Effects of the use of drainage-/ subirrigation systems in the Pleistocene uplands of the Netherlands

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The Netherlands is a low-lying, flood prone country, located in a delta. Most Dutch agricultural fields are drained to quickly get rid of excess water to increase crop production. Additionally, the freshwater demand of different sectors (agriculture, industry, drinking water) increases, causing an increased pressure on the groundwater system. The combination of fast drainage and increased use of groundwater for human activities led to declining groundwater tables in the Dutch Pleistocene uplands. Given the changing climate resulting in prolonged dry periods, solutions for water retention are needed to decrease the pressure on the groundwater system to guarantee the future water supply for different sectors.

One of the solutions could be to modify the current drainage systems to drainage-infiltration (DI)-systems with a dual purpose. First, the DI-system stores water during (heavy) rainfall in the soil, but if the risk of flooding increases, the DI-system discharges water. Second, (external) water is actively pumped into the drainage network to raise groundwater tables (subirrigation). Through efficient use of the available external water source (treated waste water, industrial waste water, surface water or groundwater) the pressure on the groundwater system reduces.

We focus on the data and model results of several field experiments using subirrigation conducted in the Dutch Pleistocene uplands (± 2017-2020). The effects of subirrigation on the groundwater table and soil moisture conditions will be shown, including water supply rate and hydrological boundary conditions. We also provide both the set-up and results of field scale model simulations (SWAP; Soil-Water-Atmosphere-Plant model) to i) quantify the impact of subirrigation on all components of the (regional) water balance (including transpiration, drainage and groundwater recharge), ii) quantify crop yields, and iii) optimize the configuration and management of subirrigation systems for different soil types, hydrological boundary conditions, and climate scenarios.

Subirrigation resulted in an increase in groundwater tables of ± 0.70 m during the growing season, leading to higher crop yields. By storing the external water at the field scale, fast drainage was prevented, which decreased drought vulnerability.