Mine and return

Agro mining is a viable green alternative in metallic mining areas

Agro mining involves growing selected hyper-accumulator plant species (‘metal crops’) on low-grade ore bodies or mineralized (e.g. ultramafic) soils, or anthropogenic metal-rich materials (e.g. contaminated soils, mine spoils, industrial sludge), followed by harvesting and incineration of the biomass to produce a ‘bio-ore’ from which target metals or salts may be recovered. The target elements may include As, Se, Cd, Mn, Ni, Tl and Zn, as well as rare earth elements, but most research has focussed on the development of Ni agro mining. Large-scale demonstration of agromining of Ni with Odontarrhenachalcidica has been undertaken in the USA and Albania, with Berkheyacoddii in South Africa and with Phyllanthusrufuschaneyi in Sabah, Malaysia.

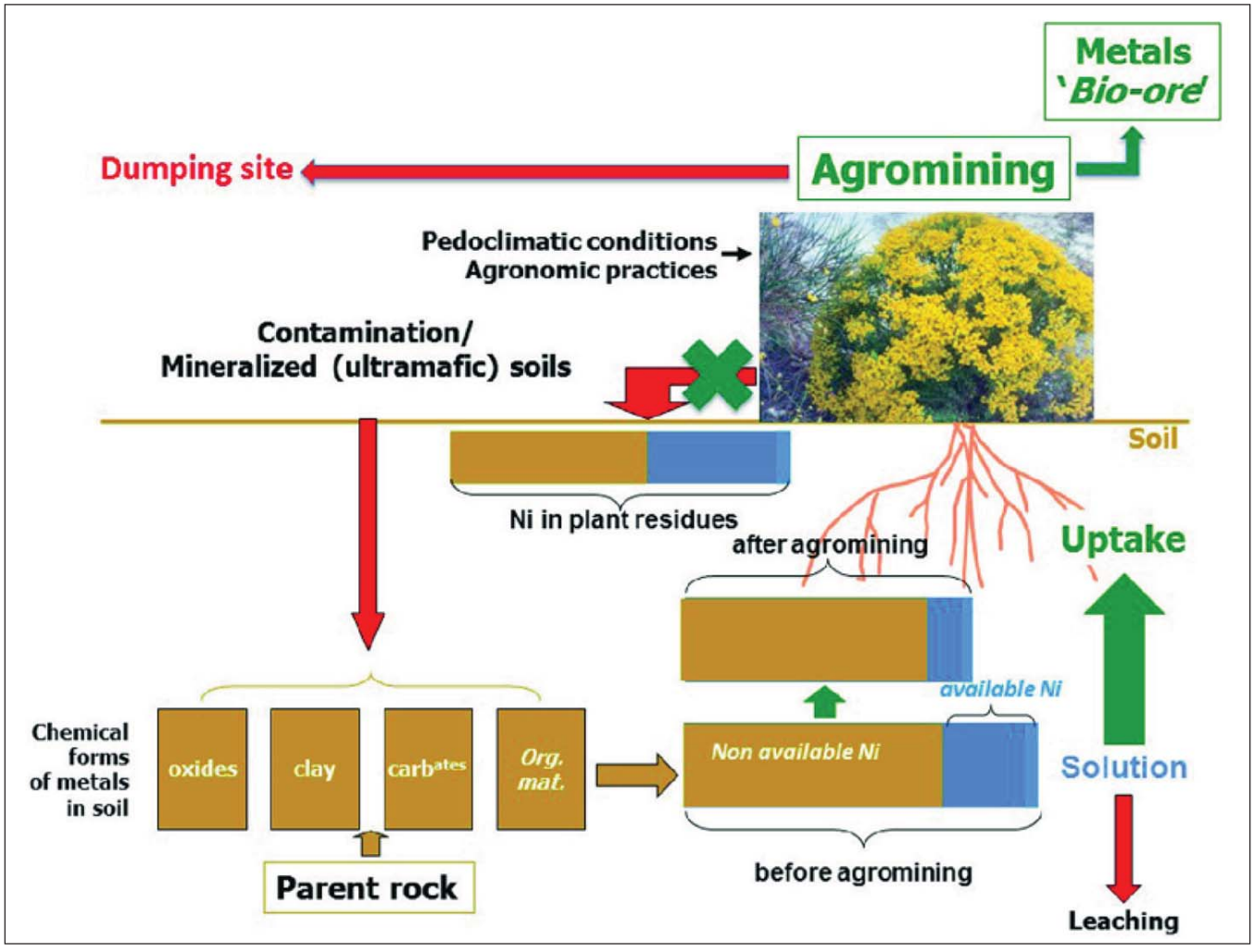

Fig.1: Influence of hyper-accumulators and agro mining on metal cycle and the scheme.

The cultivation of ‘metal crops’ could be undertaken on large metal-rich surface areas. For Ni, cultivation is feasible on ultramafic areas with suitable topography, where soils are otherwise unsuitable for food production; or degraded Ni-rich land that includes Ni laterite mine sites, smelter contaminated areas, and ore beneficiation tailings. Ultramafic soils develop from the weathering of ultramafic bedrock and are characterized by relatively high concentrations of Mg, Fe, Mn, Cr, Ni and Co, whereas the concentrations of Ca, N, P, K, Mo and B typically range from low to deficient levels.

The criteria for selection of ‘metal crops’ for Ni agro mining include high biomass yield combined with high Ni concentrations in the above-ground biomass. Most Ni hyper-accumulator plants accumulate 0.1–0.5% Ni in their biomass, but for economic agro mining only so-called ‘hyper-nickelophores’ (>1% Ni) are potentially suitable. Local plant species are recommended because of their adaptation to local climatic and edaphic conditions. Suitable species must be relatively easy to collect as bulk seed accessions and have high success rates of germination, establishment and growth. The selected species may be propagated via direct seeding, transplantation, or by using cuttings. The recommended species for the Asian region are Phyllanthusspp and Rinorea cf. bengalensis, both Ligneous shrubs. Agromining employs plant management practices, beyond fertilizer treatment and pH adjustment, to enhance metal yield in ‘metal crops’ via a number of ways: (i) plant density is important to optimize biomass production per unit area, and an intermediate density for optimum Ni yield is recommended; (ii) weed control reduces competition for essential nutrients and water between the ‘metal crop’ and weeds; (iii) plant growth regulators may increase biomass production and Ni yield .

Fig.2: A Large-scale demonstration of agro mining of Ni with Phyllanthusrufuschaneyi cultivated on ultramafic substrate and harvesting

The management of propagation and harvest will necessarily be dependent upon the species being used for phytomining and climate. If seeds are readily available, and remain viable for some time, then sowing seeds will allow establishment of phyto-mining fields. If seeds are easy to work with, ‘metal crop’ management could follow that of crop plants. But if seeds are in short supply or it is difficult to establish a stand-by sowing in the field, and the plant is perennial, coppicing can be used to make annual harvests and cuttings can be rooted for transplanting to the field. Alternatively, seedlings raised under careful management in potting media during the dry season could be another possibility. So many factors influence these management choices that it is clear that planting and harvest management will be species-specific and location specific. Perennial hyper-accumulator crops are to be preferred as costs of plant establishment are a one-time expense.

Reference, other courtesies and for more knowledge please read the book: Agro mining: Farming for Metals, Extracting Unconventional Resources Using Plants Editors Antony van der Ent, Alan J.M. BakerGuillaume, Echevarria Marie-Odile, SimonnotJean Louis Morel, 2021, Springer

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