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Assessment of the impacts of grazing dairy cattle on different ecological compartments:

a case study in the Netherlands

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Introduction

The Netherlands is the 5th smallest state in the European Union but the second largest exporter of agricultural products worldwide. Intensive agricultural activity has many negative impacts :

- Loss of biodiversity;
- Degradation of the soil potential
- Eutrophication of the aquatic ecosystem
- ...

The present study seeks to evaluate the impacts of grazing 80 dairy cattle in organic agriculture on (i) water quality by evaluating N and P discharges, (ii) on soils by comparing the organic matter rate, i.e., indirectly the carbon rate, between grassland and crop fields and (iii) the causal links between grazing management and water conductivity, which is strongly correlated to the [N03⁻].

Materials and methods

Two submerged probes at a depth of 1m50 are positioned upstream and downstream in a ditch with a dimension of 2Hx4lx650Lm (figure 1). The concentration of nitrate and phosphate were measured in a lab.



Fig 1. Spatial distribution of grazing plots on the Aeres farm.

Soil samples were taken randomly on the first 10cm layer, following the repartition : n=6 in grassland (plots A and B); n=6 in crop fields. Each samples weights approximately 10g. They were heated at 105°C, weighed, then incinerated into a furnace at 600°C for 2h and weighed again. SOM is given by the following equation :

$$\%SOM = \frac{(wt. at 105^{\circ}C) - (wt. at 600^{\circ}C)}{wt. at 105^{\circ}C} * 100$$

Results and discussion

[N03⁻]

- Almost every time lower than the threshold (<2.4mg/l)
- Two peaks of [N03⁻] during August (4mg/l) and February 2022 (7.3mg/l).

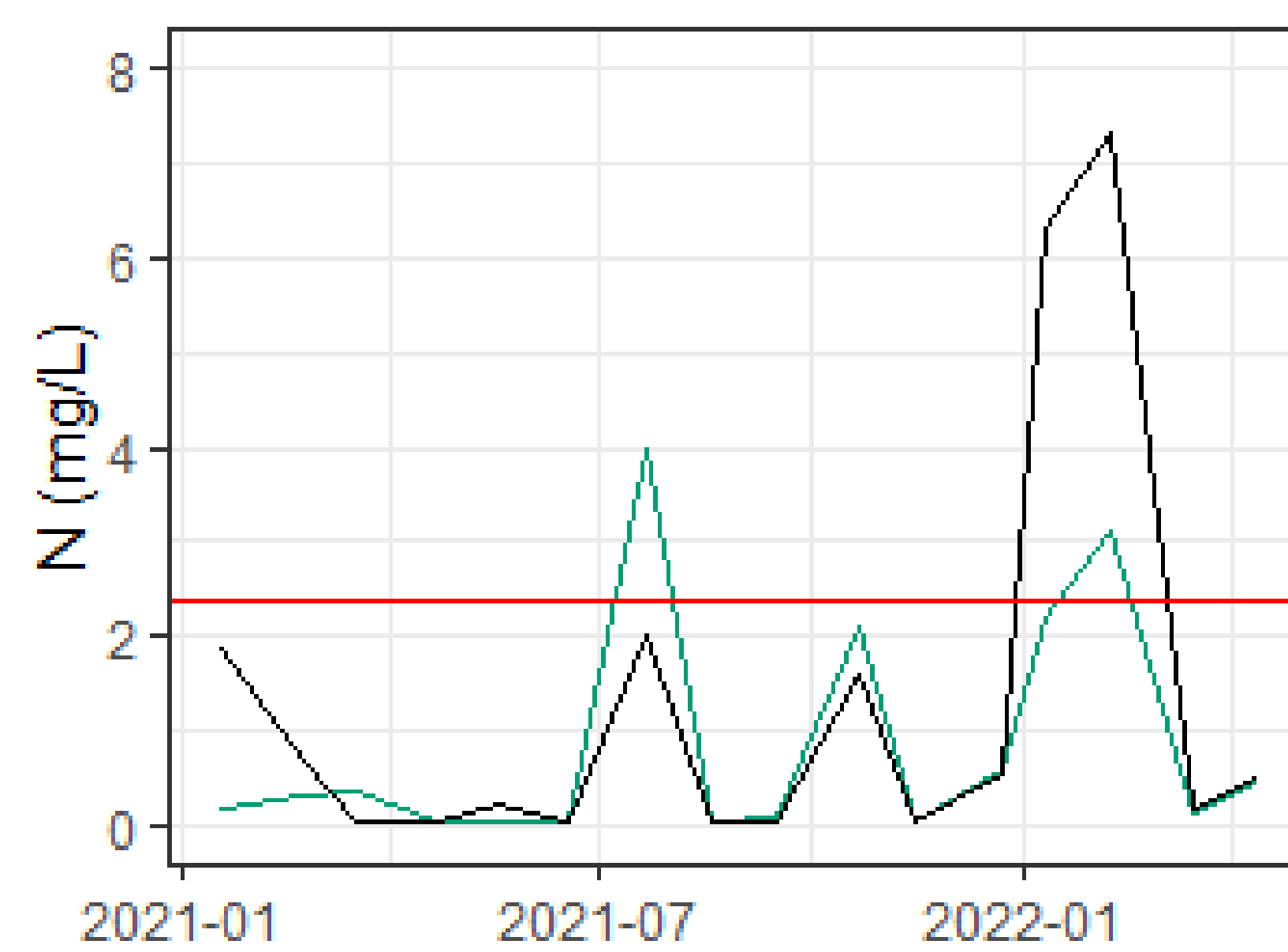


Fig 2a. Nitrate concentration on water. Red line is the threshold.

[PO₄³⁻]

- Concentration is largely higher than the reference threshold (>0.22mg/l).
- Maximum value is reached in august upstream (1.90mg/l)
- Helophytes plants seems to cleaned up the water from phosphate.

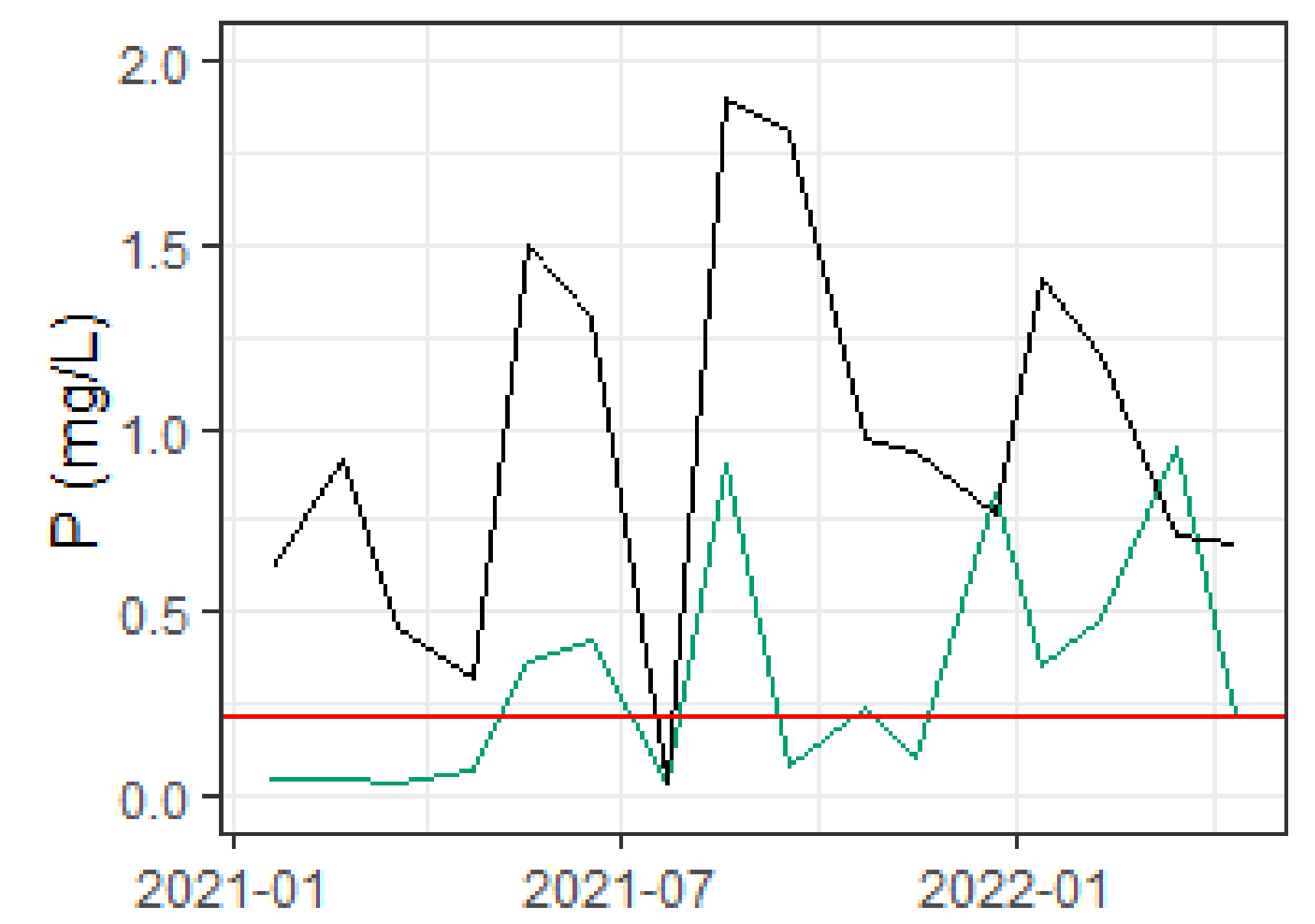


Fig 2b. Phosphate concentration on water. Red line is the threshold.

Significant negative correlation has been found between the stocking rate and the average water conductivity ($z = -4.0871$, $p\text{-value} = 4.367e-05$). No significant correlation has been found between the grazing time and the average water conductivity ($z = -1.0205$, $p\text{-value} = 0.3075$). Optimization of grass growth allows to reduce emissions into water compartment.

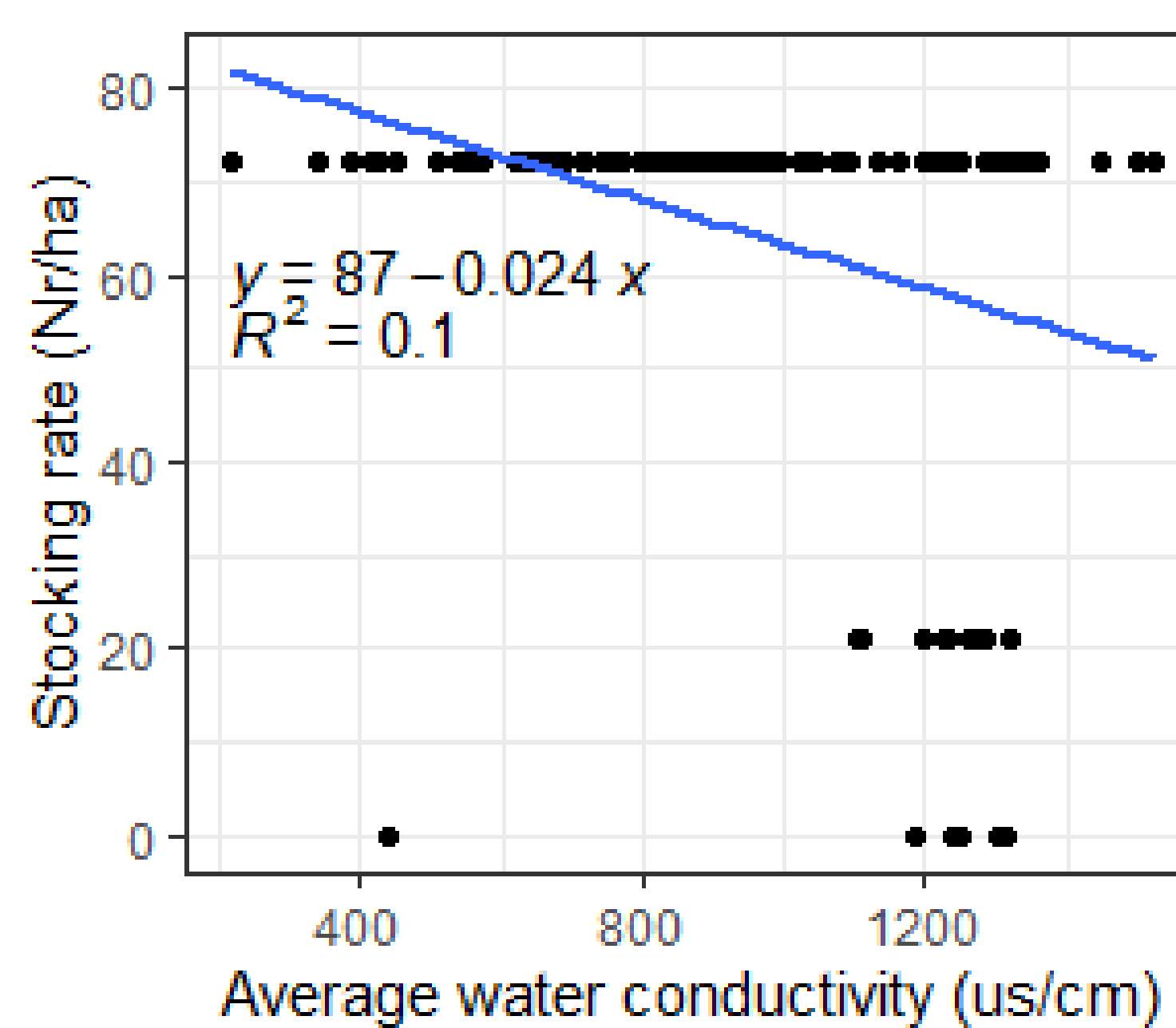


Fig 3a. Linear regression between stocking rate and the average water conductivity (us/cm).

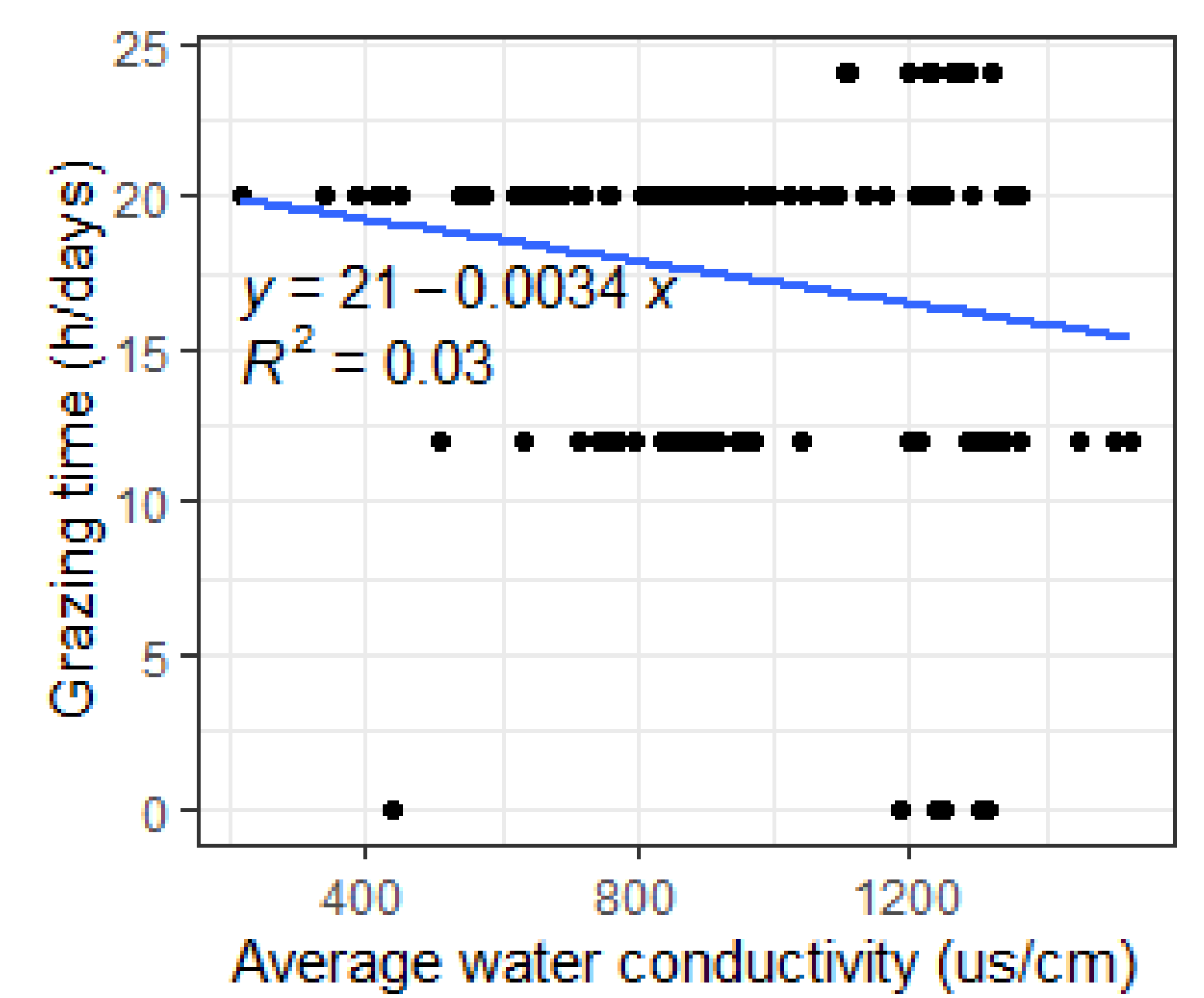


Fig 3b. Linear regression between grazing time and the average water conductivity (us/cm).

- SOM crop fields is higher than the grasslands SOM
- No significant difference (Wilcoxon test, ($V = 54$, $p\text{-value} = 0.2661$).
- Analysis method can be the explanation of the results, as the C:N ratio can be or the soil structure.

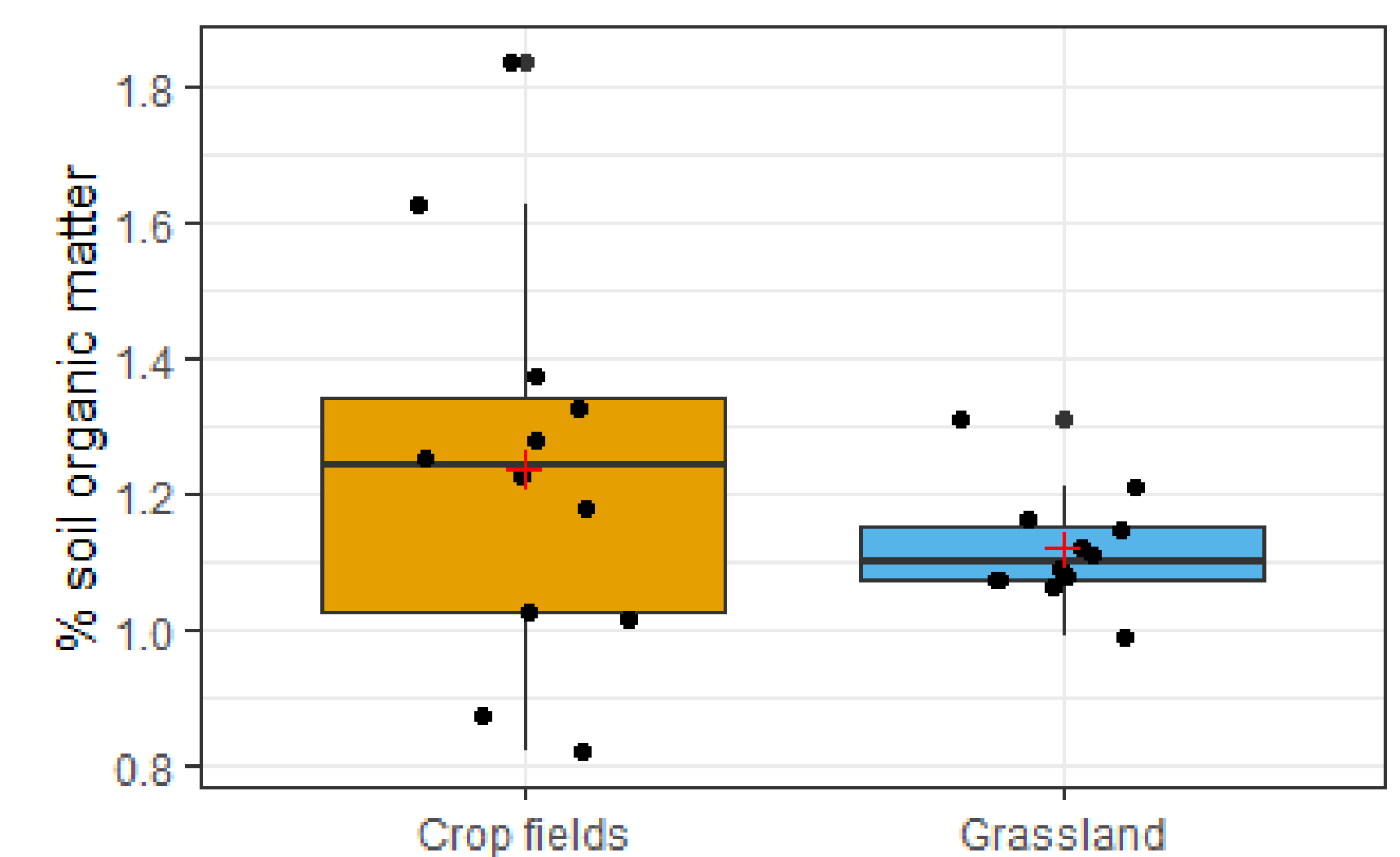


Fig 4. Distribution of data between field crops and grasslands. For each group, n=6. Red crosses represent the mean.

Conclusions

- ✓ There is no pollution caused by dairy cattle thanks to the strip grazing system
- ✓ There is no significant difference between grassland and crop fields probably due to the used method or the intrinsic characteristics of soils.
- ✓ Helophyte ditch cleaned the water, notably the phosphate

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