Conservation of peat soils in agricultural use by infiltration via submerged drains

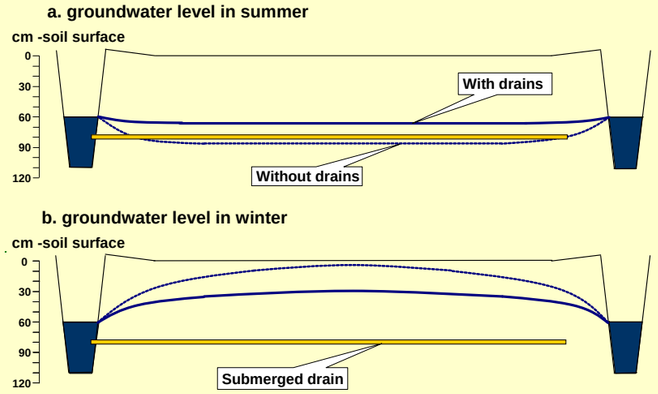
Jan van den Akker, Rob Hendriks, Idse Hoving, Karel van Houwelingen

Introduction:

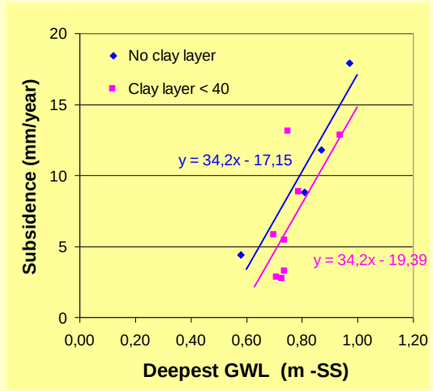
About 8% of all soils in The Netherlands are peat soils which are almost all in agricultural use as permanent pasture and drained with ditches. The largest part of the peat meadow area is situated in the densely populated western provinces South- and North-Holland and Utrecht and is called the Green Heart and is valued as a historic open landscape. Conservation of these peat soils by raising water levels and converting the peat meadow areas in very extensive grasslands or wet nature proved to be a very costly and slow process due to the strong opposition of farmers and many others who value the open cultural historic landscape and meadow birds. However, conservation of these peat soils is urgently needed because the yearly CO_2-emission is 4.2 Mt which is about 2.5 % of the yearly anthropological CO_2-emission of The Netherlands. Moreover the annual average subsidence of 9 mm per year is ever more becoming a safety threat because the surface level of these peat areas is already 1 to 2 m below sea level. The use of submerged drains seems to be an acceptable solution for dairy farmers and effective in diminishing peat oxidation and so subsidence and CO_2-emissions.

Submerged drains: infiltration in dry periods to raise groundwater levels; drainage in wet periods to lower groundwater levels

Installing the submerged drains below ditchwater level

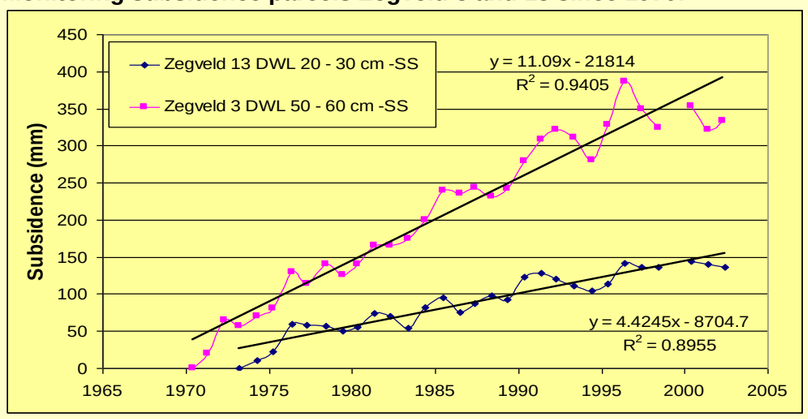


a. In summer the groundwater level is raised by infiltration via submerged drains to conserve peat soils
b. In wet periods groundwater levels are lowered for trafficability



Relation deepest groundwater level (GWL) – subsidence: 10 cm raise of groundwater level diminishes the subsidence with 3.4 mm

Monitoring subsidence parcels Zegveld 3 and 13 since 1970:



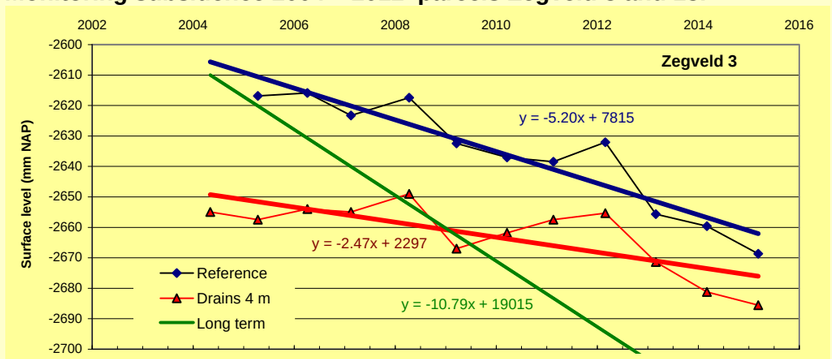
Results monitoring subsidence 2004 – 2012 Zegveld 3 and 13 with submerged drains versus their references without drains

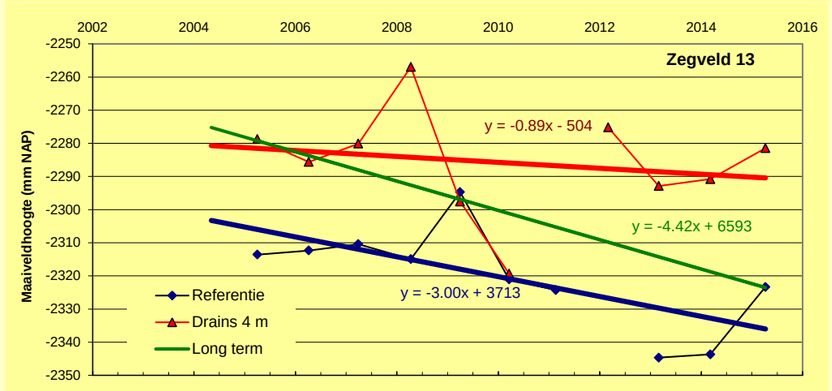
Infiltration via submerged drains reduces the subsidence with 50 -70% depending on the ditch water level. Combination of submerged drains with a high ditchwater level of about 20 cm minus surface level reduces subsidence to less than 1 mm per year.

Results pilots with infiltration via submerged drains to conserve peat

The introduction of submerged drains raised questions about the impact on water quantity (water usage), water quality and costs and benefits for the farmer. Experiments in a series of pilots showed that: (1) water usage will increase due to increased seepage and more evapotranspiration by the grass because this is not limited by drought, (2) water quality will be improved, (3) N mineralization is halved, (4) nutrient efficiency is improved, (5) grass growth is about the same, however (5) grass yield is increased because losses by trampling are less, and (6) a longer grazing season, (7) investment is €1600 – € 2400 with an expected live time of 30 years. For dairy farmers profitability of installing submerged drains is too low at the moment, however, an attractive alternative instead of raising ditch water levels.

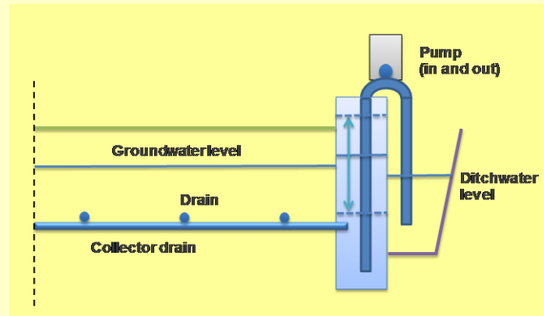
Monitoring subsidence 2004 – 2012 parcels Zegveld 3 and 13:



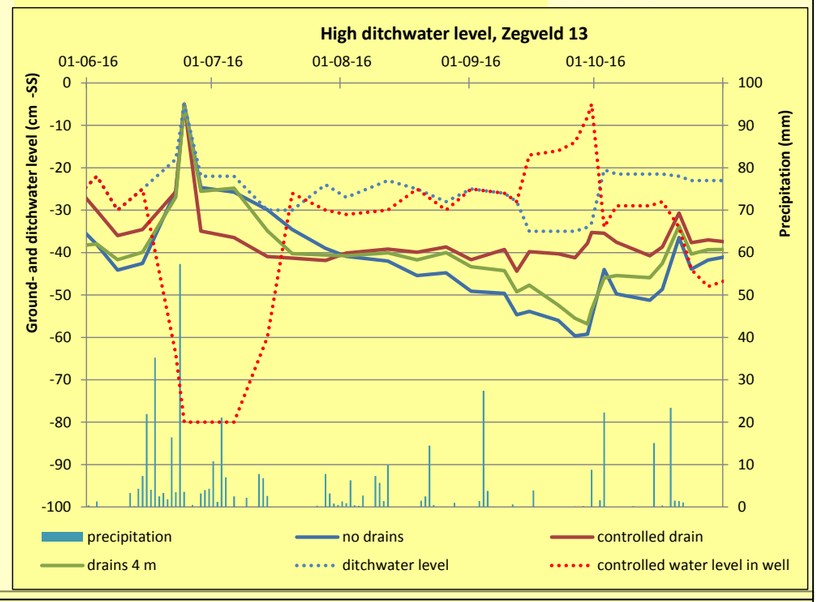


Improving the impact of submerged drains by controlled groundwater levels:

Experiments show that the effect of submerged drains can be improved by raising ditchwater levels in dry periods and lowering in wet periods. This was reason to start with controlled groundwater levels by pumping ditchwater in and out a well that is connected to a collector drain combined with submerged drains. Note: the drains are not connected to the ditch. The aim is to keep the groundwater level at a depth of about 40 cm. In that case subsidence and CO_2-emission become more or less zero. First results are promising.



Controlled groundwater level by pumping water in and out



Discussion and conclusions:

Measurements show that infiltration via submerged drains reduces subsidence and so CO_2-emissions with 50 – 70%. Also water quality and nutrient efficiency will improve. Dairy farmers are in general positive about installing submerged drains, however, their possibilities to invest in submerged drains is limited. Conservation of peat soils by installing submerged drains is very water efficient, however, water usage will be higher than in the 'business as usual' case. Additional raising and lowering ditchwater levels can improve the effect of the submerged drains considerably. First promising experiments are performed to control groundwater levels by pumping ditchwater in and out a system with submerged drains connected to a collector drain and a well. Considering that (1) no landuse change is needed, (2) dairy farmers are positive about this technique and (3) the costs expressed in cabon credits are about €10 - €20 per ton CO_2 it can be concluded that the use of submerged drains is a promising method to diminish CO_2-emissions and adapt agricultural peat lands to climate change

INFORMATION: Jan van den Akker, Wageningen Environmental Research, The Netherlands, Tel: +31317486519, e-mail: janjh.vandenakker@wur.nl

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