Effects of submerged drains on water management and nutrient loading of surface water: a modelling approach

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Introduction

Submerged drains are promising means to reduce subsidence of peat pasture areas in The Netherlands. They enhance submerged infiltration of ditch water into the peat soil during the dry and warm summer half year. The consequential rise of the groundwater level results to substantial decrease of peat oxidation.

However, when this technique was promoted, some pressing questions arose about the possible negative side effects of submerged drains:
1. will they raise the costs of pumping out excess water due to increased drainage and will they increase the demand for – in the future possibly scarce - fresh inlet water?
2. will they increase the risk of flooding during long and heavy showers?
3. will they increase nutrient leaching from the nutrient rich peat soils?

Most of these effects are not easy to assess and all of them are strongly depending on the meteorological conditions during (short) field studies. Therefore, a modelling study was conducted on the basis of results of several pilot studies on submerged drains carried out in the Western peat pasture area in The Netherlands – the Green Heart. The SWAP-ANIMO model was used to analyse and extrapolate the obtained experimental results to gain more insight in these questions and come up with some (first) answers. The poster presents model results of the pilot in the Krimpenerwaard in the heart of the Green Heart.

The model

The model was set up with site specific values of hydraulic, physical and chemical properties. It was calibrated against results of groundwater level and discharge and water inlet measurements of the two-years field study.

Calibration

The results of groundwater level and discharge were compared using the so-called Root Mean Squared Error (RMSE). The lower the RMSE the better the model performance.

Q1: effects on drainage/infiltration and discharge/water inlet

No drains: 5.1 cm; Submerged: 5.1 cm

Q2: effects on flooding

With drains the groundwater level is lowered to an acceptable level (49 cm) for farming. This is achieved with three days of infiltration.

Q3: effects on nutrient loading of surface water

Conclusions (according to the model results)

1. the use of submerged drains will increase drainage and especially infiltration (which is the purpose). Discharge and water inlet will increase as well, but less due to buffering processes in the surface water. In the future climate, sufficient fresh water may become a problem.
2. peaks in surface water level during heavy showers will rise due to submerged drains, but only a few cm’s. High groundwater tables will be lowered much (days) faster by drains which benefit the agricultural use of the fields. In the long term submerged drains may lower the risk of flooding because of maintaining downward seepage and a more level soil surface within a catchment (polder)
3. submerged drains will decrease loading of surface water with phosphorus, nitrogen and sulphate up to more than 25%. This counts for loads as well as leaching concentrations. Sulphate is the most vulnerable nutrient for submerged drains; especially in combination with low ditch water levels.

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