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Editorial

Subsurface Drainage and Water-Saving Irrigation in Sustainable Agriculture

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Salinity is a major threat for the sustainability of irrigated agriculture in drylands. To control salinity in the root zone for better crop growth, more water than required to meet crop evapotranspiration must be applied to leach excessive soluble salts out. Such an intentional "over-irrigation" is called leaching, which is the primary measure and is widely practiced as the most effective method. By carrying out leaching, salinity in the root zone can be controlled at least tentatively, but drainage below the root zone is inevitable and if subsurface drainage or groundwater discharge of the land is poor, the ground water table will rise and salts may return to the soil surface by rapid and continuous evaporation from the wet soil surface. In addition, plants will suffer from a lack of oxygen in soil pores. Therefore, securing subsurface drainage must be accompanied with irrigation in drylands. Unfortunately, the artificial enhancement of subsurface drainage is usually expensive. Even if tile drain has been already installed in the past, maintenance costs can be a heavy burden for farmers.

In this light, this Special Issue presents a review and original research papers for reviewing such drainage systems or evaluating the effect of new subsurface drainage systems or schemes for determining irrigation/leaching depths. All articles, ranging from numerical to field trials, are useful and informative even for extensionists, engineers and farmers. These articles may be even more useful for researchers to get an overview of what has yet to be addressed in future studies rather than knowing what has been found.

Yannopoulos et al. [1] presented a comprehensive review of the history and recent developments related to the materials and installation methods for subsurface drainage systems. Long-term cost-benefit analyses and durability evaluation of new/alternative technologies referred there under various conditions would be required. Okuda et al. [2] evaluated the effect of a new mole-drain drilling technology (cut-drain) as a low-cost alternative shallow subsurface drainage system through a field experiment in Uzbekistan and concluded that the proposed system can enhance salt removal from the field. Since those results may be affected by various factors, such as soil, climate, and irrigation management, further experiments under various combinations of those factors may be required to assert the effectiveness of the technology.

With intensifying water scarcity, drained water is getting reused for irrigation when fresh canal water is in shortage. Sang et al. [3] investigated the effects of alternating fresh and saline water irrigation on soil salinity and chlorophyll fluorescence using maize. Long-term experiments for evaluating salt accumulation under the recommended scheme would be desired.

Reducing the drainage rate may mitigate the burden to drainage systems and keep the groundwater depth low even when aged drainage systems are not fully functioning. Fujimaki et al. [4] reported that more than half of the water flowing into a drainage system in a farmland in the Nile Delta bypasses via cracks under surface irrigation and recommended to apply water using sprinkler or drip irrigation systems. They presented a new measure of the efficiency of leaching. Further studies to evaluate the leaching efficiency of various methods under cracking soil are required. A new scheme for the optimization of the irrigation/leaching depth considering the cost of water was presented by Fujimaki

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et al. [5]. They validated the effectiveness through a numerical experiment to clarify the theoretical advantage avoiding experimental errors which often mask differences among treatments. Still, a field validation would be required for the dissemination of the scheme.

Those limitations and challenges are mainly attributed to the long time periods and high costs required for field experiments/monitoring of drainage studies. I wish this Special Issue could promote the understanding of referees of research grants for such time-consuming and large-scale experiments so that more funding for these studies without the expectation of short-term results.

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