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Farming in high water table areas

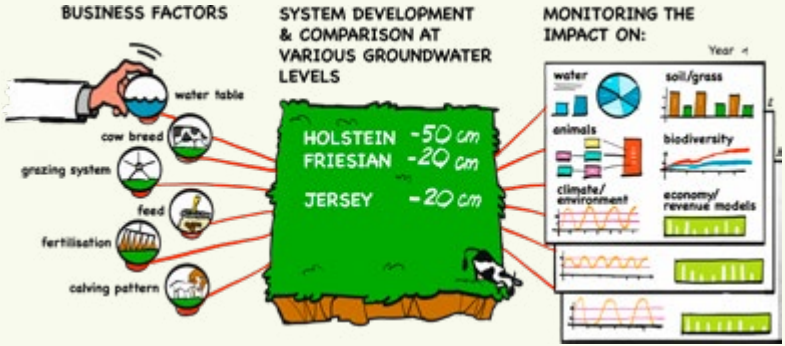
Design choices and rationale

The ‘Living Lab’ under the microscope

Set-up of ‘Living Lab’ Farming in high water table areas

The *High water table farm (Hoogwaterboerderij)* of the Knowledge Transfer Centre (KTC) at Zegveld is the ‘Living Lab’ for the programme ‘Farming in high water table areas’ of the Veenweiden Innovatiecentrum (VIC). It is intended to study what a high groundwater level (i.e. 20 cm below surface level) means for a peatland dairy farm, in practice. For the study, three farming systems have been implemented on the one farm. This brochure zooms in on farm management and the design and management choices that were made for the purpose of the study.

3 in 1



The starting point (baseline) is a dairy farm representative of those on the western peatlands, which means it has a standard cubicle shed, a pasture, an average polder groundwater level, Holstein Friesian cattle, an automatic milking system (robotic milking) and standard agricultural mechanisation. The other two farming systems make use of the same setup, but have a high water table, each with a different breed of cow (Holstein Friesian and Jersey, respectively).

The overview below shows the 3 farming systems, side by side

	HF - High water table	Jersey - High water table	HF Reference
Number of cows	22	29	44
Hectares	11.23 ha	11.23 ha	22.4 ha
Area accessible for grazing in ha	7.3	7.88	15.4
Cows per hectare	1.96	2.58	1.96
Milking system	Robot 2		Robot 1
Grazing system	Continuous rotational grazing	Continuous rotational grazing	Continuous rotational grazing
Ration	Fresh grass and/or grass silage		
Concentrate/ha	4000	4000	4000
Artificial fertiliser kg N/ha	80	80	80
Manure pit	Pit 2		Pit 1

Water management

The groundwater level is managed using a pressurised water infiltration system (pressure drain). The plots with a high water table contain infiltration pipes, every 6 metres, connected to a central supply and discharging pipe located around 70 cm below surface level. The main pipes are connected via supply pipes to a water basin. Using watermills and pumps, these basins can be filled to surface level to create water pressure. To avoid losing water pressure to the ditches, these have also been established at a high groundwater level (in the summer, on average, 25 cm below surface level). The baseline plots have no infiltration system and ditches at the regular polder level of 40–50 cm below surface level (similar to general peatland practice).

Average groundwater levels per system, 2021, incl. precipitation

Dairy cattle

Two breeds: Holstein Friesian and Jersey

To determine which breed of cow will deliver the greatest yield in a high water table area, we are comparing two different cow breeds (Holstein Friesian and Jersey). For these areas, the higher groundwater level is expected to affect the production level, quality and harvestability of the grass.

Together with the impact of grass trampling and the land's carrying capacity, these factors may affect milk production and animal welfare and, therefore, will also have an impact on business result.

The comparison does not include the rearing of young cattle.

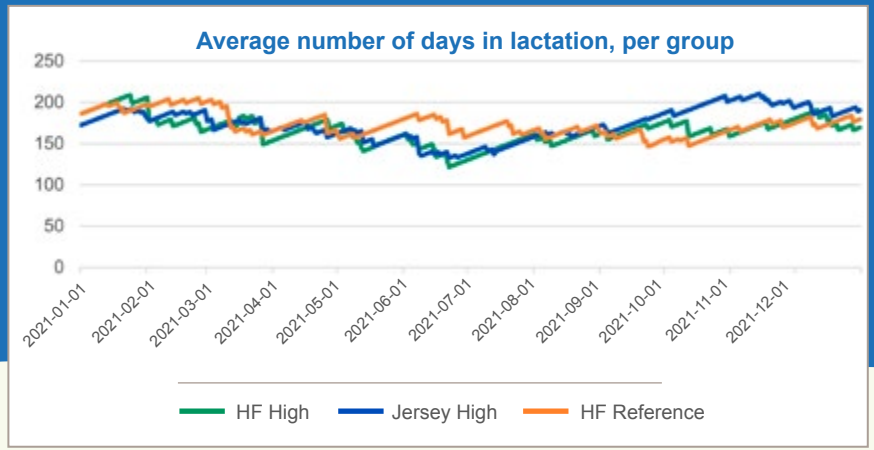
Number of cows

The number of cows is attuned to the expected yield from the land. To determine the cattle ratio, metabolic weight — a measure to compare different sizes of cows — is considered. Fore each breed, these have been kept the same per hectare, as much as possible. Since a Jersey cow is smaller and lighter, this means more Jerseys than Holstein Friesians per hectare. The aim is for the farm to be self-sufficient with respect to roughage, in an average fruitful year.

	High water table; groundwater 20 cm below surface level		**Baseline** (no infiltration)
Measured results 2021	**HF - High**	**J - High**	**HF - Reference**
Number of cows	22.11	29.46	43.49
Hectares	11.23 ha	11.23 ha	22.4 ha
Average BCS/animal	2.59	2.6	2.66
Average weight/animal	599 kg	422 kg	614 kg
Total body weight/ha	1208 kg	1107 kg	1164 kg

Dairy cow–calf separation pattern

The *High water table farm* currently has a spread-out calving pattern; the aim is to move the calving patterns more towards the spring (most but not all cows calve in the spring). The cows are inseminated sixty days after the separation.



Animal care

Animal care is like the care provided on any other farm. Milk samples are taken each month to assess milk quality and content. A veterinarian visits every month to assess and discuss all common issues related to animal health and fertility (e.g. pregnancy). Due to the wetter conditions, additional attention is paid to Fasciolosis, a parasitic infection, feet diseases and nutrition-related disorders, such as milk fever.

Milking system

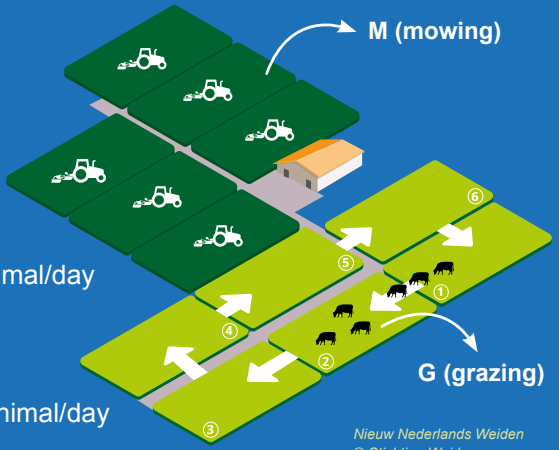
The cows are milked using an automatic milking system (AMS) — a modern, animal-friendly milking system with attention to the individual cows. On the practical side, the fully separate milking of the cows on high water and low water plots is an added advantage. In addition, it also saves labour. The cows pass the milking robot an average 2.4 times per day.

Grazing system

Number of grazing hours/ha, based on intensity

HF = 21 hours grazing per hectare
22 cows : farm of 7.3 hectares x 7 hours of grazing/animal/day

Jersey = 26.5 hours grazing per hectare
30 cows : farm of 7.88 hectares x 7 hours of grazing/animal/day



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The formation of a dense sod is essential for the carrying capacity of peatland, which is why a continuous rotational grazing system was chosen. This means that, each day, the cows move to a fresh pasture. The rotation is completed after 5 days, after which it starts again. This grazing system provides the best balance between grass quality, sod formation, ease of work and yield. Moreover, many farmers are familiar with this system.

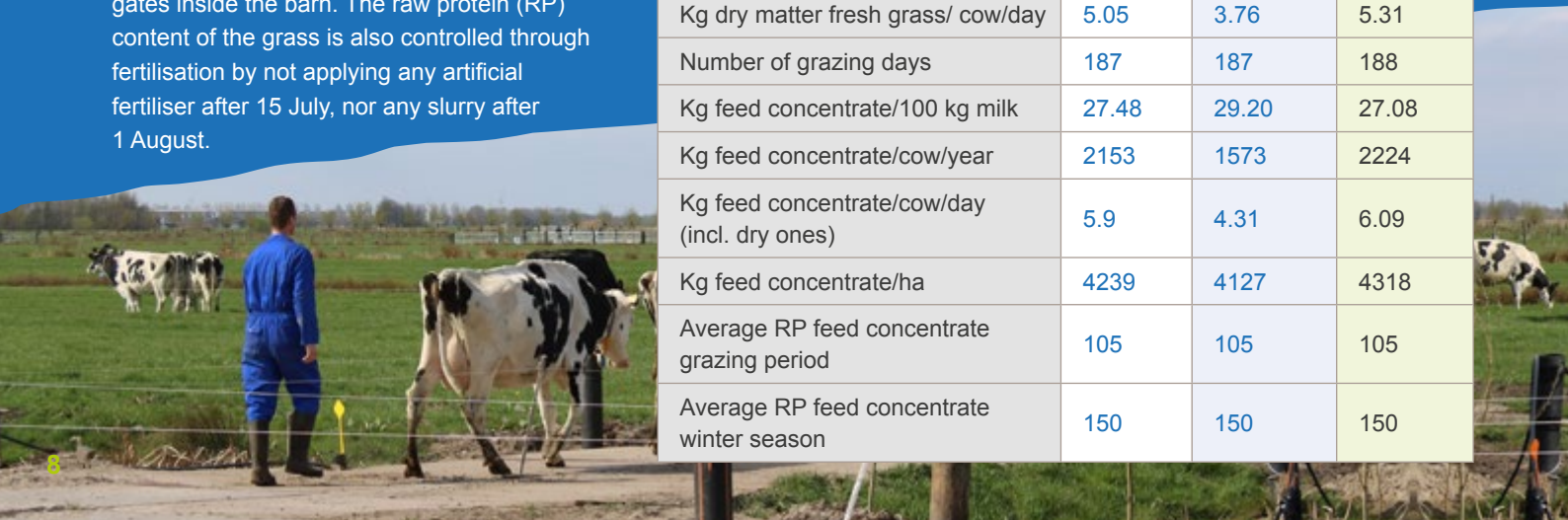
The supplementary feed is adjusted to the available grass supply on the land; if the supply is ample, the cows stay outdoors from early in the morning until late in the evening; if there is less supply, grazing hours can be shortened. There are 11 or 12 grazing plots per system. In autumn, almost all plots are used for grazing, whereas, in the spring and summer, between 5 and 7 plots are used. In the spring, grazing starts as soon as the carrying capacity allows it and continues until it no longer does. In practice, this is from early April to October. At night, the cows are in the tie stall.

Feed and milk production

The dairy cows are fed fresh grazed grass, grass silage and feed concentrate. The aim is for rations to contain 160 grams of raw protein (RP) to limit the amount of ammonia emissions. The available supply of fresh grass is the basis and determines any amount of supplemented feed. The feed concentrate is provided according to a spring, summer and autumn/winter scheme.

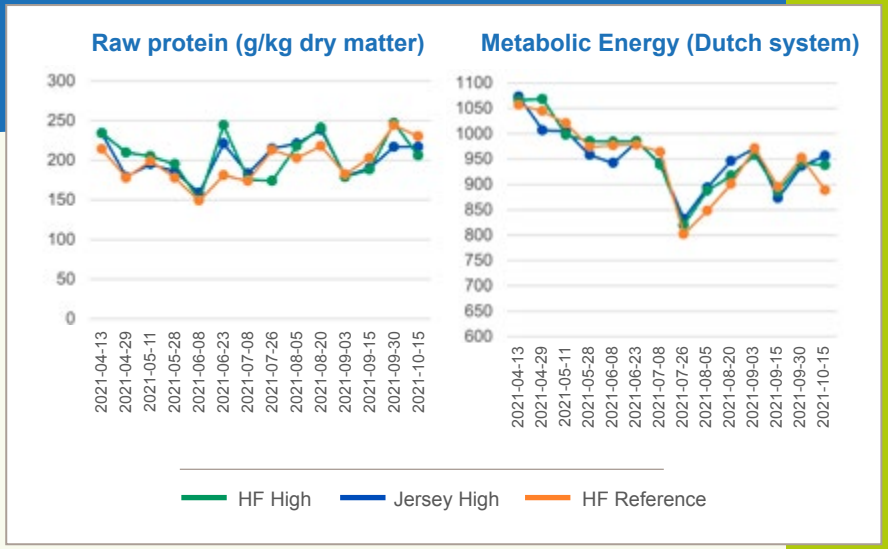
To feed the groups separately, a modified routing has been developed using selection gates inside the barn. The raw protein (RP) content of the grass is also controlled through fertilisation by not applying any artificial fertiliser after 15 July, nor any slurry after 1 August.

Measured results 2021	HF - H	J - H	HF - R
Number of cows (incl. dry ones)	22.11	29.46	43.49
Kg milk/cow	7835	5388	8211
Fat %	4.25	5.65	4.23
Protein %	3.54	4.15	3.48
Average milk urea	20.7	23.4	20.4
Kg fat and protein/cow	610.3	528	633.1
Kg fat and protein/ha	1203.8	1385.1	1229.2
€ milk yield/ha	€4858.13	€5396.78	€4958.58
Feed			
Kg dry matter fresh grass/ cow/day	5.05	3.76	5.31
Number of grazing days	187	187	188
Kg feed concentrate/100 kg milk	27.48	29.20	27.08
Kg feed concentrate/cow/year	2153	1573	2224
Kg feed concentrate/cow/day (incl. dry ones)	5.9	4.31	6.09
Kg feed concentrate/ha	4239	4127	4318
Average RP feed concentrate grazing period	105	105	105
Average RP feed concentrate winter season	150	150	150



Feed harvesting

All grass silage is baled. This makes it easy to keep the feed of the various groups separate. Moreover, for the small groups, bales offer better opportunities to combine the roughage from the farm's own land and thus assemble well-balanced, roughage-based rations.



Mowing

The farm mows the trial plots itself, but mowing, baling and fertilising of the larger plots is largely outsourced to a contractor.

Pasture management

The plots contain grasses and herbaceous crops, which are grazed and mowed for permanent pasture. For the purpose of research (i.e. pasture development and biodiversity research), there is no reseeding of the plots, and weed control is applied, locally, only if absolutely necessary (mainly against bitter dock and thistles).

Fertilisation

The farm's own manure is used, without added supply or disposal. The various farming systems are fertilised in the same way, using watered-down slurry at a 1:2 ratio (one part water, two parts manure). Initial analysis of fertilisation and harvesting showed that nitrogen (N) application from 80 kg fertiliser could work out to 160–170 RP in the farm's own grass. This is sufficient for a grassland farm. The N artificial fertiliser dosage, therefore, was set at 80 kg N in the form of calcium ammonium nitrate (CAN). The fertiliser applications are kept at an equal level between the various farm systems.

Results 2021	**HF - H**	**J - H**	**HF - R**
Slurry	High water fertilisation		Own fertilisation
Application	Trailing shoe with 1/3 to 1/2 water		
Artificial fertiliser kg/ha	71	70	73
Kg dry matter yield (acc. to Integral Nutrient Cycle Assessment tool))	10691	9457	10798
Cumulative measured grass growth pasture plots	10600	10700	11500
Gross yield trial plots on the farm	13000	11500	11700
Gross yield trial plots on the field plot	12600	14000	14900
Average VEM pasture plots	955	951	948
Average raw protein (RP) pasture plots	205	203	198

Nutrient cycle indicator

Results 2021	HF - H	J - H	HF - R
N soil surplus/ha incl. mineralisation	296	326	289
P2O5 soil surplus/ha	-21	-6	-12
N feed utilisation	25%	27%	24%
N soil utilisation	50%	45%	53%
NH_3 per dairy cow unit in kg	24	18	28
NH_3 per ha in kg	48	46	55
Proteins from own land	66%	69%	71%
Permanent grassland	100%	100%	100%
Grams CO_2 eq /kg PFCM, in grams incl. meat production*	1603	1495	1510
Grams CO_2 /kg PFCM*	1499	1333	1398
Kg CO_2 emissions/ha dairy cattle*	24195,1	23828,3	23101,3

** CO_2 figures excluding greenhouse gas emissions related to soil subsidence.*

Practice & Research

The 'Living Lab' is in search of answers to research questions about the effect of high groundwater levels on greenhouse gas emissions, soil, grass quality and quantity, animal health and biodiversity. What do these effects mean for the business case of the dairy farm, and what are the possibilities and impossibilities of the water system in realising a high water table?

Enablers

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VIPNL

Executing parties

VEENWEIDEN INNOVATIECENTRUM ZEGVELD

KENNIS TRANSFER CENTRUM Zegveld

PPP AGRO ADVIES

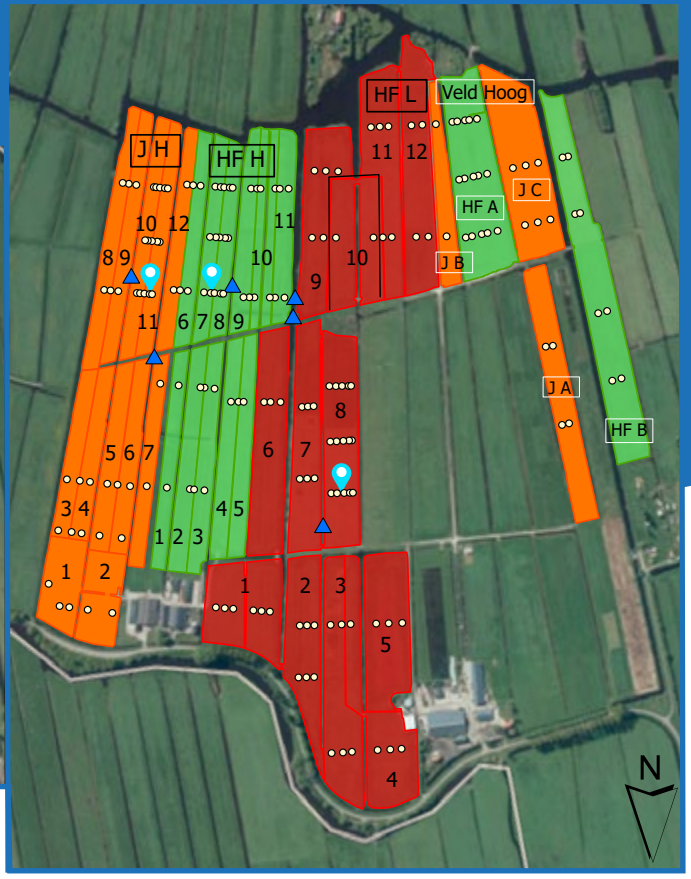
WAGENINGEN UNIVERSITY & RESEARCH

Louis Bolk Instituut

Overview of the plots of the High water table farm — what happens where?

- Groundwater measuring points (manual)
- Location of water quality measuring points
- Location of ground-water measuring points (continuous)
- HF regular groundwater level
- HF high water table (± 20 cm above surface level)
- Jersey high water table (± 20 cm above surface level)

Field plot



Farm plot

Oude Meije 18, Zegveld