Pollution load index for heavy metals in Mian-Ab plain soil, Khuzestan, Iran

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A B S T R A C T
Soil pollution by heavy metals is a major concern in agricultural area. Potential impact of heavy metals in agricultural soil on human health by accumulating in food chain demonstrated elsewhere.

In this regard Mian-Ab plain as a major agricultural site of Khuzestan province considered for Arsenic, cadmium and lead concentration as the main potential toxic pollutants in soil. 50 topsoil samples were collected and analyzed by inductively coupled plasma mass spectrometry (ICP-MS). Also Contamination level of selected heavy metals in Mian-Ab Plain, was assessed by single factor contaminant index (PI) and pollution load index (PLI). Results show mean concentration of arsenic, cadmium and lead were 2.52, 0.30 and 7.21 mg kg⁻¹. Base on PLI results 12 point (24%) of the studied area show moderately polluted and 38 point (76%) show unpolluted area.

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Specifications Table

| Subject area                        | Environmental monitoring |
|-------------------------------------|--------------------------|
| More specific subject area          | Soil pollution monitoring|
| Type of data                        | Table and Figures        |
| Data format                         | Raw and Analyzed         |
| Experimental factors                | 50 soil samples analyzed for cadmium, Arsenic and Lead concentration |
| Experimental features               | Upon soil sampling from selected point, cadmium, Arsenic and Lead concentration in soil samples measured by inductivity coupled plasma, descriptive statistics was done and distribution maps of selected heavy metals prepared. Also pollution level was assessed using single pollution indices and pollution load index. |
| Data source location                | Shushtar, Khuzestan, Iran, 31°40′ and 32°05′ N and 48°45′ and 49°00′ E |
| Data accessibility                  | Data are available in the article |

Value of the data

- Arsenic, cadmium and lead are the main potentially toxic pollutants.
- Mian-Ab Plain is one of the most agricultural sites in Khuzestan province.
- Soil pollution by heavy metals is the major concern in developing countries.

1. Data

Table 1 shows Descriptive statistics of selected heavy metals in Mian-Ab plain soil also Figs. 1–3 show distribution of Arsenic, cadmium and lead in Mian-Ab plain respectively. Table 2 shows single pollution indices and pollution load index of selected heavy metals.

Table 1
Descriptive statistics of selected heavy metals in Mian-Ab plain soil.

| Item               | Ar (mg kg\(^{-1}\)) | Cd (mg kg\(^{-1}\)) | Pb (mg kg\(^{-1}\)) |
|--------------------|---------------------|----------------------|----------------------|
| N                  | 50                  | 50                   | 50                   |
| Mean               | 2.5220              | 0.3030               | 7.2140               |
| Std. Error of Mean | 0.11785             | 0.00758              | 0.45062              |
| Median             | 2.3500              | 0.3000               | 6.6500               |
| Mode               | 2.10                | 0.31                 | 6.00                 |
| Std. Deviation     | 0.83331             | 0.05361              | 3.18639              |
| Variance           | 0.694               | 0.003                | 10.153               |
| Skewness           | 1.272               | 5.712                | 5.337                |
| Std. Error of Skewness | 0.337             | 0.337                | 0.337                |
| Kurtosis           | 2.397               | 37.353               | 31.827               |
| Std. Error of Kurtosis | 0.662            | 0.662                | 0.662                |
| Range              | 4.30                | 0.40                 | 21.60                |
| Minimum            | 1.00                | 0.25                 | 5.40                 |
| Maximum            | 5.30                | 0.65                 | 27.00                |
| Sum                | 126.10              | 15.15                | 360.70               |
| Percentiles        |                     |                      |                      |
| 25                 | 2.0000              | 0.2800               | 6.0000               |
| 50                 | 2.3500              | 0.3000               | 6.6500               |
| 75                 | 2.8750              | 0.3100               | 7.2000               |
Fig. 1. Map of arsenic distribution in Mian-Ab plain.

Fig. 2. Map of cadmium distribution in Mian-Ab plain.
2. Experimental design, materials and methods

2.1. Sampling and analysis procedure

Mian-Ab plain has an area of 28,100 ha, and is located between 31°40′ and 32°05′ northern latitudes and 48°45′ and 49°00′ eastern longitudes, north of Khuzestan province, and south west of Iran. Mian-Ab Plain is bounded between Shotait River and Gargar River [1]. Geologically, the study area is widely characterized by quaternary unconsolidated alluvial sediment. A systematic sampling procedure was performed to provide a sampling scheme over the entire plain. Therefore, in March 2016 (dry season), 50 topsoil samples (0–20 cm) were collected using a stainless steel hand auger (Fig. 4). In each sampling point, a total of 1 ± 0.5 kg of soil was taken from the mixed samples using a quartile method. The collected soil samples were stored in polyethylene bags until transport to the laboratory.

In the laboratory, all samples were air-dried at room temperature and sieved through a 2-mm sieve. Finally, the dried soil samples were sent to the MS Analytical, Canada. The soil samples were digested using the Aqua Regia, and the concentration of 3 potentially toxic elements (PTEs) including (As, Cd, Pb) was measured using inductively coupled plasma mass spectrometry (ICP-MS) [2–6].

2.2. Quality assurance (QA) and quality control (QC)

Analytical duplicates/replicates, standard reference material (OREAS 24b, and GBM908-10), and blank reagents were used for QA/QC. Recoveries ranged from 95.6% to 98.74% and the detection limits for As, Cd and Pb were 0.1, 1.88 and 0.2 respectively.

Fig. 3. Map of lead distribution in Mian-Ab plain.
Table 2
Single pollution indices (PI) and pollution load index (PLI) for selected heavy metals in Mian-Ab plain.

| Sample ID | X         | Y         | Z         | AS Conc. | AS PI | Cd Conc. | Cd PI | Pb Conc. | Pb PI | PLI Conc. | PLI PI |
|-----------|-----------|-----------|-----------|----------|-------|----------|-------|----------|-------|-----------|-------|
| 1         | 295,018   | 3545,035  | 37        | 3.2      | 1.269 | 0.31     | 1.02  | 14.7     | 2.0   | 1.4       |
| 2         | 294,968   | 3543,723  | 33        | 3.2      | 1.280 | 0.31     | 1.03  | 27.0     | 3.8   | 1.7       |
| 3         | 294,425   | 3543,546  | 45        | 1.9      | 0.760 | 0.27     | 0.90  | 5.4      | 0.8   | 0.8       |
| 4         | 295,018   | 3542,297  | 35        | 2.7      | 1.080 | 0.31     | 1.03  | 7.7      | 1.1   | 1.1       |
| 5         | 296,443   | 3542,297  | 52        | 2.0      | 0.800 | 0.29     | 0.97  | 7.2      | 1.0   | 0.9       |
| 6         | 293,595   | 3540,873  | 53        | 2.1      | 0.840 | 0.27     | 0.90  | 5.6      | 0.8   | 0.8       |
| 7         | 290,747   | 3539,449  | 54        | 2.4      | 0.960 | 0.32     | 1.07  | 5.9      | 0.8   | 0.9       |

2.3. Soil pollution assessment

Contamination level of selected heavy metals in Mian-Ab Plain, was assessed by single factor contaminant index (PI) and pollution load index (PLI) using Eqs. (1) and (2) [7].

\[
PI = \frac{C_n}{B_n} 
\]
Where PI is the single factor pollution index of each metal, \( C_n \) and \( B_n \) is the concentration of metal in the soil sample and background, respectively (mg/Kg).

\[ PI < 1 \text{ (Non polluted); } 1 \leq PI < 2 \text{ (Slight polluted); } 2 \leq PI < 3 \text{ (Moderately polluted); } PI < 3 \text{ (Highly polluted)}. \]

\[ PLI = \sqrt{PLI_1PLI_2...PLI_n} \]

Where PI is the single factor pollution index of each metal, \( C_n \) and \( B_n \) is the concentration of metal in the soil sample and background, respectively (mg/Kg).

\[ PLI = 0 \text{ (background concentration); } 0 < PLI \leq 1 \text{ (Unpolluted); } 1 < PLI \leq 2 \text{ (Moderately to unpolluted); } 2 < PI \leq 3 \text{ (Moderately polluted); } 3 < PLI \leq 4 \text{ (Moderately to highly polluted); } 4 < PLI \leq 5 \text{ (Highly polluted); } PLI > 3 \text{ (Very highly polluted)}. \]

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Transparency document. Supplementary material

Transparency document associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2017.10.017.

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