

# Science for Environment Policy

## What are the health costs of cadmium contamination in fertilisers?

**The health impacts** of consuming food that has been grown using cadmium-contaminated fertilisers are an increasing concern. New Danish research has estimated that the annual monetary cost of these impacts is €15.53 per km<sup>2</sup> of agricultural land treated with mineral fertilisers. This cost rises to €37.04 per km<sup>2</sup> if pig manure is used.

**Cadmium is a toxic metal** naturally present in varying concentrations in the phosphorus ore that is mined to make mineral fertiliser. Recycled organic fertilisers used for agriculture, such as sludge from wastewater treatment plants and struvite, a form of phosphorus fertiliser recovered from wastewater, introduce cadmium that was previously concentrated in the waste.

The cadmium present in fertilisers can be taken up by food crops, thus making its way into the diet. Such long-term, low-level exposure can contribute to health conditions, such as diabetes, osteoporosis, hypertension and cancer. This in turn creates 'external costs' – costs created by this specific sector but absorbed by wider society.

For this study, the researchers estimated the monetary costs of the health impacts associated with cadmium in fertilisers over a 95-year period in Denmark. They modelled nine scenarios: three focusing on mineral fertiliser, pig manure or struvite, and six on wastewater sludge from varying types of wastewater treatment.

For each scenario the researchers modelled the probability of developing osteoporosis or kidney disease as result of consuming food fertilised with cadmium-containing materials. They then estimated the economic cost of these two illnesses. Future costs were adjusted to the present value at a discount rate of 3%.

The external human health cost of cadmium was calculated to be €334 for each kilogram of cadmium added to the soil. This is five times higher than costs estimated by previous research. This study considered long-term, cumulative effects of cadmium, which largely explains its much higher figure.

External costs varied according to the type of fertiliser. The health cost of mineral fertiliser was estimated at €15.53 per year for each square kilometre of Danish agricultural soil to which it is applied. This figure rises to an average of €28.60 for the six types of sludge, and €37.04 for pig manure. The most costly sludge was €50.42 per year from medium-sized wastewater treatment plants performing anaerobic sludge digestion.

Struvite contained much less cadmium than the assessed mineral fertiliser: 0.06 mg per kilogram of fertiliser, compared with 4.40 mg for mineral fertiliser. Struvite also contained less cadmium per unit of phosphorus: 0.0000004 mg of cadmium per mg of phosphorus (mg\_Cd/mg\_P), whereas mineral fertiliser contained 0.0000219 mg\_Cd/mg\_P. The costs of struvite's health impacts were estimated to be just €0.29 per km<sup>2</sup> per year.

However, although this result suggests that struvite is the best option from an environmental and health point of view, it represents only a minor fraction of fertiliser products and may not yet constitute an economically feasible solution.

Taxing the cadmium content of fertilisers is one approach, among others, that could reduce levels of cadmium in soil. The researchers suggest that their figures could help guide effective and fair taxes that are based on the actual societal costs of cadmium's damaging health impacts. They could also be useful in guiding incentives to encourage technological development, production and use of fertilisers with reduced cadmium content.

The external costs calculated by this study are specific to Denmark. If they are applied elsewhere, the researchers explain that they should be adjusted for local soil quality, the amount of crop eaten by the exposed population and local background exposure to cadmium. They also acknowledge some simplifications in their study's design. For example, they assumed that all fertilisers are equally effective, when in fact local conditions, such as soil nutrients, will affect their performance.



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