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Editorial: Translating soil science to improve human health

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Editorial on the Research Topic
Translating soil science to improve human health

Introduction

Soil could function as a sink, source and storage to regulate the entry and leave of beneficial and unwanted inorganic and organic compounds to atmosphere, biosphere, hydrosphere and lithosphere. These processes could impact human health beneficially or harmfully. For instance, soil acts as sink for toxic chemicals and greenhouse gases, which can improve human and ecosystem health. Soil is the natural domains for C and plant nutrient cycling (Singer and Munns, 2002). Appropriate regulations of physical, chemical and biological processes in soils are of utmost importance to manipulate the chemical flow pathways towards ameliorating human health. This is even more important today than ever because we are facing the cascading climate change impacts, one of the major challenges of our time. Moreover, the combined pressure from increasing human populations and waste generation, as well as decreasing area of *per capita* cultivated land, further stress the soil resources to meet the ever-increasing requests for food production and waste treatment. This need has been extended to utilize marginal or under-performing agricultural lands for food production to meet rapidly growing global food demands and to manage our increasing volume of wastes.

Summaries of paper in this research topic collection

This Research Topic Research Topic of articles cannot cover the full spectrum of Research Topic areas highlighting soil science in relation to human health; however, it represents a major cross-section of the Research Topic areas.

Managing soils to reduce bioavailability of contaminants

The commentary by Duckworth et al. discusses how soil property and constituents, such as clay minerals, soil organic matter, pH, and E_h, could influence the sequestration of contaminants and reduce their mobility, which in turn alter their bioavailability to human and environmental health. Soil chemists need to develop new methodology to better evaluate the extent to which molecular-scale knowledge could be upscaled to macroscopic measurements, to more accurately assess contaminant risks to human and environmental health, to quantitatively describe spatial and temporal heterogeneity in soil properties that are related to contaminant exposure risks. Such knowledge could be obtained *via* engaging environmental health scientists to address the contaminant exposure and toxicity.

Most trace elements form the sparingly soluble complexes in soils and do not easily transfer to plants. However, plants can readily take up Cd from soils and translocate to the edible fractions. For this reason, Cd is one of the most concerned elements in soils in terms of food-chain contaminant transfer (McLaughlin et al., 1999; Smolders and Mertens, 2013). Organic amendments could potentially alter Cd speciation and distribution in soils and thereby change soil Cd transfer patterns to plants. Gutiérrez et al. studied the effects of compost application on Cd fractions in soils and transfer to cacao (*Theobroma cacao L.*) tissues in four Ecuadorian cacao farms. They found that Cd mobility in soils cultivated with cacao, as measured by plant uptake, was strongly associated with soil characteristics, especially pH and soil organic matter. Their results suggest that aged composts could help reduce Cd transfer to plant from soils, likely due to the enhanced formation of sparingly soluble organic ligand-Cd complexes.

Humans could simultaneously assimilate beneficial and toxic chemicals and pathogens from soils through direct or indirect pathways. The specific exposure could be related to their bioavailability which is determined by the chemical forms and speciation in soils. One of the major challenges is to quantify the bioavailability of these chemicals in soils. Previous studies have been attempted to develop accurate and sensitive laboratory-based methods to simulate human digestion processes for assessing chemical bioavailability/bioaccessbility. Mayer et al. conducted a meta-analysis to examine the average reduction in bioaccessibilty of Pb in soils by adding phosphate amendments. Through the analysis of five databases and 44 studies, it was found that inorganic phosphate amendments, especially soluble phosphoric acid, could effectively reduce the *in vitro* bioaccessibility (IVBA) of Pb in soils. The average reduction in IVBA Pb as a fraction of the total Pb was 12%, and the relative reduction based on the IVBA Pb of the control soil was 25%. The authors identified the lack of necessary soil information reported in some studies as a problem. Moreover, currently, there is no standardized *in vitro* method for treated Pb-contaminated soils. Out of the several tested methods, EPA Method 1,340 was the least sensitive method.

Managing soils to enhance bioavailability of nutrients

Biofortification is defined as the processes used to enhance the accumulation of target elements or substances of interest in the edible portion of crop plants through soil amendment/fertilization (agronomic biofortification), or through crop selection or breeding (genetic biofortification) (Premarathna et al., 2010; Premarathna et al., 2012). Kumawat et al. assessed the impacts of amendment application on soil physical and chemical properties, and long-term impacts on yield, quality, and nutrition status of rice grains in an organic basmati rice-based cropping system in a typic Ustchrept Soil of India. Soil amendments included seven combinations of different organic materials and biofertilizers (BF), farmyard manure (FYM), vermicompost (VC), FYM + crop residues (CR), VC + CR, FYM + CR + BF, and VC + CR + BF. Their work showed that soil amendments could improve soil properties, such as soil moisture content, soil organic C, total N, and available P and micronutrients. Green and organic manure incorporation could positively impact the physical (hulling, milling, and head rice recovery) and nutritional quality of grain (protein, macro and micronutrient content).

Soils and human health: connection between socio-demographic and other factors

A survey study was conducted to assess the mineral nutrition in the hair samples of women living in rural tribal communities of Jharkhand, India, and possible connection with the mineral content in soils and staple crop rice (Rekik and van Es). The connections were explored with inherent and dynamic life features, such as geography, socio-demographics, and agronomic, processing and cooking practices. However, it was difficult to establish the consistent connections between soil health, food quality, and human health, even in a subsistence farming environment where most food was sourced locally.

A survey results-based commentary by Johnson et al. discusses how boosting soil literacy in schools can help improve understanding of the linkage between soil quality and human health, specifically, in generation Z. The study showed that students with higher levels of soil literacy consider farming is a good way to make money highlighting the importance of soil literacy for future food security.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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