

Science for Environment Policy

Study investigates attitudes of soil-remediation experts to phytoremediation

An investigation into the attitudes of Canadian soil-remediation experts has shown that they tend to prefer conventional remediation methods over phytoremediation – which relies on plants to clean soils – despite evidence that the latter can have advantages. The researchers behind the study highlight that this 'status-quo bias' poses a barrier to the uptake of novel technologies such as phytoremediation, and that scientists may need to find different ways of disseminating evidence to increase the use of new techniques among practitioners.

Soil contamination in the EU is addressed under the [Soil Thematic Strategy](#). A serious environmental problem, there are an estimated 160 000 sites in Europe where pollutants such as heavy metals, benzene and polychlorinated biphenyl (PCB) present a [risk to humans](#) and ecosystems¹. Inhabitants of areas near these sites are at higher risk of dying from leukaemia, bladder and gastrointestinal cancers, while processes such as leaching and plant uptake can widen the area in which inhabitants will be at-risk as contaminants enter the food chain.

The need to excavate and transport soil to landfills or treatment facilities can make remediation of these sites prohibitively expensive, and many are simply abandoned, according to the researchers behind this study. They set out to investigate why a more cost-effective alternative is not more widely employed, by looking at the evidence surrounding phytoremediation and conducting a survey among soil-remediation experts in Quebec, Canada.

In a literature review, the researchers found that 1 795 articles were published between 1994 and 2015 with the word 'phytoremediation' in the title, including substantial evidence that the technique works under specified conditions, depending on the level, depth and type of contamination. It is most effective on organic contaminants, but can also remediate sites polluted with trace elements, the researchers note. For example, studies show that species such as willow (*Salix*), poplar (*Populus*) and *Brassica* can accumulate metals such as cadmium and lead (the metals are taken out of the soil and then either the contaminated biomass is dealt with, or the metals are stabilised in the wood). Revenue may even be generated by harvesting their biomass – for example for energy² – making phytoremediation a low-cost alternative to conventional techniques involving removal and off-site treatment of soil.

Despite the advantages of phytoremediation, the researchers note that successful uptake of new technologies is influenced by a variety of factors such as cost, time, certainty of outcomes, risk frameworks (relating to the extent of remediation required) and habits, which bias users towards familiar technology.

In order to investigate attitudes towards phytoremediation, the researchers issued a survey to 193 soil-remediation practitioners in Quebec, Canada, in November to December 2013. Out of the recipients, 113 responded and 94 completed the entire questionnaire. The questionnaire included four simple true/false statements on phytoremediation, e.g. 'Phytoremediation involves plants' and 'Phytoextraction removes organic contaminants', which were used to judge awareness of the technique. On average, only two of these questions were answered correctly by the experts and 73% of respondents admitted their knowledge of the technology was not good. The researchers infer, therefore, that scientific literature on the subject has not reached experts on the ground.

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1. Panagos, P., Van Liedekerke, M., Yigini, Y., & Montanarella, L. (2013). Contaminated sites in Europe: Review of the current situation based on data collected through a European network. *J. Environ. Public Health*: 1–11

2. Młeczek, M., Rutkowski, P., Rissmann, I. et al. (2010). Biomass productivity and phytoremediation potential of *Salix alba* and *Salix viminalis*. *Biomass and Bioenergy*, 34(9): 1410–1418.

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Another question was posed in the context of a hypothetical site ideal for phytoremediation, in a municipality seeking a low-cost solution with no time constraints. The experts were asked to rate the acceptability of a conventional treatment plan and a plan involving willows and poplars. Results showed that only 19% would prefer to use trees over conventional treatment, despite the advantages of phytoremediation in this scenario. There was a slight, but not significant, increase in acceptability of phytoremediation when the experts were told that the scenario only involved organic contaminants, for which there is better evidence of the efficacy of phytoremediation. The researchers found a significantly lower preference for phytoremediation among experts who had often recommended excavation in recent years.

Half the participants were also given the abstract of a fictional scientific article giving unambiguous evidence that phytoremediation with willow would effectively remove zinc, copper and lead. The article was said to be authored by MIT (Massachusetts Institute of Technology) professors and published in the respected journal *Nature*, to give it a high level of credibility. The other participants were asked only to re-read the hypothetical scenario presented, which gave zinc, copper and lead as the contaminants. Both groups were then asked to re-rate the willow-based phytoremediation plan for this site.

A just-significant increase in acceptability of phytoremediation was detected in the group who read the article, but it was still below the level of preference for conventional techniques. Exposure to scientific evidence, therefore, made only a small difference, indicating a status-quo bias that works against uptake of phytoremediation. In justifying their rejection of phytoremediation, some respondents wrote comments such as "this thing does not work" and "excavating the soil is the proper way to go", clearly demonstrating their objection to the technique, but without scientific basis. One expressed fear that support for phytoremediation would not be forthcoming from bankers and public authorities.

The researchers acknowledge that exposure to a single scientific publication might have only a limited effect, but the experiment nevertheless shows that professionals are reluctant to change prior judgements. This might partly be due to institutional demands, they say — insurers, banks and even government policy may promote conventional techniques with known outcomes. Vested interests may also be at play, e.g. the survey respondents might be employed by firms owning excavation machinery.

Although the status-quo bias poses a barrier to uptake of new environmental technology, the researchers conclude that phytoremediation might be gradually accepted through small shifts in attitudes among professionals. Being aware of the bias is an important step to overcoming it. Scientists may need to increase their efforts at disseminating findings in different publications; scientific journals may not be the best way to reach practitioners. Detailing how well phytoremediation works in a variety of settings is also important, they note.

