A PHYTOEXTRACTION DECISION SUPPORT SYSTEM AND ITS USE IN THE COMMERCIAL ENVIRONMENT

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Phytoextraction, the use of plants to remove water and metals from contaminated substrates, is touted as a low-cost, 'clean green' solution to ameliorate degraded lands, and a possible method of mining high-value metals from low-grade ores. The effectiveness of this new technology is, however, variable and highly site-dependent. The decision to implement phytoextraction is usually made on cost. Phytoextraction should compare favourably to the cost of inaction and the best alternative technology. One of major barriers to the use of this technology is uncertainty of its performance on a given site, as compared to 'tried and true' alternatives. A robust assessment of the likely success and cost of phytoextraction for each site may help circumvent this barrier. This assessment necessarily has to consider biogeochemical, climatic and economic variables.

A phytoextraction decision support system (phyto-DSS) was constructed to integrate environmental and economic data to provide a rapid assessment of phytoextraction as an appropriate management practice across various scenarios. The phyto-DSS calculates daily plant water-use, plant metal uptake, leaching and the cost-benefit of the operation. The system requires daily climate data, as well as data on the substrate and the plants that are to be used. An economic assessment is made by comparing the costs of phytoextraction with those of inaction, and the best alternative technology.

The phyto-DSS was used to assess the viability of a commercial phytoextraction operation and a potential phytomining project. Mesocosm and field trials were used to parameterise the inputs. Based on phyto-DSS outputs, phytoextraction was implemented on a 5 ha sawdust pile in New Zealand, that is leaching unacceptable amounts of boron into a local stream. In 2000, the site was planted in poplars to control leaching and remove boron from the pile. When the trees are mature, selective coppicing will be used to remove boron from the site. Plant material could even be used as an organic mulch on nearby boron deficient orchards. Leaching has been reduced to three months of the year. The leaching that occurs is collected in a small pond at the foot of the pile and used for irrigation during the summer months. The cost of phytoextraction was US$ 50,000 with annual costs of US$ 5000 for fertiliser and running costs of the irrigation system. The cost of capping the site, the best alternative technology, was estimated at US$ 600,000.

The phyto-DSS has also been used to examine the economics of a generic gold phytomining operation. Gold phytomining must generate a profit so the value of gold recovered must be greater than the combined costs of site engineering, fertiliser and lime amendment, and chemicals where these are required. The suitability of gold phytoextraction relies strongly on the geochemical properties of the substrate. The phyto-DSS predicts that in some scenarios, phytoextraction can be used to simultaneously stabilise mine tailings, and phytomine economic quantities of gold.