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Subirrigation as measure for climate change adaptation: from technological development and participatory monitoring to guidelines for implementation

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We are increasingly confronted with drought damage in agriculture and nature (both terrestrial and aquatic). Parallel, the pressure increases on the availability of water for high-grade applications such as the production of drinking water. Strategies are being developed to manage these risks and to secure supplies of freshwater to all water users in the long term. This includes increasing regional self-sufficiency to better match supply with demand for freshwater and improving the utilization of the available freshwater sources. We provide results of pilot studies in which surface water and treated wastewater (both from domestic and industrial origin), that are usually discharged from the drainage basin, are used for local-scale water supply by subirrigation. The use of these freshwater sources for subirrigation purposes may be an effective strategy to contribute to both improved water availability for crops and a reduced pressure on the regional groundwater system. However, besides technological field-scale knowledge, a proper knowledge base for both farmers and regional water authorities about the propagation of the measure through the water system is required for responsible implementation of the measure.

Subirrigation is a subsurface irrigation method that can be more efficient than classical surface irrigation methods. The main reason is that only water that is used for plant transpiration leaves the soil and groundwater system. Unused water is kept within the groundwater system. For a farmer, the goal of subirrigation is to raise the groundwater level and increase the soil moisture availability for plant growth through capillary rise. For a water manager, subirrigation limits the use of groundwater for surface sprinkler irrigation and unused surplus water may additionally recharge the regional groundwater system. However, the freshwater availability for subirrigation is generally limited and subirrigation could lead to negative impacts to other users of the water system and the water system itself, if not implemented and managed well. Additionally, it is of great importance to pay attention to cooperation between farmers and regional water authorities on water use and availability.

Large-scale subirrigation affects the regional allocation of water resources. Therefore, an analysis of the propagation of subirrigation management through the local to regional hydrological system is required to support water managers. Moreover, stakeholders need to be actively involved in order to get feedback and trust. Therefore, we provide results of i) pilot studies quantifying the physical aspects of subirrigation, including the gross and net water use. Results are shown in Sankey-flow diagrams providing a clear visualization of the propagation of water use by subirrigation through the water system and impact (both positive and negative) on the water balance and water availability for other e.g. downstream users, ii) participatory monitoring and evaluation, guiding both farmers and regional water authorities to a responsible and sound implementation of subirrigation systems.