

Evaluation and management of arsenic contamination in agricultural soil and water - AgriAs

Deliverable 4.2. Model for the exposure of people and recipient waters to arsenic in agricultural soil

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Public Summary

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The report describes the risk assessment model developed for the assessment of health risks from arsenic in agricultural soils.

The exposure pathways included in the model are direct exposure to soil (e.g. direct oral intake, inhalation of dust, dermal uptake), dietary exposure through plants and animal products; and drinking water.

The model calculates arsenic exposure on the studied site, background exposure to arsenic from sources away from the site (such as consumption of food and drink produced in areas away from the site) and the total exposure. The risks from on-site and off-site exposure can be presented separately and compared to see the extra arsenic exposure due to the contaminated site and the relative importance compared to off-site exposure.

For site specific estimates, the model can use measured concentrations of arsenic in soil and water, and measured concentrations in foodstuffs and animal fodder. If measured concentrations in foodstuffs and fodder are not available, they can be calculated from the concentrations of arsenic in the soil using transfer factors. The calculations can be carried out with site-specific transfer factors, which express the relationship between the concentrations in foodstuffs and the concentrations in soil and water. If there are no site-specific transfer factors, generic factors taken from the scientific literature can be used. If there are no data at all for some food groups, generic concentrations (from EFSA) can be used so that the exposure pathway is not left out of the consideration of total exposure.

The model considers two different age-groups, adults and children.

It is possible to include site-specific information about the bioavailability following oral intake of arsenic in soil, food and fodder for people and for animals.

The exposure model is an equilibrium model. A dynamic model, which can consider changes in the concentration of arsenic in soils and groundwaters over time, was judged not to be necessary, based on estimates of arsenic inputs and losses to the soil. The estimates showed that the arsenic losses and inputs are very small in relation to the total amount of arsenic in the soil and changes in the total arsenic concentration will occur very slowly. Processes considered were the weathering of rock, aerial deposition of contaminants, inputs in sewage sludge or biocompost and fertiliser, and the return of arsenic in discarded plant parts, such as straw. Output processes considered were leaching, removal of arsenic in plant products, erosion of soil.

The likelihood of harmful health-effects from the estimated or measured exposure is estimated by using toxicological reference values derived by panels of experts (for example the international panels of WHO and EFSA) based on experimental and epidemiological studies of the toxic effects of substances in animals and in humans. The model allows the determination of risks for both threshold and non-threshold effects by including risk based toxicological reference values for the carcinogenic effects of arsenic and non-threshold values for the non-carcinogenic effects.



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