**Integrated risk assessment of potentially toxic elements and particle pollution in urban road dust of mega city of Pakistan**

**For submission**

**Human and Ecological Risk Assessment: An International Journal**

**SUPPLEMENTARY INFORMATION**

**Table S1:** Classification ofgeoaccumulation (Igeo), contamination factor (CF), ecological risk (Ei) and pollution index values.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Geoaccumulation Index value( Igeo) | Pollution level | Contamination factor (CF) values | | Contamination range | Ecological risk (Ei) range | | | Risk level | Pollution index(PI) values | Pollution level |
| Igeo < 0 | unpolluted | CF< 1 | Low contamination factor | | Ei < 40 | | | Low |  |  |
| 0 < Igeo ≤ 1 | unpolluted to moderately polluted | 1 ≤CF<3 | Moderate contamination factor | | 40 ≤ Ei < 80 | | | Moderate | PI≤ 1 | Low |
| 1 < Igeo ≤ 2 | Moderately polluted | 3=CF<6 | Considerable contamination factor | | 80 ≤ Ei< 160 | | | Higher | 1<PI≤ 3 | Middle |
| 2 < Igeo ≤3 | Moderately to heavily polluted | CF=6 | Very high contamination factor | | 160 ≤ Ei< 320 | | | High | PI>3 | High |
| 3 < Igeo ≤ 4 | Heavily polluted |  | |  | | 320 ≤ Ei | | Serious |  |  |
| 4 < Igeo ≤ 5 | Heavily to extremely polluted |  | |  | | |  |  |  |  |
| Igeo > 5 | Extremely polluted |  | |  | | |  |  |  |  |

Martin and Meybeck (1979); Chen et al., (2015); Muller (1969); Harikumar et al. ([2009](https://link.springer.com/article/10.1007%2Fs10653-018-0091-2#CR24)); Hussain et al. ([2015](https://link.springer.com/article/10.1007%2Fs10653-018-0091-2#CR27))

**Table S2.** Parameters along with symbols and values used to estimate the health risk in urbanized city.

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| --- | --- | --- | --- | --- |
| Parameters | Symbol | Units | Values | References |
| Average time cancer | ATc | Days | 70 × 365 | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Average daily dose |  | (mg/kg)/day |  |  |
| Average time non-cancer | ATnc | Days | 30 × 365 | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Body weight | BW | Kg | 70a, 6b | USEPA (2002), Askarova and Mussagaliyeva, (2014 |
| Carcinogenicity slope factor | SF | Per (mg/kg)/day | Inhalation SF: 6.3(Cd), 0.84 (Ni), Pb (0.008) | Ferreira-Baptista and De Miguel, (2005) Lu *et al.* (2014), USDOE (2011) |
| Ingestion SF: 0.0085(Pb) |
| Chronic reference dose | RfD | Per (mg/kg)/day | Oral RfD: 0.001 (Cu), 0.0003 (Mn), 0.003 (Pb), 0.024 (Cd), 0.0035 (Ni), 0.3 (Zn) | (Askarova and Mussagaliyeva, 2014), Ferreira-Baptista and De Miguel (2005) |
| Dermal RfD: 0.012 (Cu), 0.046 (Mn), 0.00005 (Pb), 0.046 (Mn), 0.00001 (Cd), 0.005 (Ni) |
| Inhalation RfD:0.04(Cu), 0.00005(Mn), 0.0035 (Pb), 0.00001(Cd), 0.00005 (Ni) |
| Concentration of soil heavy metals | C | mg kg-1 |  |  |
| Dermal absorption factor | ABS | Unit less | 0.1 (Cd), 0.04 (Cr), 0.006 (Pb), 0.02 (Zn), 0.001 (Mn, Co) | HC (2004), Chen *et al.* (2015) and Kelepertzis (2014) |
| Exposed skin exposed surface area | SA | m2 | 5700a, 2800b | [(Askarova and Mussagaliyeva 2014)](file:///D:\New%20project\Table1.xlsx#RANGE!CR16) |
| Exposure duration | ED | Year | 30a, 6b | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Exposure frequency | EF | Day year−1 | 350 | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Ingestion rate | IngR | mg d−1 | 100a, 200b | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Inhalation rate | InhR | m3day−1 | 20a, 7.6b | USEPA, (2002), Zheng *et al.* (2010) |
| Particular emission factor | PEF | m3kg−1 | 1.36E−09 | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |
| Skin adherence factor | SAF | mg/cm2 | 0.07a, 0.2b | [USEPA (2002)](file:///D:\New%20project\Table1.xlsx#RANGE!CR72) |

aAdult and bChildern

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table S3: AQI criteria associated with PM concentration ranges | | | | |
| AQI | Concentration breakpoints of PM (µg m-3) | | | AQI Category |
| PM 2.5 | PM 10 | TSP |
| 0-50 | 0.0 – 12 | 0.0 – 54 | 0 – 104 | Good |
| 51-100 | 12.1 – 35.4 | 55 – 154 | 105 – 264 | Marginal (moderate) |
| 101-150 | 35.5 – 55.4 | 155 – 254 | 265 – 364 | Unhealthy for sensitive |
| 151-200 | 55.5 – 150.4 | 255 – 354 | 365 – 464 | Poor (unhealthy) |
| 201-300 | 150.5 – 250.4 | 355 – 424 | 465 – 524 | Very poor (very unhealthy) |
| 301-400 | 250.5 – 350.4 | 425 – 504 | 525 – 604 | Hazardous |
| 401-500 | 350.5 – 500 | 505 – 604 | 605 – 704 | Very Hazardous |
| >500 | >500 | >604 | > 704 | Very Critical |
| US-EPA Standard | 35 | 150 | 260 |  |

US EPA (2012) ; Gurjur *et al.* (2008)

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