**Contamination level, source identification and health risk assessment of potentially toxic elements in water sources of mining and non-mining areas of Khyber Pakhtunkhwa, Pakistan**

Zahid Imran Bhatti a,b, Muhammad Ishtiaqc, Said Akbar Khand, Javed Nawabe\*, Sardar Khanf Shams Ali Baige, Ihsan Muhammade, Zia Ud Dine, Asad Khang, Junaid Ghanih,

*aState Key Laboratory of Nuclear Resources and Environment, East China University of Technology, Nanchang 330013, Chinab*

*bSchool of Earth Sciences, East China University of Technology, Nanchang 330013, China*

*cDepartment of Community Medicine Northwest School of Medicine Hayatabad Peshawar, Pakistan*

*dDepartment of Earth & Environmental Sciences, Bahria University Islamabad, Pakistan*

*eDepartment of Environmental Sciences, Abdul Wali Khan University Mardan, Pakistan*

*fDepartment of Environmental Sciences, University of Peshawar, Peshawar 25120, Pakistan*

*gDepartment of Geology, FATA University, F.R. Kohat, Darra Adam Khel, Pakistan*

*hSchool of Environmental Studies, China University of Geosciences, Wuhan, 430074, China*

\*Corresponding Authors’ E-mails: [javednawab11@yahoo.com](mailto:javednawab11@yahoo.com); [dr.ishtiaq@nwsm.edu.pk](mailto:dr.ishtiaq@nwsm.edu.pk)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table S1  Summary of exposure assumptions used to calculate drinking water intake via ingestion and dermal contact. | | | | | |
| Factor | Description | Unit | Value | | References |
| Adults | Children |
| DI ing | Ingestion rate | mg/kg/day | 2.2 | 1.8 | USEPA, (2002)  Qiao et al. (2020)  Long et al. (2020)  Ngo et al. (2020) |
| ED | Exposure duration | Years | 70 | 6 |
| EF | Exposure frequency | days/year | 365 | 365 |
| BW | Body weight | Kg | 70 | 15 |
| CF | Conversion factor | kg/mg | 0.001 | 0.001 |
| SA | Skin surface area | cm2 | 5700 | 2800 |
| AF | Adherence factor of soil | mg/cm2 | 0.001 | 0.001 |
| Kp | Permeability coefficient | cm/hour | Cr, Cu and Mn  Pb  Zn | 0.001  0.0001  0.0006 |
| AT | Average time | Days | 25550 | 2190 |
| ET |  |  | 0.58 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tables S2**  Parameters used to assess the human health risk through water ingestion and dermal contact. | | | | |
| HMs | RfD ingestion (mg/kg/day) | Gastrointestinal absorption factor (GIABS) | Cancer Slope Factor (CSF) | References |
| Ni | 0.02 | 4.00E-02 | 0.7 | Duggal and Rani, (2018)  USDOE, (2011) |
| Cr | 1.5 | 1.30E-02 | 0.5 |
| Zn | 0.3 | 1.00E+00 |  |
| Cu | 0.04 | 1.00E+00 |  |
| Pb | 0.0035 | 1.00E+00 | 0.0085 |
| Mn | 0.046 | 4.00E-02 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table S3**  HMs concentrations (μg L–1 ) in drinking water sources, reported in previous studies of mining areas. | | | | | | | | | | | | | | |
| Site | Ni | | Cr | | Zn | | Cu | | Pb | | Mn | | References | |
| Mining | Ground | Surface | Ground | Surface | Ground | Surface | Ground | Surface | Ground | Surface | Ground | Surface | | This study | |
| Mohmand | 92.3 | 110.22 | 414.4 | 497.44 | 47 | 58 | 40 | 50.22 | 37 | 46.44 | 242.5 | 179.33 | |
| Bajaur | 12.83 | 16.93 | 112.67 | 19.49 | 59.33 | 19 | 19.94 | 20.22 | 10.19 | 90.44 | 19.21 | 15.91 | |
| Khyber | 11.25 | 12.03 | 19.63 | 21.33 | 56.75 | 77.22 | 19.45 | 21.3 | 10.54 | 12.64 | 18.93 | 21.53 | |
| Non-Mining |  |  |  |  |  |  |  |  |  |  |  |  | |
| Mohmand | 25.78 | 31.5 | 32.56 | 44.22 | 203.56 | 225.1 | 23 | 32.22 | 17 | 13.6 | 227.22 | 254.9 | |
| Bajuar | 5.33 | 5.78 | 11.1 | 14.33 | 5.11 | 19.56 | 23.11 | 14.11 | 6.56 | 8.56 | 9.78 | 13.44 | |
| Khyber | 7.87 | 12.89 | 11.8 | 15.37 | 4.44 | 18 | 12.33 | 17.7 | 5.56 | 5.9 | 13.55 | 13.59 | |
| Hunan | - | - | - | - | 4172 | - | 25.4 | - | 16.9 | - | - | - | | Gong et al. (2014) |
| Dabaoshan | 58.32 | - | - | - | 2742.5 | - | 213.8 | - | 13.83 | - | 6372.6 | - | | Wang et al. (2019) | |
| Palma | 0.89 | - | - | - | 104 | - | 7 | - | 1.35 | - | - | - | | Rodellas et al. (2014) |
| Brajrajnagar | 35 |  | 6.44 | - | 46 | - | 28 | - | 21 | - | 31 | - | | Sahoo and Khaosh, (2020) |
| Taojian | - | - | 10.5 | - | 101 | - | 153 | - | 33 | - | - | - | | Chen et al. (2019) |
| Maracas | 2.1 |  | 2.2 | - | 38 | - | 3.5 | - | 19 | - | 178 | - | | Santana et al. (2020) |
| Mantaro | - | - | - | - | 58 | - | 14 | - | 9.5 | - |  | - | | Custodio et al. (2020) |