**Heavy Metal distribution in surface water, sediment and fishes of Nambul River, Imphal River and Lokatak lake of Manipur, India**

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**Table S1** **Sampling stations with GPS coordinates**

|  |  |  |
| --- | --- | --- |
| **Site No.** | **Name of station** | **GPS coordinates** |
| 1 | Nambul River-WahengbamLeikai | 24.801953, 93.934559 |
| 2 | Nambul River-Yangoiningthou | 24.611445, 93.813027 |
| 3 | Imphal River-Telipati | 24.815070, 93.952918 |
| 4 | Mayang Imphal lake | 24.586233, 93.854067 |
| 5 | Karang (OFAD) | 24.537817, 93.832023 |
| 6 | Karang (IFAD) | 24.5378373, 93.8315493  |
| 7 | Thanga (OFAD) | 24.529481, 93.808134 |
| 8 | Thanga (IFAD) | 24.529457, 93.808134  |
| 9 | Ithing (OFAD) | 24.529154, 93.801151 |
| 10 | Ithing (IFAD) | 24.529416, 93.801493 |
| 11 | Moirang River Confluence | 24.531415, 93.802160  |
| 12 | Naransena (OFAD) | 24.570110, 93.780213  |
| 13 | Naransena (IFAD) | 24.567880, 93.784762  |
| 14 | Toubul Canal | 24.618639, 93.806744  |
| 15 | Komlakhong (OFAD) | 24.529517, 93.851456 |
| 16 | Komlakhong (IFAD) | 24.529727, 93.850839 |
| 17 | LaphupatTera (OFAD) | 24.493220, 93.873401 |
| 18 | LaphupatTera (IFAD) | 24.493923, 93.873100 |
| 19 | Imphal River-Komlakhong | 24.527589, 93.869855 |

OFAD: Outside Fish Aggregating Device; IFAD: Inside Fish Aggregating Device

**Table 2** Heavy metal concentrations (μg L‑1) in the surface water of study sites

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site no** | **Sites** | **Cd**  | **Co**  | **Cr**  | **Cu**  | **Fe**  | **Ni**  | **Pb**  | **Zn**  | **Mn**  |
| 1 | Nambul River-WahengbamLeikai | 0.00 | 0.22 | 0.32 | 4.60 | 2548.87 | 3.76 | 0.06 | 2.01 | 142.35 |
| 2 | Nambul River-Yangoiningthou | 0.29 | 0.19 | 0.43 | 0.00 | 1653.75 | 1.24 | 6.58 | 1.12 | 112.12 |
| 3 | Imphal River-Telipati | 0.12 | 0.45 | 0.56 | 5.36 | 1879.24 | 8.69 | 4.26 | 14.26 | 156.25 |
| 4 | Mayang Imphal lake | 0.00 | 0.00 | 0.17 | 0.49 | 389.36 | 1.46 | 0.03 | 1.55 | 173.26 |
| 5 | Karang (OFP) | 0.60 | 0.09 | 0.56 | 5.67 | 396.92 | 10.91 | 3.93 | 22.49 | 27.03 |
| 6 | Karang (IFP) | 0.02 | 0.18 | 0.94 | 2.38 | 896.81 | 8.12 | 2.50 | 10.10 | 46.30 |
| 7 | Thanga (OFP) | 0.00 | 0.10 | 3.50 | 0.07 | 988.13 | 1.06 | 0.00 | 2.17 | 78.41 |
| 8 | Thanga (IFP) | 0.00 | 0.11 | 0.93 | 2.59 | 445.96 | 12.50 | 2.55 | 16.41 | 30.20 |
| 9 | Ithing (OFP) | 0.02 | 0.10 | 0.43 | 3.84 | 340.62 | 6.55 | 2.68 | 11.72 | 26.36 |
| 10 | Ithing (IFP) | 0.00 | 0.00 | 0.02 | 0.09 | 124.74 | 0.39 | 0.01 | 1.23 | 15.37 |
| 11 | Moirang River Confluence | 0.10 | 0.49 | 0.97 | 7.27 | 1528.35 | 52.23 | 2.88 | 17.79 | 136.43 |
| 12 | Naransena (OFP) | 0.01 | 0.09 | 0.81 | 2.90 | 493.51 | 12.80 | 3.01 | 9.71 | 34.20 |
| 13 | Naransena (IFP) | 0.00 | 0.00 | 0.07 | 0.27 | 6.71 | 1.01 | 0.09 | 4.02 | 17.10 |
| 14 | Toubul Canal | 0.03 | 0.18 | 0.94 | 2.84 | 1603.82 | 10.15 | 2.14 | 8.93 | 71.44 |
| 15 | Komlakhong (OFP) | 0.01 | 0.09 | 0.67 | 2.61 | 379.55 | 5.09 | 1.47 | 18.29 | 16.61 |
| 16 | Komlakhong (IFP) | 0.00 | 0.02 | 0.46 | 1.52 | 42.36 | 2.25 | 0.05 | 3.55 | 10.24 |
| 17 | LaphupatTera (OFP) | 0.03 | 0.06 | 0.81 | 1.80 | 167.93 | 1.58 | 1.38 | 6.94 | 27.68 |
| 18 | LaphupatTera (IFP) | 0.01 | 0.01 | 0.14 | 1.13 | 42.36 | 0.52 | 0.41 | 5.36 | 10.12 |
| 19 | Imphal River-Komlakhong | 0.15 | 0.03 | 0.55 | 2.15 | 645.36 | 10.24 | 1.33 | 9.35 | 89.65 |

OFP: Outside Floating Pond; IFP: Inside Floating Pond

**Table 3** Heavy metal concentrations (μg g‑1) in the sediment of study sites

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site no** | **Sites** | **Cd** | **Co** | **Cr** | **Cu** | **Fe** | **Ni** | **Pb** | **Zn** | **Mn** |
| 1 | Nambul River-WahengbamLeikai | 0.30 | 43.63 | 180.31 | 75.76 | 85096.87 | 199.74 | 49.16 | 364.52 | 711.42 |
| 2 | Nambul River-Yangoiningthou | 0.47 | 59.67 | 320.02 | 102.53 | 125782.65 | 297.85 | 28.99 | 486.01 | 1144.80 |
| 3 | Imphal River-Telipati | 0.07 | 23.82 | 97.09 | 29.34 | 52376.79 | 110.91 | 13.41 | 133.62 | 451.71 |
| 4 | Mayang Imphal lake | 0.14 | 18.54 | 111.47 | 37.21 | 45138.58 | 126.14 | 19.16 | 161.93 | 526.86 |
| 5 | Karang (OFP) | 0.12 | 42.87 | 270.66 | 81.71 | 99171.97 | 296.56 | 25.42 | 229.76 | 486.57 |
| 6 | Karang (IFP) | 0.10 | 34.21 | 271.19 | 68.13 | 83584.77 | 253.72 | 14.29 | 195.71 | 345.31 |
| 7 | Thanga (OFP) | 0.14 | 39.29 | 292.89 | 80.37 | 89532.84 | 303.63 | 19.40 | 216.79 | 542.81 |
| 8 | Thanga (IFP) | 0.12 | 40.77 | 200.64 | 68.80 | 92763.44 | 254.64 | 23.58 | 196.41 | 442.40 |
| 9 | Ithing (OFP) | 0.16 | 39.42 | 179.61 | 55.26 | 75074.76 | 213.30 | 23.72 | 225.64 | 783.31 |
| 10 | Ithing (IFP) | 0.25 | 44.60 | 348.38 | 94.35 | 84465.53 | 339.88 | 19.15 | 258.17 | 411.82 |
| 11 | Moirang River Confluence | 0.09 | 48.26 | 246.42 | 78.24 | 102843.12 | 296.34 | 24.29 | 213.67 | 510.59 |
| 12 | Naransena (OFP) | 0.07 | 56.76 | 304.53 | 91.79 | 129330.15 | 371.74 | 42.86 | 260.08 | 872.99 |
| 13 | Naransena (IFP) | 0.32 | 38.91 | 201.37 | 71.54 | 77067.21 | 251.93 | 38.34 | 242.12 | 852.73 |
| 14 | Toubul Canal | 0.11 | 50.85 | 251.99 | 80.32 | 87502.93 | 292.22 | 30.20 | 272.36 | 419.55 |
| 15 | Komlakhong (OFP) | 0.20 | 59.79 | 257.16 | 86.86 | 77975.34 | 312.16 | 24.28 | 272.70 | 513.40 |
| 16 | Komlakhong (IFP) | 0.14 | 43.24 | 327.71 | 96.55 | 91114.04 | 318.27 | 28.38 | 267.93 | 596.37 |
| 17 | LaphupatTera (OFP) | 0.06 | 42.21 | 202.05 | 52.98 | 73350.01 | 232.62 | 21.45 | 176.51 | 1139.42 |
| 18 | LaphupatTera (IFP) | 0.24 | 39.36 | 288.06 | 88.25 | 57182.73 | 300.26 | 15.87 | 257.55 | 257.51 |
| 19 | Imphal River-Komlakhong | 0.09 | 25.46 | 238.23 | 68.49 | 38065.45 | 235.72 | 13.56 | 124.00 | 164.92 |

LEL, lowest effect level; PEL, probable effect level; TEL, threshold effect level; SEL, severe effect level; TET, toxic effect threshold

**Table 4** Heavy metal concentrations in collected fishes.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site no** | **Fish** | **No. fish** | **Body Part** | **w.w./d.w.** | **Cd**(μg.g‑1 d.w.) | **Co** (μg.g‑1 d.w.) | **Cr** (μg.g‑1 d.w.) | **Cu** (μg.g‑1 d.w.) | **Fe** (μg.g‑1 d.w.) | **Ni** (μg.g‑1 d.w.) | **Pb** (μg.g‑1 d.w.) | **Zn** (μg.g‑1 d.w.) | **Mn** (μg.g‑1 d.w.) |
| 8 (Thanga inside FP) | *Macrobrachium* sp. | 4 | Whole | 5.12 | 0.02 | 0.13 | 6.76 | 1.97 | 144.16 | 3.24 | 0.48 | 88.28 | 29.83 |
| *Amblypharyngodon mola* | 6 | Whole | 3.88 | 0.02 | 0.08 | 5.42 | 0.90 | 44.66 | 2.55 | 0.31 | 53.71 | 13.90 |
| *Chanda nama* | 2 | Whole | 4.17 | 0.01 | 0.07 | 2.36 | 0.81 | 195.35 | 0.25 | 0.04 | 126.45 | 63.54 |
| 4 (Mayang outside FP) | *Amblypharyngodon mola* | 2 | Whole | 3.41 | 0.00 | 0.15 | 6.12 | 1.60 | 107.70 | 2.56 | 0.08 | 44.63 | 29.20 |
| *Chanda nama* | 1 | Whole | 4.00 | 0.00 | 0.14 | 6.70 | 1.66 | 81.85 | 3.11 | 0.43 | 27.72 | 46.59 |
| *Puntius sophore* | 1 | Whole | 2.74 | 0.00 | 0.07 | 5.34 | 0.73 | 36.31 | 2.19 | 0.20 | 18.29 | 15.81 |
| *Trichogaster fasciata* | 1 | Flesh  | 3.77 | 0.04 | 0.21 | 7.35 | 5.43 | 469.53 | 3.56 | 0.18 | 243.95 | 100.56 |
| *Channa punctata* | 1 | Flesh | 3.89 | 0.01 | 0.08 | 1.38 | 5.38 | 201.84 | 0.56 | 0.00 | 188.05 | 60.14 |
| *Anabas testudineus* | 1 | Flesh | 3.62 | 0.02 | 0.12 | 4.26 | 2.41 | 188.90 | 2.10 | 0.27 | 133.01 | 66.11 |
| *Pethia ticto* | 4 | Whole | 3.89 | 0.03 | 0.49 | 7.11 | 2.68 | 1191.92 | 3.58 | 1.20 | 118.46 | 135.86 |
| *Puntius sophore* | 1 | Whole | 2.63 | 0.00 | 0.06 | 2.71 | 0.86 | 56.96 | 0.92 | 0.09 | 30.99 | 26.24 |
| *Amblypharyngodon mola* | 5 | Whole | 3.47 | 0.00 | 0.10 | 4.41 | 1.28 | 90.91 | 2.18 | 0.15 | 35.30 | 33.01 |
| *Trichogasterfasciata* | 1 | Whole | 4.04 | 0.01 | 0.13 | 2.53 | 2.56 | 88.13 | 0.60 | 0.04 | 27.18 | 12.85 |
| *Anabas testudineus* | 1 | Flesh | 2.93 | 0.00 | 0.10 | 4.30 | 1.80 | 112.20 | 0.10 | 0.02 | 75.39 | 24.95 |
| *Channa punctata* | 1 | Flesh | 3.88 | 0.00 | 0.10 | 1.46 | 0.04 | 59.30 | 1.47 | 0.02 | 49.42 | 13.35 |
| 6 (Karang inside FP) | *Amblypharyngodon mola* | 4 | Whole | 4.08 | 0.01 | 0.14 | 2.50 | 1.50 | 149.34 | 1.82 | 0.09 | 93.72 | 30.93 |
| 13 (Naransena inside FP) | *Amblypharyngodon mola* | 7 | Whole | 3.68 | 0.01 | 0.12 | 4.61 | 1.03 | 106.08 | 2.61 | 0.00 | 51.43 | 27.80 |
| *Amblypharyngodon mola* | 5 | Whole | 4.87 | 0.01 | 0.10 | 3.51 | 0.83 | 66.38 | 1.53 | 0.56 | 19.42 | 10.34 |
| *Pethia ticto* | 1 | Whole | 3.62 | 0.01 | 0.11 | 4.42 | 0.98 | 272.02 | 0.97 | 0.15 | 76.20 | 47.39 |

W.W., Wet weight; D.W., Dry weight