          |      |      |      |        |      |        |      |
| Temp      | 1   |      |      |          |      |      |      |        |      |        |      |

### Table 10
Absolute difference between the correlations coefficients and their percentages.

| Variables | D₁ | D₂ | D₃ | %D₁ | %D₂ | %D₃ |
|-----------|----|----|----|-----|-----|-----|
| 1         | 0.207| 0.195| 0.012| 20.7| 19.5| 1.2 |
| 2         | 0.049| 0.050| 0.001| 4.9 | 5.0 | 0.1 |
| 3         | 0.074| 0.223| 0.149| 7.4 | 22.3| 14.9|
| 4         | 0.033| 0.023| 0.010| 3.3 | 2.3 | 1.0 |
| 5         | 0.181| 0.260| 0.079| 18.1| 26.0| 7.9 |
| 6         | 0.100| 0.123| 0.023| 10.0| 12.3| 2.3 |
| 7         | 0.034| 0.189| 0.155| 3.4 | 18.9| 15.5|
| 8         | 0.447| 0.624| 0.177| 44.7| 62.4| 17.7|
| 9         | 0.191| 0.287| 0.096| 19.1| 28.7| 9.6 |
| 10        | 0.122| 0.146| 0.024| 12.2| 14.6| 2.4 |
| 11        | 0.123| 0.004| 0.119| 12.3| 0.4 | 11.9|
| 12        | 0.098| 0.034| 0.064| 9.8 | 3.4 | 6.4 |
| 13        | 0.137| 0.159| 0.022| 13.7| 15.9| 2.2 |
| 14        | 0.058| 0.022| 0.036| 5.8 | 2.2 | 3.6 |
| 15        | 0.194| 0.137| 0.057| 19.4| 13.7| 5.7 |
| 16        | 0.043| 0.131| 0.088| 4.3 | 13.1| 8.8 |
| 17        | 0.132| 0.139| 0.007| 13.2| 13.9| 0.7 |
| 18        | 0.068| 0.069| 0.137| 6.8 | 6.9 | 13.7|
| 19        | 0.016| 0.015| 0.089| 1.6 | 10.5| 8.9 |
| 20        | 0.064| 0.163| 0.099| 6.4 | 16.3| 9.9 |
| 21        | 0.142| 0.026| 0.168| 14.2| 2.6 | 16.8|
| 22        | 0.029| 0.077| 0.048| 2.9 | 7.7 | 4.8 |
| 23        | 0.002| 0.010| 0.008| 0.2 | 1.0 | 0.8 |
| 24        | 0.261| 0.293| 0.032| 26.1| 29.3| 3.2 |
| 25        | 0.086| 0.061| 0.025| 8.6 | 6.1 | 2.5 |
| 26        | 0.219| 0.263| 0.044| 21.9| 26.3| 4.4 |
| 27        | 0.129| 0.037| 0.092| 12.9| 3.7 | 9.2 |
| 28        | 0.029| 0.009| 0.020| 2.9 | 0.9 | 2.0 |
| 29        | 0.077| 0.146| 0.069| 7.7 | 14.6| 6.9 |
| 30        | 0.252| 0.279| 0.027| 25.2| 279.2| 2.7|
| 31        | 0.001| 0.056| 0.055| 0.1 | 5.6 | 5.5 |
| 32        | 0.047| 0.164| 0.117| 4.7 | 16.4| 11.7|
| 33        | 0.042| 0.187| 0.145| 4.2 | 18.7| 14.5|
| 34        | 0.272| 0.357| 0.085| 27.2| 35.7| 8.5 |
| 35        | 0.208| 0.350| 0.142| 20.8| 35.0| 14.2|
| 36        | 0.490| 0.547| 0.057| 49.0| 54.7| 5.7 |
| 37        | 0.229| 0.309| 0.080| 22.9| 30.9| 8.0 |
| 38        | 0.134| 0.110| 0.024| 13.4| 11.0| 2.4 |
| 39        | 0.226| 0.271| 0.045| 22.6| 27.1| 4.5 |
| 40        | 0.037| 0.044| 0.007| 3.7 | 4.4 | 0.7 |
| 41        | 0.179| 0.242| 0.063| 17.9| 24.2| 6.3 |
2.4. Correlation coefficient

Correlation among the parameters is conducted to determine the extent of relationship and these are presented in Tables 7–9.

In order for better understanding of the correlations, the distances between the correlations are computed using the following:

\[ D_1 = \left| \frac{\text{Pearson} - \text{Spearman}}{\text{Pearson}} \right| \]

\[ D_2 = \left| \frac{\text{Kendall} - \text{Pearson}}{\text{Pearson}} \right| \]

\[ D_3 = \left| \frac{\text{Spearman} - \text{Kendall}}{\text{Kendall}} \right| \]

The application of the transformations and their percentages using Tables 7–9 are presented in Table 10.

### Table 10 (continued)

| Variables | \(D_1\) | \(D_2\) | \(D_3\) | \%\(D_1\) | \%\(D_2\) | \%\(D_3\) |
|-----------|--------|--------|--------|----------|----------|----------|
| 42        | 0.177  | 0.059  | 0.118  | 17.7     | 5.9      | 11.8     |
| 43        | 0.059  | 0.031  | 0.028  | 5.9      | 3.1      | 2.8      |
| 44        | 0.062  | 0.123  | 0.061  | 6.2      | 12.3     | 6.1      |
| 45        | 0.280  | 0.297  | 0.017  | 28.0     | 29.7     | 1.7      |
| 46        | 0.040  | 0.094  | 0.134  | 4.0      | 9.4      | 13.4     |
| 47        | 0.111  | 0.236  | 0.125  | 11.1     | 23.6     | 12.5     |
| 48        | 0.165  | 0.318  | 0.153  | 16.5     | 31.8     | 15.3     |
| 49        | 0.396  | 0.343  | 0.053  | 39.6     | 34.3     | 5.3      |
| 50        | 0.297  | 0.347  | 0.050  | 29.7     | 34.7     | 5.0      |
| 51        | 0.028  | 0.089  | 0.061  | 2.8      | 8.9      | 6.1      |
| 52        | 0.094  | 0.175  | 0.081  | 9.4      | 17.5     | 8.1      |
| 53        | 0.014  | 0.107  | 0.093  | 1.4      | 10.7     | 9.3      |
| 54        | 0.300  | 0.223  | 0.077  | 30.0     | 22.3     | 7.7      |
| 55        | 0.239  | 0.314  | 0.075  | 23.9     | 31.4     | 7.5      |
| 56        | 0.203  | 0.221  | 0.018  | 20.3     | 22.1     | 1.8      |
| 57        | 0.023  | 0.118  | 0.141  | 2.3      | 11.8     | 14.1     |
| 58        | 0.092  | 0.238  | 0.146  | 9.2      | 23.8     | 14.6     |
| 59        | 0.276  | 0.324  | 0.048  | 27.6     | 32.4     | 4.8      |
| 60        | 0.068  | 0.023  | 0.045  | 6.8      | 2.3      | 4.5      |
| 61        | 0.157  | 0.254  | 0.097  | 15.7     | 25.4     | 9.7      |
| 62        | 0.163  | 0.236  | 0.073  | 16.3     | 23.6     | 7.3      |
| 63        | 0.082  | 0.016  | 0.066  | 8.2      | 1.6      | 6.6      |
| 64        | 0.043  | 0.133  | 0.090  | 4.3      | 13.3     | 9.0      |
| 65        | 0.023  | 0.144  | 0.167  | 2.3      | 14.4     | 16.7     |
| 66        | 0.158  | 0.121  | 0.037  | 15.8     | 12.1     | 3.7      |

The variables are the correlations between the parameters.

### Table 11

Analysis of variance (ANOVA) for the samples.

| Source of variation | D.F | S.S   | M.S   | F-value | P-value |
|---------------------|-----|-------|-------|---------|---------|
| Sample              | 11  | 10,729,618 | 975,419.9 | 78.99464 | < 0.0000005 |
| Error               | 108 | 1,333,576   | 12,347.92  |         |         |
| Total               | 119 | 12,063,194  |         |         |         |

2.4. Correlation coefficient

Correlation among the parameters is conducted to determine the extent of relationship and these are presented in Tables 7–9.

In order for better understanding of the correlations, the distances between the correlations are computed using the following:

\[ D_1 = \left| \frac{\text{Pearson} - \text{Spearman}}{\text{Pearson}} \right| \]

\[ D_2 = \left| \frac{\text{Kendall} - \text{Pearson}}{\text{Pearson}} \right| \]

\[ D_3 = \left| \frac{\text{Spearman} - \text{Kendall}}{\text{Kendall}} \right| \]

The application of the transformations and their percentages using Tables 7–9 are presented in Table 10.
2.5. Analysis of variance

The result showed that there are significant differences in the means of the parameters that constitute contamination of the 10 samples collected from the study area. This is presented in Table 11.

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Transparency document. Supplementary material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.01.072.

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