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Will Dutch water management strategies result in a transition of peatland use?

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Problem

Top-down raise in water levels → locked-in conflicts with farmers and inhabitants

Consensus possible on gradual raise of water levels → only gradual changes

Faster change with paludiculture and carbon credits? Which water management?

Image credit:
ANP, Remko de Waal


Image credit:
Groene Hart Werkt!

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Approach

Impact assessment of water management strategies, with timeframe 2020–2100:

(1) Traditional water level management:
levels 35–60 cm below soil surface,
levels adjusted for soil subsidence

(2) Levels not adjusted for soil subsidence
→ progressively higher water levels
relative to the soil surface

(3) Raised water levels:
levels 10–30 cm below soil surface,
levels not adjusted for soil subsidence

Regional projection of IPCC ’13 scenario with mid-century 2.0 °C temperature rise

Research area: Polder de Ronde Hoep,
an agricultural peatland polder
of 11.9 km² near Amsterdam

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Impact assessment

RE:PEAT template on the Tygron Geodesign Platform

Van Hardeveld et al. (2019) https://doi.org/10.1016/j.envsoft.2019.06.001

- Water levels, groundwater tables and soil subsidence assessed with a site-specific empirical regression, at 10-year intervals adjusted for temperature
  Van Hardeveld et al. (2017) https://doi.org/10.1016/j.eiar.2017.06.007
- CO_2 emissions derived from peat oxidation, CH_4 and N_2O emissions assessed with empirical regressions
  Van den Akker et al. (2008) http://edepot.wur.nl/159747
  Couwenberg et al. (2011) http://dx.doi.org/10.1007/s10750-011-0729-x
  Motelica-Wagenaar et al. (2020) https://doi.org/10.5194/piahs-382-635-2020
- Crop yield of grass assessed with Watervision Agriculture
  Hack-ten Broeke et al. (2016) https://doi.org/10.5194/soil-2-391-2016

Tygron Geodesign Platform
GPU-based: up to 100,000 tasks parallel
Calculation with 25m² resolution: 23 sec.

Impact assessment

Switch in land use when Net Value Added paludiculture > Net Value Added dairy farming

Net Value Added dairy farming: max. € 1,550 ha^{-1} y^{-1} (current market conditions)

- Income: (milk production × milk price) + CAP subsidy
- Costs: interest, depreciation, maintenance + ((cattle feed – crop yield) × feed price)

Net Value Added paludiculture (in general): max. € 650–1,550 ha^{-1} y^{-1}

- Income: crop yield × market price
- Costs: interest, depreciation, maintenance
- Upper boundary: biomass as building material
- Lower boundary: fodder crops as feed for cattle
- Estimation crop yield: optimal when groundwater table < 20 cm below surface

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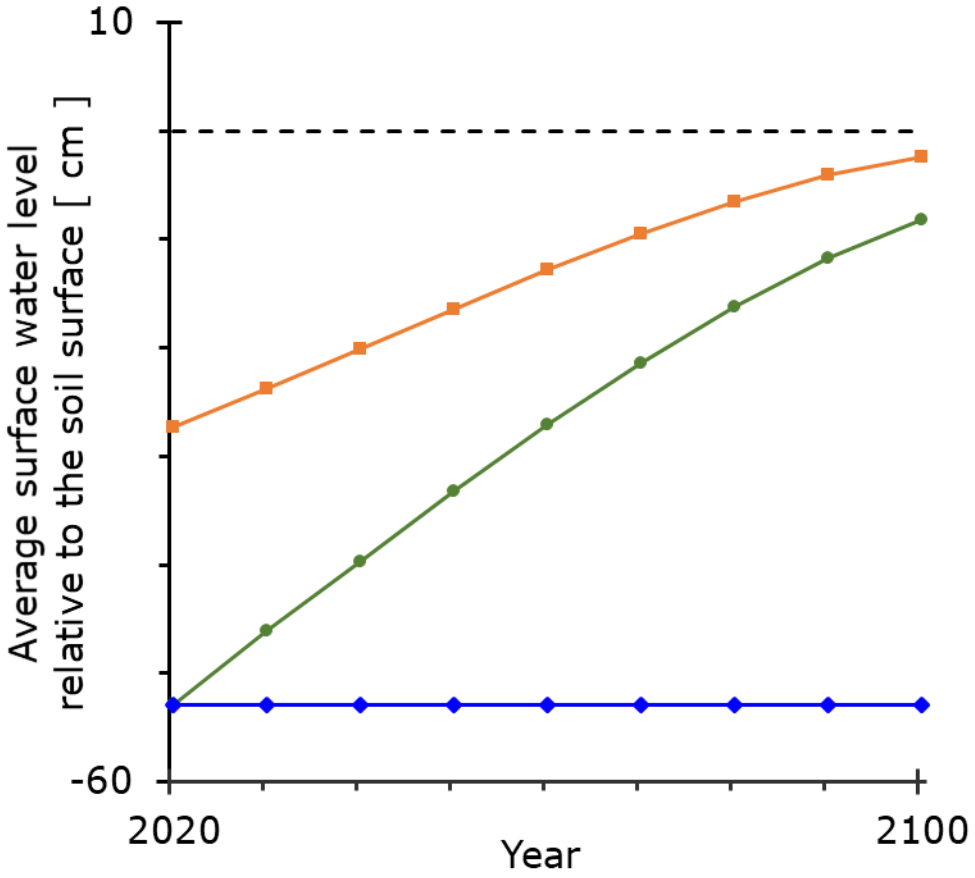
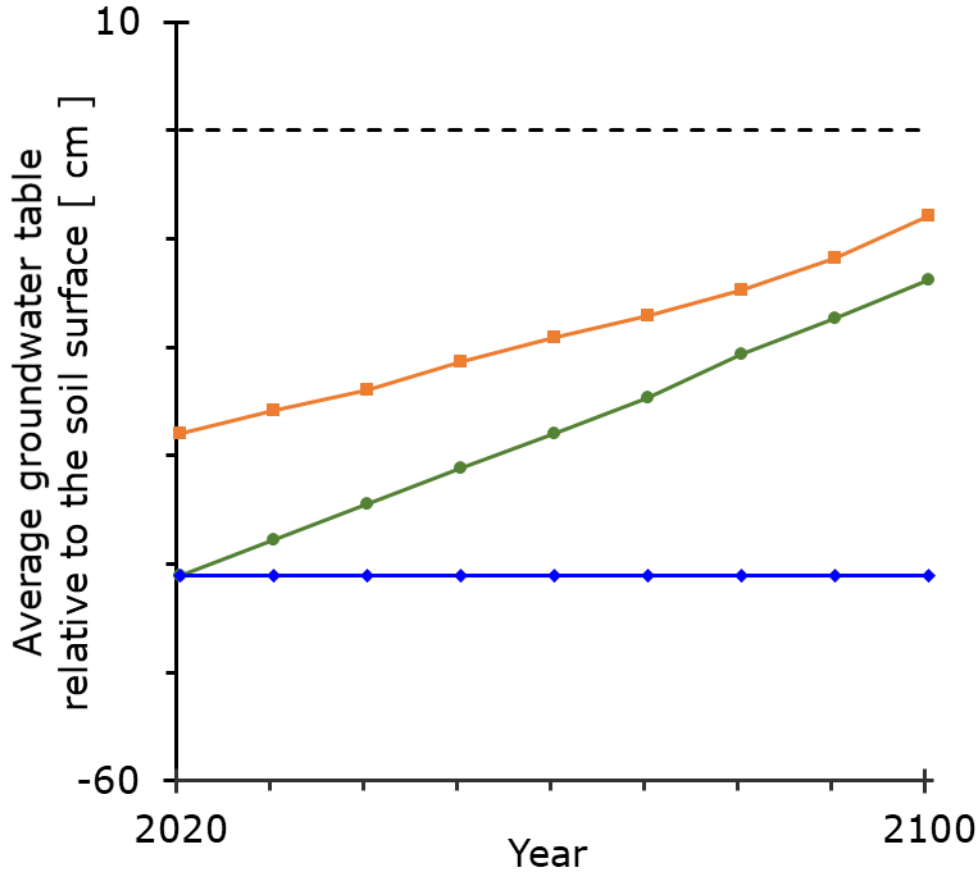
Results





(1) Traditional water level management
(2) Progressively higher water levels
(3) Raised water levels

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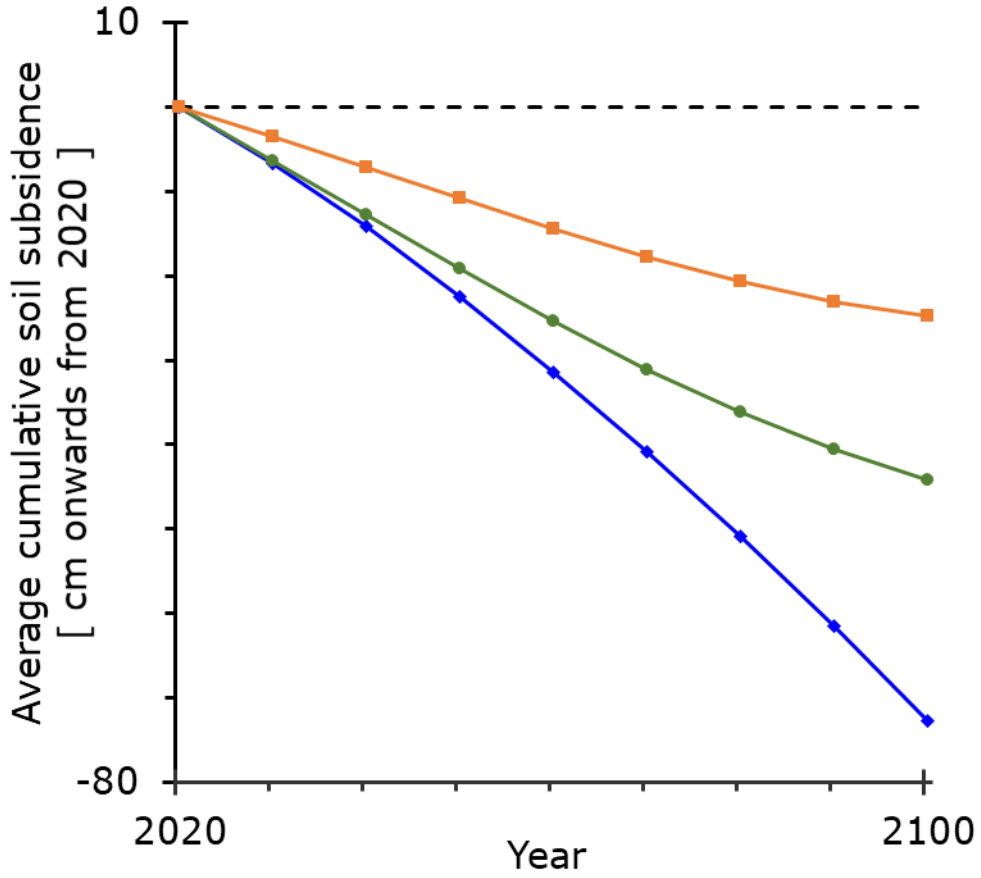
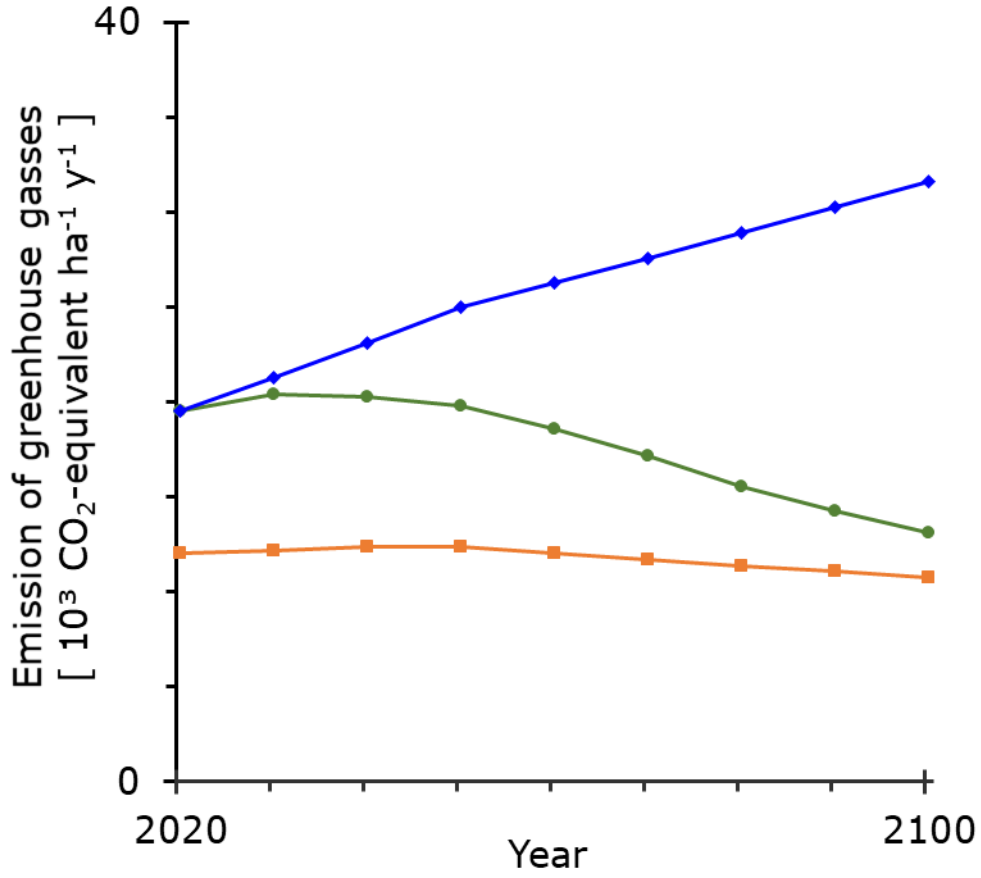
Results





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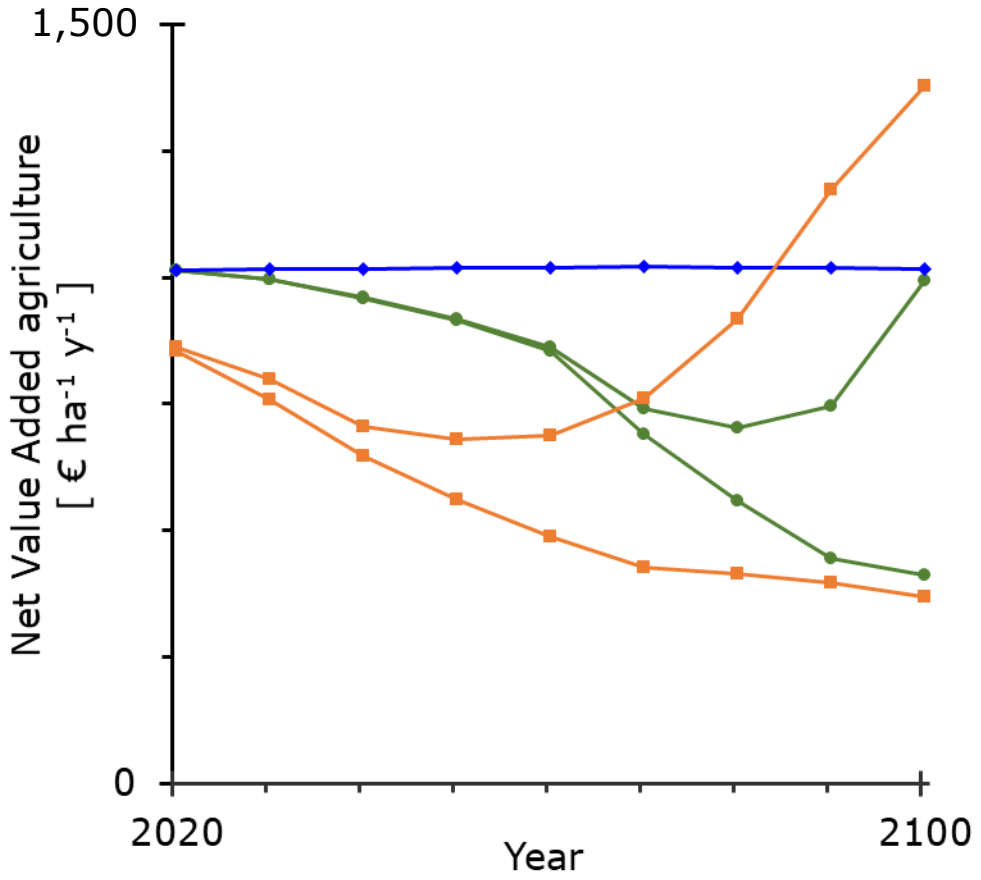

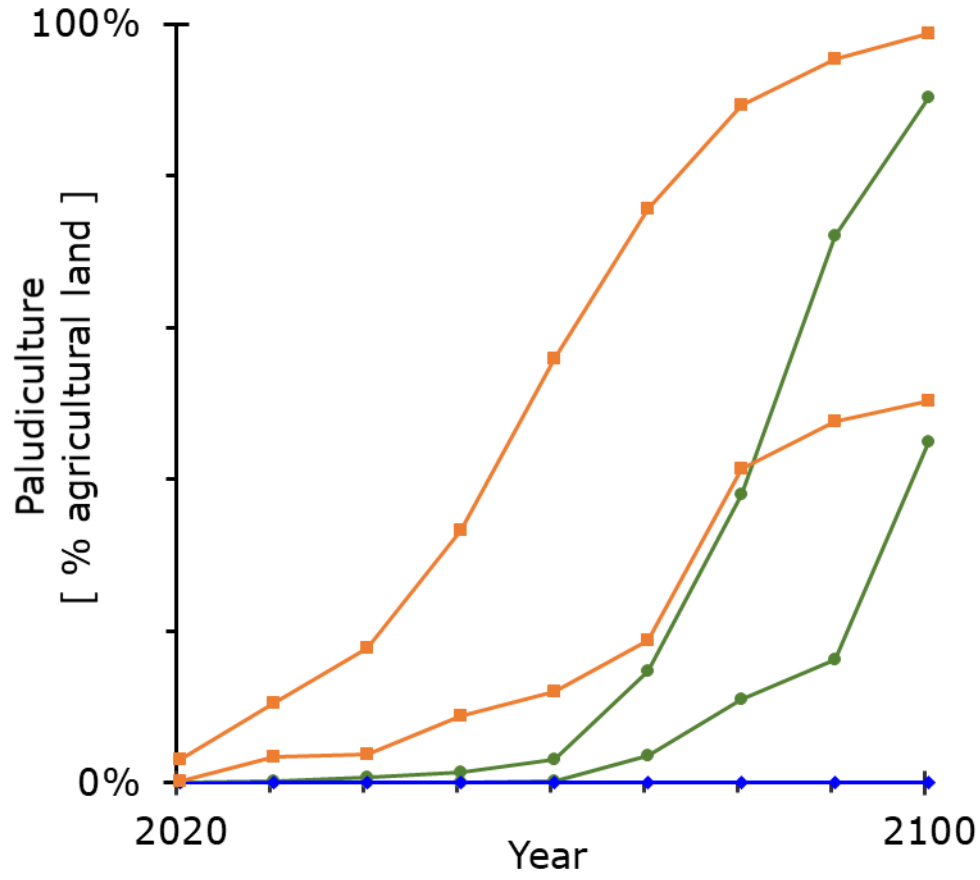

(1) Traditional water level management

(2) Progressively higher water levels

(3) Raised water levels

Conclusions

- A transition from dairy farming to paludiculture
  - will not occur with traditional water level management
  - will take the entire 21st century with progressively higher water levels
  - can be accelerated by raising water levels

- Price of carbon credits / 10^3 CO_2-eq. needed to redistribute costs and benefits:

Strategy		2020	2060	2100
Progressively higher water levels	Upper boundary	not an option	€170	€95
	Lower boundary	not an option	€180	€5
Raised water levels	Upper boundary	€20	€45	€0
	Lower boundary	€20	€70	€75

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What's next?

Suggestions for (collaborative) policy:

- Viable upper boundary: raise water levels enthusiastically, switch to paludiculture
- Viable lower boundary: raise water levels, combine paludiculture and dairy farming
- No short term viability: switch from traditional management to intermediate strategies
- Consider a broad(er) range of costs, benefits, and ecosystem services

Further research:

- Improved assessments, using new results of paludiculture and GHG research
- Impacts assessment of intermediate short term water management strategies
- Broader RE:PEAT template: habitat meadow birds and other biodiversity indicators
- RE:PEAT for the entire 1,800 km² "green heart" of the western part of the Netherlands


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Questions?
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