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Editorial: Ecological restoration in drylands: toward land degradation neutrality

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Land degradation neutrality (LDN) has been defined as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services remains stable or increases within specified temporal and spatial scales and ecosystems." In practice, the application and success of LDN in drylands vary greatly depending on the targeted ecosystem services and the impacts of environmental conditions and various restoration methods on the efficacy and sustainability of restoration. In this editorial, we summarize the most viewed and downloaded articles contributing to the Research Topic "*Ecological Restoration in Drylands: Toward Land Degradation Neutrality*" of the journal *Frontiers in Environmental Science*.

KEYWORDS

land degradation, ecological restoration, biodiversity, ecosystem services, land degradation neutrality

Editorial on the Research Topic
Ecological restoration in drylands: towards land degradation neutrality

1 Spatiotemporal evolution of drylands and its impact on soil erosion: observations

Given the increasing degradation trend of drylands, continuous remote sensing monitoring of sand or precipitation in drylands is one of the main concerns for governments. In addition, exploration of the spatiotemporal evolution characteristics of soil erosion has great scientific value for desertification and degradation prevention and ecological restoration. This theme is represented by the case study reported by Dang et al. who showed that differences in sand types contributed most to the reduction of soil–wind erosion intensity, while ecological restoration played a key role in reducing soil erosion

intensity. Their study also indicated that the increase in forest and grass vegetation cover and agricultural oases play a positive role in soil restoration and wind-proofing sand and that the pattern of dryland changes in desert areas is closely related to the ecological construction policy and the impact of climate change. Furthermore, detecting the areas subjected to desertification and degradation requiring management within the shortest time and at the lowest cost is a necessity, especially in border areas. This Research Topic is represented by the case study by Zolfaghari et al. who showed that when the surface of a wetland dries, the land surface, which is free of moisture and vegetation, should be classified as being under extreme degradation; when the wetland is flooded, the area of degradation is highly reduced, but contrary to expectations, the land area without any degradation also increased due to temporarily supported vegetation. All these studies address the needs of target 15.3 in the LDN initiative (an accelerator of the Sustainable Development Goal 15): Goal 15 aims to conserve life on land, protect and restore terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and stop biodiversity loss; by 2030, Goal 15.3 aims to combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world (United Nations, Sustainable Development Goals, 2015).

2 Soil and vegetation relationships: experiments

In recent decades, soil restoration and sand transformation methods, including mechanical sand barriers (Bo et al., 2015), biological soil crusts (Li et al., 2011), and afforestation (Deng et al., 2021), have been implemented. In particular, afforestation, plantation, and vegetation methods have been successfully established as feasible methods of environmental management for desertification control in drylands (Tang and Li, 2018; Song et al., 2020). Li et al. conducted a survey in the field and a seed germination experiment in the laboratory to investigate the characteristics of soil seed banks of different sizes and parts of nebkhas and examine their relationship with aboveground vegetation. Ren et al. described a case of ectomycorrhizal fungal communities associated with *Pinus sylvestris* var. mongolica that were altered by soil environments with aging plantation in drylands in China. These experiments provide a better understanding of the relationship between soil properties and vegetation, which is critical to sustainable forest management and biodiversity restoration in the future. The work mentioned above meets the needs of the Aichi Biodiversity Targets in LDN (ways LDN can support each of the strategic goals for biodiversity conservation): "enhance benefits to all from biodiversity and ecosystem services."

3 Characteristics of water–carbon exchanges and environmental driving mechanisms in drylands: modeling

We are now familiar with the implementation of observations and experiments in ecological restoration in drylands and have found that vegetation plays a key role in soil transformation. In general, the canopy is the core location of water vapor and carbon exchanges between plants and the atmosphere in the soil–plant–atmosphere continuum. However, more research studies should focus on the characteristics of water–carbon exchanges and their environmental driving mechanisms in drylands. Wu et al. indicated that temperature is an important factor limiting and driving canopy conductance in different climate regions and that there is a synergistic effect between moisture and temperature factors jointly driving the change in canopy conductance. They also showed that the synergistic driving effects on different climatic regions all had a certain threshold and indicated that modeling of these factors can be useful for predicting water–carbon exchanges in drylands in the future. In another case study, Wang et al. found that changes in precipitation amount and frequency caused by global climate change will increase carbon emissions of cyanobacterial crusts and underlying soil, suggesting that cyanobacteria should be considered in projections of the future carbon budget.

4 Final considerations

In conclusion, these studies promise to improve our knowledge of ecological restoration in drylands and foster land degradation neutrality through observations, experiments, and modeling. This Research Topic included reports that provided useful additional insights into research in these directions. In addition to the papers highlighted herein, many other high-quality studies on this Research Topic, which well deserve discussion, including those on urban green spaces, natural suitability of human settlements, and microclimate and wind regime of typical landscapes in drylands, have been published. This series "*Ecological Restoration in Drylands: Toward Land Degradation Neutrality*" spans a wide range of important subjects.

Author contributions

JD: conceptualization, supervision, writing–original draft, and writing–review and editing.

Conflict of interest

Author JD was employed by Liaoning Fengyu Ecological Technology Co., Ltd.

The remaining 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.

Publisher's note

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