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Editorial: Urban soil formation, properties, classification, management, and function

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Editorial on the Research Topic
Urban soil formation, properties, classification, management, and function

Urban soil science is critical and expanding. Urbanization rates continue to rise, leading to more urban lands and higher human population densities in urban areas. Urbanization increases soil disturbance, alteration, and movement by humans. Because urban populations depend on soil for many ecosystem services, the direct connection between human health and urban soil quality is evident.

Soils in urban environments experience unique properties, functions, values, and management. The anthropogenic factor often supersedes other soil-forming factors. The unique processes occurring in urban environments can lead to distinct soil physical, chemical, and biological properties. The functions and associated values of urban soils are also unique compared to other ecosystems because they are both highly affected by, and connected to, humans. Management of these soils involves innovative approaches to accommodate the urban environments in which they are found, to support the urban population and to improve urban sustainability.

Our knowledge of urban soils and their formation factors, soil processes, and physical, chemical, and biological properties is proliferating. Efforts are underway across the globe to classify, map, and interpret these soils. Improved understanding of urban soils' specific functions and values of urban soils and the necessary management is also increasing. However, much research and data are still needed as our understanding of the urban environment continues to evolve. This article collection contains five papers on new research findings, management approaches, and synthesis of current knowledge.

The article collection for this Research Topic represents a wide scope of urban soil research from participatory approaches that enhance urban soil initiatives to research approaches that improve knowledge of soil properties across spatiotemporal scales. A key theme of this collection is to enhance urban soil science for improved participation and management of this vital resource for urban residents. Co-production of project goals

across communities, policy-makers, and researchers is needed for meaningful engagement that leads to relevant, rigorous outcomes.

Schwarz et al. provide an exemplary approach to incorporating multiple stakeholder groups in setting goals for future urban soil research and management. Across Los Angeles County (the most populous in the U.S.), Schwarz et al. conducted online surveys and focus groups to determine community needs, perceptions, and concerns regarding LA urban soils. The authors identified challenges for comprehensive urban soil research initiatives and provide a path forward for addressing these challenges for future policy and advocacy.

Similarly, Fernández-Viña et al. use community science that centers on the participation of community members, who may co-develop research questions, inform study methods, collect data, interpret findings, or implement projects related to pollution in urban soil systems. This results in more considerable community interest, community involvement, community-led and structural changes. Two models were highly recommended the Spectrum of Community Engagement to Ownership (SCEO) and Urban Sustainability Directors Network High Impact Practices (USDN HIPs) to ensure that the process of doing science will result in the intended outcome, such as structural change. Researchers should employ community-driven decision-making processes that center on equity and inclusion in this case. Future research should include a broader review of participatory approaches in soil systems, encompassing biological and ecological studies that use participatory methods to meet research goals.

Long-term studies across broad spatial scales are warranted to build deeper understanding of soil formation in urban environments. Along an urban-rural gradient in Baltimore, MD, Yesilonis et al. resampled forest soils 17 years after initial sampling to assess chemical changes in soil across spatiotemporal scales. This is the first publication of long-term soil change in urban ecosystems. One of the strengths of the study design is the ability to decipher local and regional effects on soil chemistry. The research findings demonstrated spatiotemporal shifts indicating local and regional factors jointly influence soil chemistry in forest patches. Furthermore, changes in urban-rural soil chemistry over time differed from non-urban long-term studies demonstrating the vital need to continue long-term soil research in human-dominated landscapes.

Paltseva et al. provide a synthesis paper on legacy in lead urban gardens with the goal of producing clear recommendations on risk and exposure of lead. The study summarizes the current state of knowledge on lead in urban gardens. The study describes exposure pathways for lead and also remediation methods to limit that exposure. To that end, the study details best management practices on urban soil testing for lead contamination, documentation of land-use history in relation to potential contamination, soil amendment limitations for lead contamination, variation in crop susceptibility to lead contamination, idealized growing conditions and substrates for potential lead contamination sites.

Urban agriculture is an essential soil function in many cities in developing countries and is returning to many developed cities as the social and well-being benefits of a direct connection to food production, nutrition and gardening are recognized. At the same time, a common barrier to urban food production can be access to uncontaminated soils within which plants can be safely grown for human consumption. Araujo et al. provide an innovative study of how safe and productive soils can be made from combining subsoil mineral waste, a byproduct of urban construction and redevelopment, with composted organic green waste, a byproduct of urban vegetation management. This is urban metabolism in its purest form, making use of two urban waste streams to create a valuable, and perhaps higher value, secondary resource—uncontaminated urban agriculture soils. The study also demonstrates the profound benefit of soil fauna, in this case earthworms, in enhancing soil aggregation which improves soil properties and can result in increased plant growth.

The articles in this Frontiers Research Topic are essential for advancing urban soil science. They and others like them will help promote the importance of urban soils in creating and maintaining livable, sustainable cities and towns.

Author contributions

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

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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