Survey and mapping of heavy metals in groundwater resources around the region of the Anzali International Wetland; a dataset

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

\textbf{Article history:}
Received 23 January 2018
Received in revised form 22 February 2018
Accepted 13 March 2018
Available online 19 March 2018

\textbf{Keywords:}
Heavy metal
Groundwater
Anzali wetland
GIS

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

The purpose of this study is zoning and determining the concentration of heavy metals including Arsenic (As), Mercury (Hg), Lead (Pb), and Cadmium (Cd) in the groundwater resources of villages located around the Anzali International Wetland. The amount of heavy metals (As, Hg, Pb, and Cd) in the collected samples were determined by the Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) technique. The maximum concentrations of As, Hg, Pb and Cd were 0.216, 0.059, 0.090 and 0.006 mg/L, respectively.

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\textbf{Specifications table}

| Subject area | Environmental Sciences |
|--------------|------------------------|
| More specific subject area | Drinking water monitoring |
| Type of data | Table and figure |
| How data was acquired | Measurements of all parameters was done according to standard methods [1]; |

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https://doi.org/10.1016/j.dib.2018.03.058
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pH was analyzed by digital pH meter (Metrohm). Digital thermometer was applied for temperature determination. Heavy metals were measured using Inductively Coupled Plasma (ICP-OES) technique. Scaling method was used for Total Dissolved Solids (TDS) analyzing. EC of water was measured by electrical conductivity meter.

### Data format
Raw, analyzed

### Experimental factors
The data were obtained in both dry and wet season, summer and winter, and the Electrical Conductivity (EC), pH and temperature were measured in the place, and the other samples were transferred to the laboratory for TDS and heavy metals measurements.

### Experimental features
All studied parameters were determined and compared with standards [2,3]. A spatial distribution map of heavy metals and weighted interpolation was made using the ArcGIS.

### Data source
Guilan Province, Iran (Fig. 1).

### Data accessibility
All data are available.

## Value of the data
- The data will be useful for health risk assessment of heavy metals related drinking water consumption.
- The data shown here can be helpful for Ministry of Power, water and wastewater companies for managing of groundwater resources.
- The zoning of the heavy metals was done to make a clear picture of the heavy metals concentrations in the groundwater resources of studied area.

## 1. Data
The contamination of groundwater is one of the most important environmental issues in the world [4–9]. Among the various pollutants that affect water resources, pollutants containing heavy metals are particularly important due to their high toxicity, even at low concentrations [10–13]. The parameters in the experiments of this research are including pH, TDS, EC, temperature and heavy metals (As, Hg, Pb, and Cd), in both season of winter and summer. The mean and standard deviation of the heavy metals concentrations and the physico-chemical parameters including pH, temperature, TDS and EC for both wet and dry seasons were given in Table 1. The statistical description of the concentration of heavy metals of water samples in the two seasons was given in Table 2. The average concentration of heavy metals in two seasons, for all studied parts and regions were given in Table 3. The Comparison of the average concentration of heavy metals in the dry and wet seasons was shown in Fig. 2, and the results of zoning the average concentrations of heavy metals evaluated in the groundwater of the study area in both the dry and wet seasons were shown in Figs. 3 and 4. The data of statistical comparison of the average concentration of heavy metals in the dry and wet seasons were given in Table 4. The results of statistical tests (one-way Analysis of variance, ANOVA) to compare the average concentration of heavy metals in two seasons in the eastern, central, and western parts of the study area were given in Table 5.
**Table 1**
The standards, mean and standard deviation values of parameters in both of wet and dry seasons.

| Parameter | Unit | Dry season | Wet season | Maximum permissible |
|-----------|------|------------|------------|---------------------|
|           |      | Mean       | Std. D     | Mean                | Std. D | National standard | WHO guideline |
| As        | mg/l | 0.179      | 0.062      | 0.051               | 0.040 | 0.01             | 0.01          |
| Hg        | mg/l | 0.022      | 0.011      | 0.020               | 0.007 | 0.006            | 0.006         |
| Pb        | mg/l | 0.012      | 0.022      | 0.011               | 0.023 | 0.01             | 0.01          |
| Cd        | mg/l | 0.002      | 0.002      | 0.001               | 0.001 | 0.003            | 0.003         |
| EC        | µS/cm| 741.156    | 256.530    | 718.780             | 254.940 | –                | –             |
| TDS       | mg/l | 370.578    | 128.260    | 359.390             | 127.470 | 1500            | –             |
| pH        | –    | 7.781      | 0.221      | 7.652               | 0.310 | 6.5-9            | –             |
| T         | °C   | 20.698     | 1.775      | 19.271              | 1.944 | –                | –             |

Fig. 1. Geographical position of the triple studied area and sampling point.
2. Experimental design, materials and methods

2.1. Study area description

The study area is a part of the lowland plains of Foumanat (northern section) in Guilan province and is located in north of Iran (Fig. 1). Foumanat lowland is a part of the Anzali wetland watershed and the Caspian Sea, with area of 3,828.8 square kilometers. Sampling point include public and private wells that are the main sources of drinking water for local people. The locations of wells were recorded using geological positioning system (GPS).

2.2. Sample collection and analytical procedures

The study area was partitioned into three radial areas and three geographical sections of east, center, and west areas (Fig. 1). Forty five active deep wells in these nine sections were selected by systematic random sampling and for each sheet, five wells were taken for sampling. The 90 samples were collected in summer of 2016 and in winter of 2017. The sample containers were washed three

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Table 2. The statistical description of the concentration of heavy metals.

| Heavy metals | Unit | Min  | Max  | Mean | Std. D |
|--------------|------|------|------|------|--------|
| As           | mg/l | 0.039| 0.216| 0.115| 0.036  |
| Hg           | mg/l | 0.014| 0.059| 0.021| 0.008  |
| Pb           | mg/l | 0.000| 0.090| 0.012| 0.022  |
| Cd           | mg/l | 0.000| 0.006| 0.002| 0.001  |

Table 3. The average concentration of heavy metals in two seasons, for all studied parts and regions.

| Heavy metals | Unit | Parts | Regions |
|--------------|------|-------|---------|
|              |      | East  | Center  | West   |
| As           | mg/l | 0.137 | 0.107   | 0.100  |
| Hg           | mg/l | 0.021 | 0.016   | 0.025  |
| Pb           | mg/l | 0.009 | 0.023   | 0.002  |
| Cd           | mg/l | 0.002 | 0.002   | 0.001  |

Fig. 2. Average values of heavy metals in the study area in wet and dry season.

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Fig. 3. Zoning map of Arsenic, mercury, lead and cadmium concentrations in studied area in the dry season.

Fig. 4. Zoning map of Arsenic, mercury, lead and cadmium concentrations in studied area in the wet season.
times with distilled water and from each well 1.5 liter of water sample was obtained. The parameters of temperature, EC, TDS and pH were measured in place by portable devices. The other samples were fixed by nitric acid and stored in a dark cold box (4 °C) and transferred to laboratory for analyzing of heavy metals. Statistical analysis of data was done using SPSS 22 and the spatial variability and estimation of the concentration of heavy metals (preparation of zoning map) in the study area, was done by the Inverse Distance Weighting (IDW) method with Arc GIS software, version 10.1.

Table 4
Comparison of mean concentration of heavy metals in wet and dry seasons.

| Season   | Heavy metals | One-sample t- Test |
|----------|--------------|---------------------|
|          | t            | df      | p-value |
| Wet season | As           | 6.846   | 44      | 0.000 |
|          | Hg           | 13.682  | 44      | 0.000 |
|          | Pb           | 0.395   | 44      | 0.690 |
|          | Cd           | -23.500 | 44      | 0.000 |
| Dry season | As           | 18.341  | 44      | 0.000 |
|          | Hg           | 10.041  | 44      | 0.000 |
|          | Pb           | 0.559   | 44      | 0.580 |
|          | Cd           | -3.511  | 44      | 0.000 |

Table 5
Comparison of the mean concentration of heavy metals in the eastern, middle and western parts and in the three regions of the study area.

| Parameter | (I) parts | (J) parts | Std. D (I - J) | P-value | (I) region | (J) region | Std. D (I-J) | P-value |
|-----------|-----------|-----------|----------------|---------|------------|------------|----------------|---------|
| As        | East      | Center    | 0.030          | 0.327   | 1          | 2          | -0.012         | 0.854   |
|           | West      | 0.038     | 0.179          | 3       | -0.011     | 0.870      |                |         |
|           | Center    | 0.008     | 0.933          | 3       | 0.001      | 0.999      |                |         |
|           | West      | -0.038    | 0.179          | 3       | 0.011      | 0.870      |                |         |
|           | Center    | -0.008    | 0.933          | 2       | -0.001     | 0.999      |                |         |
| Hg        | East      | Center    | 0.006*         | 0.040   | 1          | 2          | 0.008*         | 0.000   |
|           | West      | -0.004    | 0.181          | 3       | 0.009*     | 0.999      |                |         |
|           | Center    | -0.006*   | 0.040          | 2       | -0.008*    | 0.000      |                |         |
|           | West      | -0.009*   | 0.000          | 3       | 0.002      | 0.665      |                |         |
|           | West      | 0.004     | 0.181          | 3       | -0.009*    | 0.000      |                |         |
|           | Center    | 0.009*    | 0.000          | 2       | -0.002     | 0.665      |                |         |
| Pb        | East      | Center    | -0.014*        | 0.029   | 1          | 2          | 0.017          | 0.007   |
|           | West      | 0.007     | 0.402          | 3       | 0.008      | 0.355      |                |         |
|           | Center    | 0.014*    | 0.029          | 2       | -0.017*    | 0.007      |                |         |
|           | West      | 0.021*    | 0.001          | 3       | -0.009     | 0.196      |                |         |
|           | West      | -0.007*   | 0.402          | 3       | -0.007     | 0.355      |                |         |
|           | Center    | -0.021*   | 0.001          | 2       | 0.009      | 0.196      |                |         |
| Cd        | East      | Center    | 0.001          | 0.808   | 1          | 2          | 0.001          | 0.881   |
|           | West      | 0.002*    | 0.000          | 3       | 0.001      | 0.881      |                |         |
|           | Center    | -0.001    | 0.808          | 2       | -0.001     | 0.881      |                |         |
|           | West      | -0.002*   | 0.003          | 3       | 0.000      | 1.000      |                |         |
|           | Center    | -0.001*   | 0.003          | 2       | 0.000      | 1.000      |                |         |
Acknowledgements

The authors gratefully acknowledge staff of School of Health Laboratory, Guilan University of Medical Sciences, Iran.

Funding sources

This paper was a part of master science thesis of the first author that has been registered in Ethics Committee of Guilan University of Medical Sciences under ID no: IR.GUMS.REC.1395.93 and supported financially by a grant (No. 95032528) from the Guilan University of Medical Sciences, Rasht, Iran.

Transparency document. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.03.058.

References

[1] W.E. Federation, A.P.H. Association, Standard Methods for the Examination Of Water and Wastewater, American Public Health Association (APHA), Washington, DC, USA, 2005.
[2] WHO, Guidelines for Drinking Water Quality, World Health Organization, Geneva (2017) 468–475.
[3] Industrial research and standard institute of Iran, Physical and Chemical Quality of Drinking Water, Fifth edn, No.1053, Tehran, 2010. Available from: ⟨http://www.isiri.org/std/1053.pdf⟩.
[4] S.D. Ashrafi, H. Kamani, H. Soheil Arezomand, N. Yousefi, A.H. Mahvi, Optimization and modeling of process variables for adsorption of Basic Blue 41 on NaOH-modified rice husk using response surface methodology, Desalin. Water Treat. 57 (2016) 14051–14059.
[5] D. Naghipour, S.D. Ashrafi, A. Mojtahedi, M. Vatandoost, L. Hosseinizadeh, E. Roobhkakhsh, Data on microbial and physiochemical characteristics of inlet and outlet water from household water treatment devices in Rasht, Iran, Data Brief 16 (2018) 1005–1009.
[6] S. Hosseinipour Dizgah, K. Taghavi, J. Jaafari, E. Roobhkakhsh, S.D. Ashrafi, Data on pollutants content in the influent and effluent from wastewater treatment plant of Rasht in Guilan Province, Iran, Data Brief 16 (2018) 271–275.
[7] N. Yousefi, A. Fatehizadeh, K. Ghadiri, N. Mirzaei, S.D. Ashrafi, A.H. Mahvi, Application of nanofilter in removal of phosphate, fluoride and nitrite from groundwater, Desalin. Water Treat. 57 (2016) 11782–11788.
[8] S.D. Ashrafi, H. Kamani, A.H. Mahvi, The optimization study of direct red 81 and methylene blue adsorption on NaOH-modified rice husk, Desalin. Water Treat. 57 (2016) 738–746.
[9] S.D. Ashrafi, H. Kamani, J. Jaafari, A.H. Mahvi, Experimental design and response surface modeling for optimization of fluoroquinolone removal from aqueous solution by NaOH-modified rice husk, Desalin. Water Treat. 57 (2016) 16456–16465.
[10] A. Mohseni-Bandpei, S.D. Ashrafi, H. Kamani, A. Paseban, Contamination and ecological risk assessment of heavy metals in surface soils of Esfarayen City, Iran, Health Scope 6 (2) (2017) e39703. http://dx.doi.org/10.5812/jhealthscope.39703.
[11] H. Kamani, S.D. Ashrafi, S. Isazadeh, J. Jaafari, M. Hoseini, F. Kord Mostafapour, E. Bazrafshan, S. Nazmara, A.H. Mahvi, Heavy Metal Contamination in Street Dusts with Various Land Uses in Zahedan, Iran, Bulletin of Environmental Contamination and Toxicology 94 (3), pp. 382–386. https://doi.org/10.1007/s00128-014-1453-9.
[12] D. Naghipour, J. Jaafari, S.D. Ashrafi, A.H. Mahvi, Remediation of heavy metals contaminated silty clay loam soil by column extraction with ethylenediaminetetraacetic acid and nitrilo triaetic acid, J. Environ. Eng. 143 (8) (2017) 04017026. http://dx.doi.org/10.1061/ASCE EE.1943-7870.0001219.
[13] H. Kamani, A.H. Mahvi, M. Seyedsalehi, J. Jaafari, M. Hoseini, G.H. Safari, A. Dalvand, H. Aslani, N. Mirzaei, S.D. Ashrafi, Contamination and ecological risk assessment of heavy metals in street dust of Tehran, Iran, Int. J. Environ. Sci. Technol. 14 (12) (2017) 2675–2682. http://dx.doi.org/10.1007/s13762-017-1327-x.