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Trace element (TE) accumulation in agricultural soils may have long-term implications for crops quality. Input of organic or chemical fertilizers is one of the major sources of TE in agricultural systems, due to their composition and the quantities involved. However, the balance with TE exported by crops is not well known and these fluxes need to be calculated to predict the potential future contamination of soils.

The aims of our study were (1) to quantify TE contents in soil, plants, organic and chemical fertilizers, (2) to estimate their fluxes at field scale and (3) to compare the impact of different farming systems.

On the whole French territory, a network of 90 plots in conventional or organic farming was built (QUASAPROVE). Three different types of fertilization were used: nitrate (N) fertilization, nitrate-phosphate-potassium (NPK) fertilization or organic fertilization. The plots were cultivated with sunflower, durum wheat or common wheat. The soil surface horizons (0-30 cm), fertilizers and crops were sampled and analysed for their contents of arsenic, cadmium, copper, lead and zinc. The TE inputs and exports were calculated. Atmospheric inputs and leaching were disregarded in order to focus on the impact of agricultural practices. All fertilizers showed low concentrations in TE, except for phosphate fertilizers which appeared to have the highest TE concentrations and were the main source of arsenic, cadmium, copper and zinc in conventional farming. For organic fertilizers, concentrations were low except for lead in some cases but the amount applied generates a significant inflow in TE.

Whatever the cultivated crop, the balance is determined by the type of fertilization. In the case of N fertilization only, the balance is always negative for the five trace elements. In the case of organic fertilisation, for both conventional and organic farming, the balance is always positive and the soil accumulates the five trace elements. In the case of conventional farming with NPK fertilization, the balance is positive for arsenic, cadmium and lead, and negative for copper and zinc.

Using repeated NPK and organic fertilization over multiple years will induce an accumulation in soils. For example, the cadmium concentration could double in soils with low initial concentration, after 120 years of annual applications of phosphate fertilizer. However the effects on the bioavailability of TE could also be modified by these inputs, especially in the case of organic inputs. The characterisation of TE bioavailability will be studied on the different soils of the QUASAPROVE network using soil solution extractions and passive samplers (DGT).