## ROLE OF PLANTS IN POLLUTANT REMEDIATION

Plants can be used to cleanup or remediate contaminated sites by several ways in order to remove contaminants from the soil, sediment, or water. Such plants can breakdown or decompose organic pollutants or may stabilize metal pollutants by acting as filters or traps. Plants usually take contaminants through their root system in which the main mechanism for controlling the contaminant's toxicity lies. The root system of plants provides wide surface area to absorb and accumulate the nutrients and water that is required for growth and other non-essential pollutants. Research is still going on finding the use of trees rather than smaller plants for affective treatment in deeper contamination because tree roots can penetrate more deeply into the soil. Further polluted ground water can undergo treatment by pumping out the water from the ground and using plants to treat the contamination.

Plants roots releases organic and inorganic compounds (root exudates) in the rhizosphere that causes changes at the soil root interface. This is an effective alternative technology which can replace mechanical conventional clean-up technologies that often needs high capital inputs, labour and energy. Phytoremediation is an in-situ remediation technique that uses the inherent capacities of living plants. It is also an eco- friendly, solar energy driven clean-up technology based on the principle of using nature itself to clean nature.

**Table 1. Some hyper accumulator species and their accumulation level.**

| **Plant species** | **Metal** | **Reference** |
|---|---|---|
| *C. papyrus* | Pb | Mugisa et al. (2015) |
| *Phragmites australis* | Pb | Mugisa et al. (2015) |
| *Hydrilla verticillata* | Cd | He et al.(2016) |
| *Hydrocotyle ranoncloides* | Cd | VahdatiRaad and Khara (2012) |
| *Hydrocotyle ranoncloides* | Pb | VahdatiRaad and Khara (2012) |
| *Ceratophyllum demersum* | Cd | VahdatiRaad and Khara (2012) |
| *Ceratophyllum demersum* | Pb | VahdatiRaad and Khara (2012) |
| *Alyssum heldreichii* | Ni | Bani et al. (2010) |
| *Alyssum markgrafii* | Ni | Li et al. (2003) |
| *Alyssum bertolonii* | Ni | Li et al. (2003) |
| *Alyssum caricum* | Ni | Li et al. (2003) |
| *Alyssum corsicum* | Ni | Bani et al. (2010) |

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|---|---|---|
| *Alyssum murale* | Ni | Bani et al. (2010) |
| *Myriophyllum spicatum* | Cu | Kamel (2013) |
| *Ceratophyllum demersum,* | Cu | Kamel (2013) |
| *Eicchornia crassipes,* | Cu | Kamel (2013) |
| *Lemna gibba,* | Cu | Kamel (2013) |
| *Phragmites australis* | Cu | Kamel (2013) |
| *Typha domingensis* | Cu | Kamel (2013) |
| Salvinia *sp* | Cr | Espinoza -Quinones et al. (2005 |
| Salvinia *sp* | Cu | Espinoza -Quinones et al. (2005 |
| Salvinia *sp* | Zn | Espinoza -Quinones et al. (2005 |
| *Thlaspi caerulescens* | Cd | Lombi et al. (2001) |

Most of the phytoremediation processes are targeted on inorganic pollutants through different attempts which is termed as phytoextraction (the utilization of metal accumulating species to transport and accumulate metals from the soil to roots and above ground biomass), rhizofiltration (the utilization of plant roots to absorb, precipitate and concentrate toxic contaminants from polluted effluents, phytovolatilization (some metal pollutants such as As, Hg and Se occur in gaseous forms in the environment; scientists have recently discovered genetically-modified plants that are capable of absorbing metals in their elemental forms from the soil, thus converting them biologically to gaseous species within the plants and release them into the atmosphere) and phytostabilization (the utilization of plants in lowering down the mobility of metals) (Mandal, 2014).

## APPLICATIONS OF PHYTOREMEDIATION IN INDIA

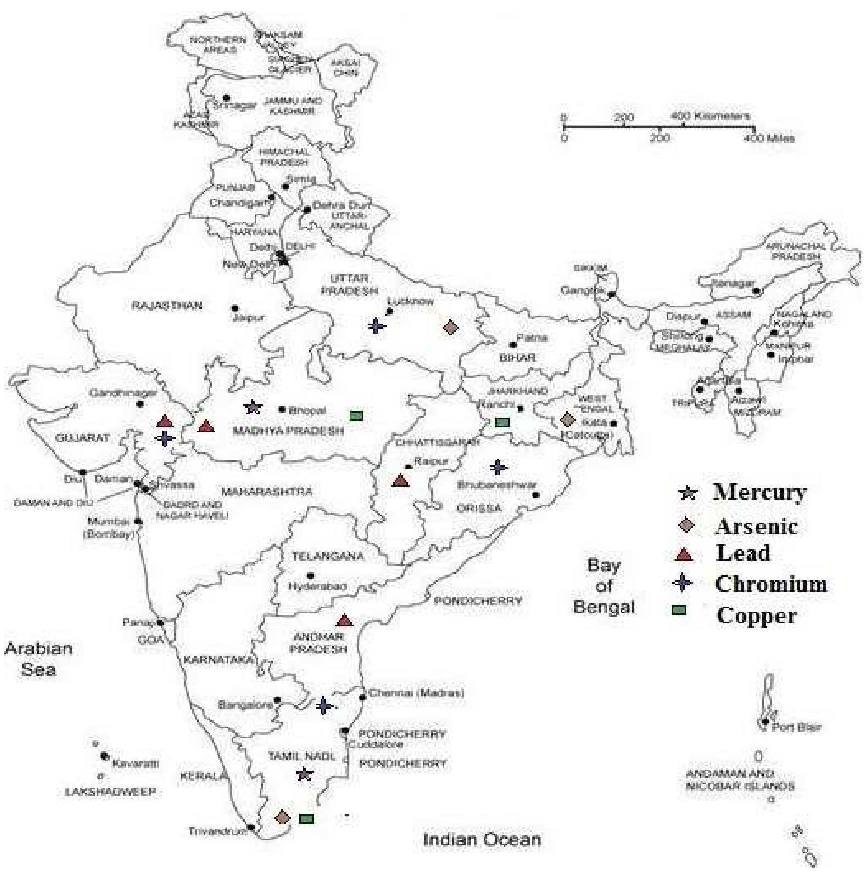
One of the most promising applications of phytoremediation techniques is the possibility of deriving additional benefit from the plant system during or after the prevention or clean-up technology. Ali et al. (1999) studied the physico- chemical parameters of Nainital lake and the functions of macrophytes in phytoremediation and biomonitoring of metallic ions that are toxic in nature. Reports showed that the concentrations of metals such as Cr, Cu, Fe, Mn, Ni, and Pb are much higher than their be effectively used in phytoremediation of metal pollutants from water bodies (Rai et al., 1995; Nirmal Kumar et al., 2006; Prasad, 2007; Shah and Nongkynrih, 2007; Shrivastava, 2008; Dixit and Dhote, 2009; Mishra and Tripathi, 2009; Narendra et al., 2012; Swain et al., 2014; Phukan, 2015; Shafi et al., 2015; Kumar and Chopra, 2016; Shekhar and Prashik, 2016).

**Table 2. Phytoremediation in different states of India.**

| **State** | **Plant species** | **Metal** | **Reference** |
|---|---|---|---|
| **Delhi** | *Lemna minor* | Ni<br>Cd<br>Cu | Kaur et al. (2008) |
| **Uttarakhand** | *T. natans* | Fe<br>Ni<br>Pb<br>Zn | Kumar and Chopra (2016) |
| **Madhay Paradesh** | *E. crassipes Americana; J. philoxeroides; A. latifolia T.* | Cu<br>Zn<br>Mn<br>Fe | Archana Dixit et al. (2011) |
| Maharashtra | *E. crassipes; Azolla* | Cu<br>Cr | Shekhar and Prashik (2016) |
| Odisha | *E. crassipes* | Cd<br>Cu | Swain et al. (2014) |
| Mizoram | *Spirodelapolyrhiza* | Ni<br>Pb | Prabhat kumarai and Tripathi (2011) |
| Assam | *Hydrilla verticillata* | Cr<br>Cd | Phukan et al. (2015) |
| Jammu&Kashmir | *Azolla pinnata*<br>*E. colonum*<br>*E. crassipes*<br>*H. verticillata* | Cu;Pb;Cr;Cd;<br>Zn | Shafi et al. (2015) |
| Gujarat | *I. aquatic*<br>*N. nucifera*<br>*T. angustata*<br>*V. spiralis*<br>*B.monnieri*<br>*E.crassipes* | Cd;Co;Cu;Ni;<br>Pb;Zn | Kumar et al. (2008) |
| Uttar Pradesh | *H.verticillata*<br>*I.aquatica*<br>*M.minuta*<br>*Eichhornia sp.* | Cr;Ni;Cu;Pb | Narendra et al. (2012) |

| | | | |
|---|---|---|---|
| Kerala | *Eichhornia* sp.<br>*Pistia* sp. p.<br>*Salvinia* s | Cu;Fe;Pb | Preetha and Kaladevi (2014) |
| West Bangal | *Pistia* sp.<br>*Salvinia sp.*<br>*Eichhornia* sp. | Pb; As;Cu;Cd | Sukumaran (2013) |
| Karnataka | E. crassipes<br>S. mucronatus | Pb<br>Cu | Seema et al. (2013) |
| Meghalaya | *S. mucronatus*<br>*R. rotundifolia* | Cd | Marbaniang and Chaturvedi (2014) |

**Cd; Cadmium; Ni, Nickel; Cd, Cadmium; Zn, Zinc; Cr, Chromium; Cu, Copper; As, Arsenic; Fe, Iron; Mn, Manganese; Co, Cobalt.**




**Heavy metals contaminated states of India.**

**Source- Zaidi J, and Pal A (2017). Review on heavy metal pollution in major lakes of India: Remediation through plants, in African Journal of Environmental Science and Technology, 11(6), pp. 255-265.**