

Factors influencing impacts of drought on grass yields in Dutch dairy farms

Preliminary results of a statistical analysis

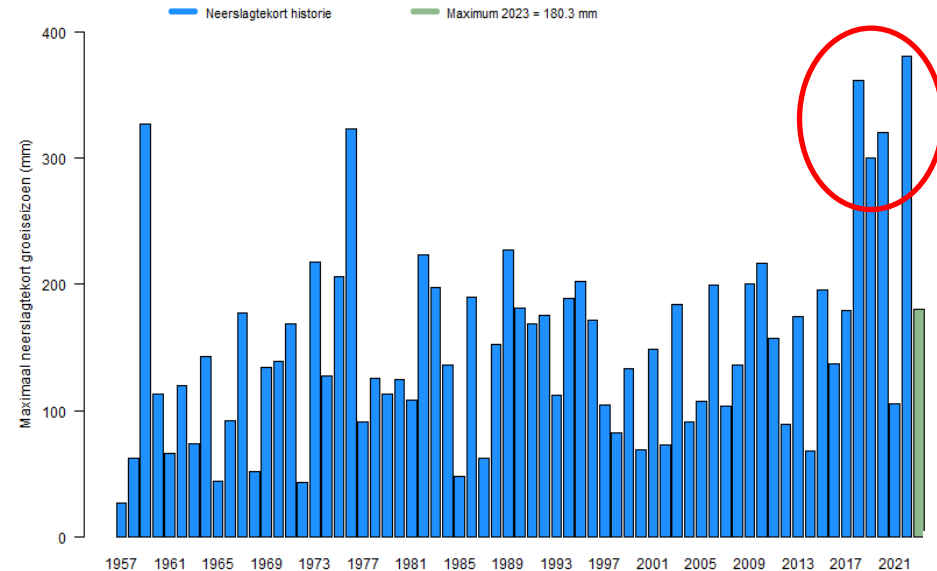
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Introduction

- Scenarios for climate change in the Netherlands
 - Increase in droughts
- Prolonged periods of drought in recent years
- Large reductions in grass yield on dairy farms
 - Impacts varied among farms

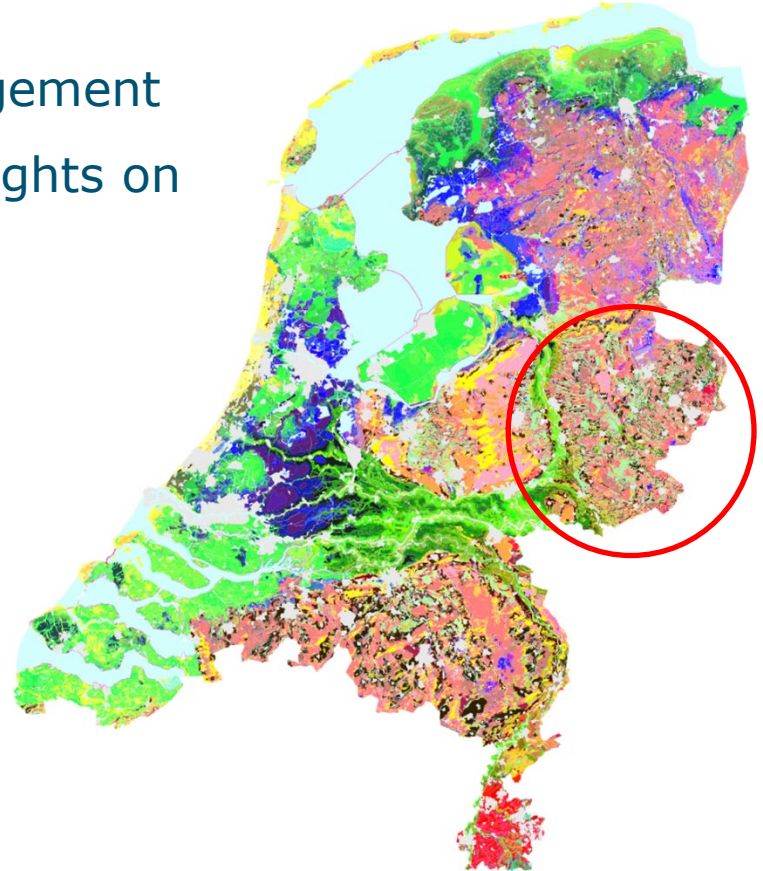


*Precipitation deficit in East Netherlands
1957-2022 (water board Rijn IJssel)*

Objective

Identify farm characteristics and management practices that influenced effects of droughts on grass yields of dairy farms

- Dairy farms in East Netherlands
- Mainly rainfed sandy soils
- Period: 2016-2021



Materials & methods

Survey of 165 dairy farms

- Group of 350 dairy farmers in East Netherlands ('VK-Oost')
- Survey in winter 2020/2021, n=165 respondents
- Questions about farm management practices in 2017-2021 (e.g. irrigation, grassland management)

Existing farm data (ANCA tool)

- Annual Nutrient Cycling Assessment (ANCA) tool
- Farm management and production
- Period 2016-2021
- After applying selection criteria: n=123 farms

Area-specific precipitation deficit

- Data on precipitation (n=19 nearest meteo stations)
- Data on evaporation (n=3 nearest meteo stations)
- Period: 2016-2021
- Area-specific precipitation deficit (cumulative March-Oct)

Calculation of grass yield in ANCA

- Grass yield calculated based on feed intake (Dutch 'BEX' method)
- Calculation of feed intake:
 - Energy requirements ('VEM') of the herd
 - Amount of purchased feed is known
 - Remainder is fresh grass and harvested grass and maize
- Grass yield calculated based on ratio of fresh grass (grazing time) and measured stocks of grass and maize (P used as a tracer)
- $\text{Grass yield} = (\text{grass}_{\text{fresh}} + \text{grass}_{\text{harvested}}) / \text{hectares of grassland}$

Statistical analysis

- Statistical analysis in Genstat 22.1
- 3 steps:

- 1 Model the farm-specific response to **net precipitation, soil type and irrigation**
 - Mixed model (REML), 717 **farm-year** combinations
 - Response variable: grass yield (kg DM/ha/y) (log-transformed)
 - Explanatory variables:
 - net precipitation per year / 100 (**NP_100**)
 - soil type (3 clusters: zand, clay, mixture)
 - share of grassland irrigated (irr) per year (irr_year)

Statical analysis - step 2 & 3

2

Identify variables explaining 'random farm effect'

- Linear model, $n=123$ farms
- Response variable: 'Random farm effect'
- 22 explanatory variables (farm management practices)
 - Pre-screening (1 term in model)
 - Screening (most promising variables, multiple terms)
 - Model selection (adjusted R^2)

3

Include selected explanatory variables in mixed model of Step 1.

Results – effect of prec deficit on grass yield

Response variate: eLOG(grass_yield)

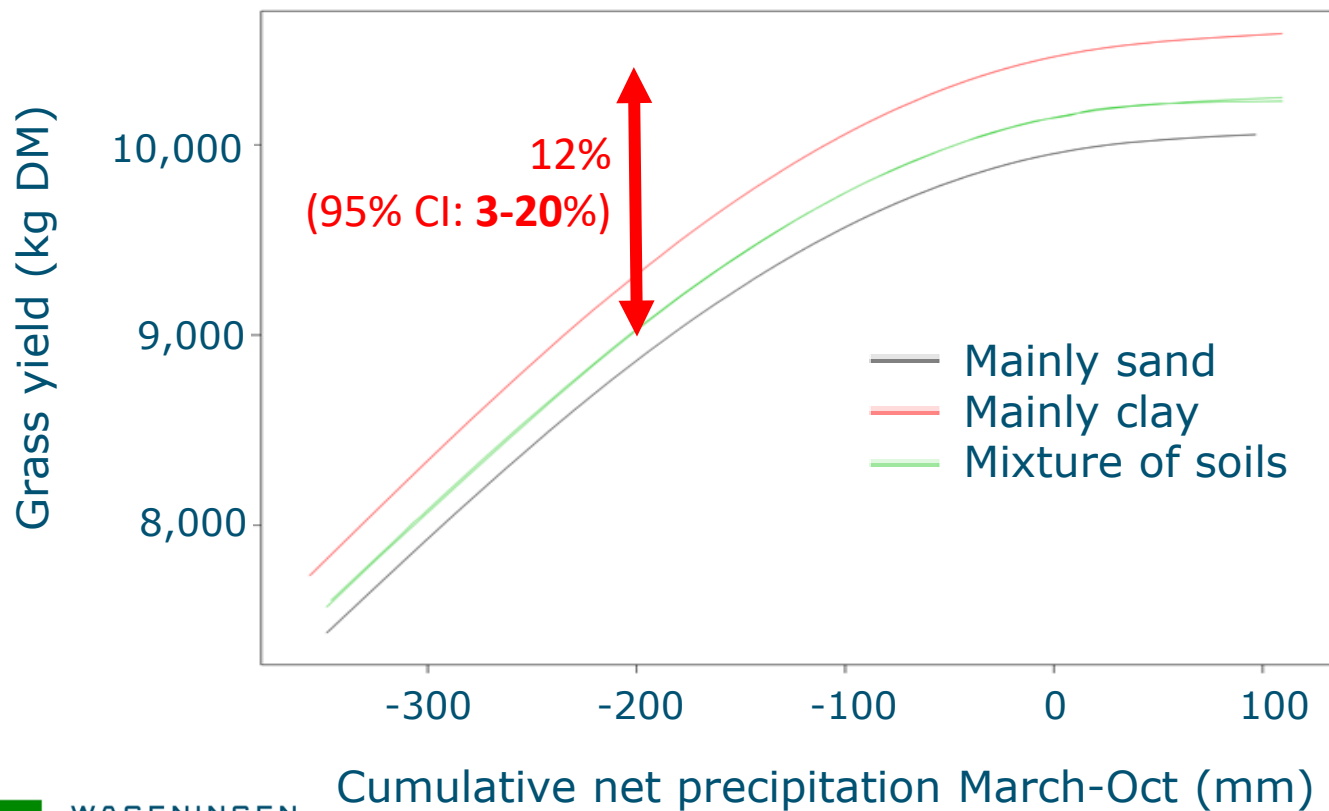
Random terms: year + farm + farm*NP_100 (NP_100=net precipitation/100)

Number of units: 716

Term	Effect	S.E.	F-pr
NP_100 x soil_type			N.S.
NP_100 x irr	-0.160	0.041	<0.001
NP_100_sq x irr	-0.022	0.0137	0.102
NP_100 x irr_year	-0.076	0.027	0.005
Constant (soil cluster 1)	9.204	0.045	

- No significant difference between soil types (except for intercept)
- Large effect of irrigation

Response of grass yield to precipitation deficit



*Not corrected
for irrigation*

Effect of irrigation

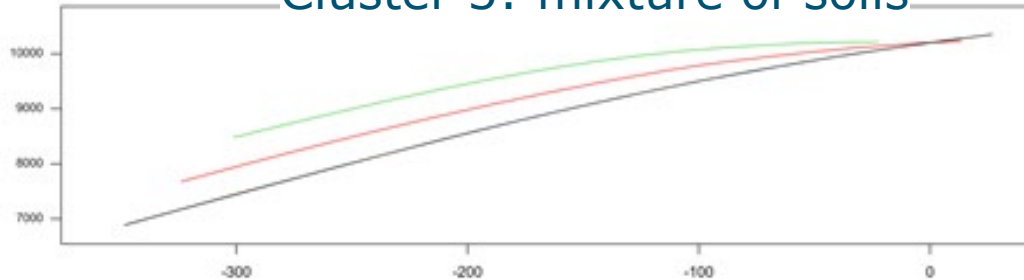
Cluster 1: mainly sand



Cluster 2: mainly clay



Cluster 3: mixture of soils



Share of grassland irrigated

- No irrigation
- 20% irrigated
- 40% irrigated

Explanatory variables screened in step 2

- Farm intensity (kg milk/ha)
- Share of permanent grassland (%)
- Share of grassland with clover (%), clover/grass balance (%)
- Slurry application rate (kg N/ha and m³/ha)
 - Synthetic fertilizer application (kg N/ha)
 - Grazing (kg N/ha)
 - Organic matter inputs to soil (effective organic matter) (kg/ha)
- Water management practices (e.g. dams in waterways, drainage of soils)
- Grassland management practices (e.g. herbal leys, no slurry injection and no grazing during dry or hot periods)

Results - final model

Response variate: eLOG(grass_yield)
Random terms: year + farm + farm*NP_100
Number of units: 716

Terms	Effect	S.E.	F-pr
NP_100_sq	-0.026	0.006	<0.001
NP_100 x irr (% area)	-0.102	0.018	<0.001
NP_100 x irr_year (% area)	-0.064	0.027	0.002
NP_100 x slurry (kg N/ha)	-0.076	0.027	<0.001
NP_100 x gr_clover (>20% vs. 0%)	-0.034	0.013	0.038
NP_100 x drainage (y/n)	0.022	0.011	0.052
NP_100 x good_pract ¹ (y/n)	0.025	0.010	0.038
Constant	9.230	0.040	

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Conclusions

- Large variation in the impacts of drought on grass yields in dairy farms in East Netherlands in 2016-2021
- Irrigation strongly reduced effects of droughts on grass yields
- Practices increasing yields in a 'normal' year (slurry application, good practice) may be less effective in dry years
- Further explore grass-clover and no drainage as adaptation measures when irrigation is not possible
- Small observational study - causality uncertain, further research needed to confirm hypotheses

Thank you!

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