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Editorial: Impacts of Climate Change and Land-Use on Soil Functions and Ecosystem Services in Drylands

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Editorial on the Research Topic

Impacts of Climate Change and Land-Use on Soil Functions and Ecosystem Services in Drylands

Evidence of climate change at geological time scales are long known, and are attributed to natural causes. However, climatic change since the mid-19th century is mostly attributed to anthropogenic causes, and specifically, to the increasing emissions of greenhouse gases. Climatic change has become particularly evident since the 1970s, with global temperatures increasing at faster rates and precipitations decreasing over extensive parts of the world (Masson-Delmotte et al., 2019). Over recent decades, record-breaking high temperatures and severe droughts on the one hand, with extremely powerful rainstorms and devastating floods on the other hand, have become the new "normal" weather regime (Bowen, 2015). While these new climatic patterns affect vast parts of the world, they are most prominent in dryland regions. Over the last decades, the world's drylands have faced both aridity aggravation and territorial expansion into previously moister areas (Huang et al., 2016), consequently lowering potential net primary productivity and accelerating desertification.

Drylands cover approximately 40% of the global terrestrial area, encompass over 40% of the world's croplands, and support 50% of its livestock (Davies et al., 2016). Human population in the world's drylands surpassed 2.6 billion in 2010 and is projected to increase by 40–50%, to around 4.0 billion, by 2050 (PBL, 2017). Because of the demographic growth, agricultural and grazing lands have been forced into more intensive systems, and simultaneously pushed into dryer and more marginal lands. Concordantly, land-use change of drylands' "natural systems" into cropping and grazing systems, alongside land misuse and mismanagement have become widespread (Bestelmeyer et al., 2015). Simultaneously, increasing investments in dryland areas by private enterprises or corporations—often supported by governments and international firms—have resulted in land grabbing and expropriation of extensive croplands and pasturelands for the establishment of large-scale infrastructures (Achiba, 2019).

Altogether, the mounting pressures imposed on the already fragile dryland environments have increased land degradation process, including soil compaction, depleted soil organic carbon pools, deteriorated soil quality, accelerated soil erosion, extended salinization and sodification, species invasion, biodiversity loss, and decreased productive capacity (FAO, 2015). Land degradation and desertification inevitably cause the deterioration of provisioning, supporting, regulating, and cultural ecosystem services. Since a large share of the local populations directly rely on agriculture or livestock, the exacerbating environmental pressures put them at a highly vulnerable position, and risk their socioeconomic and food security (UN, 2018). This calls for urgent interventions by policy makers at local, national, regional, and global levels, aimed to minimize land degradation processes, support land restoration projects, and encourage best management practices.

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In this Research Topic, we present three articles that discuss specific aspects of dryland degradation and restoration. The first article, by Zhang et al., reports the environmental effects of coal mining in semiarid northern China. The mining-induced surface subsidence affects spatial variability of soil erosion, microbial communities, and vegetation. The study demonstrates that the relationships between the modified microtopography and microbial communities are complex, that the soil degradation level changes gradually from the top to the bottom of the slope, and that it is mainly driven by organic matter transport. Results of the study may be relevant for researchers of ecological restoration in subsided mining areas in drylands. The second article, by Stavi et al., reviews the topic of dryland salinization and sodification. The study reviews the natural and anthropogenic causes for soil salinity and sodicity, as well as methods for monitoring these processes. Further, the study reviews the means of prevention, mitigation, and restoration of anthropogenically salinized and sodified lands, including site selection, leaching techniques, tillage schemes, irrigation methods, fertilizer management, soil amending with chemical or organic additives, and phytoremediation. A specific emphasis is given to tree and shrub planting under a wide range of forestry and agroforestry techniques. The third article, by Zhang et al., assesses the changes in soil microbial activity following tillage practices (including conventional tillage and subsoil tillage) and straw management after corn cropping in corn-soybean systems in Mollisols of northeastern China. Overall, the results show that microorganisms' activity is limited by C and P, but not by N. Deep tillage aggravates C inadequacy, while straw incorporation alleviates P inadequacy. Regardless of management practices, the N-rich soil across the region does not limit microbial activity, suggesting that N fertilizing may be substantially reduced.

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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.