

# WP3.2 – Formation and fate of micropollutant transformation products in subsurface water systems

Alessia Ore  
alessia.ore@wur.nl



## Research objective

**Micropollutants (MPs)** affect the quality of the freshwater sources. Once in the environment, MPs can undergo biodegradation, in which they are transformed by microorganisms into **transformation products (TPs)**. TPs can be more persistent, mobile, or toxic than the **parent compounds (PCs)**, and still, not much is known about their fate and formation. This research studies how different environmental parameters (Fig 1) affect TPs formation in subsurface water systems. Lab experiments are performed to study the interconnection of microbial diversity and redox conditions with TPs. Field studies are included to compare lab observation with real conditions.

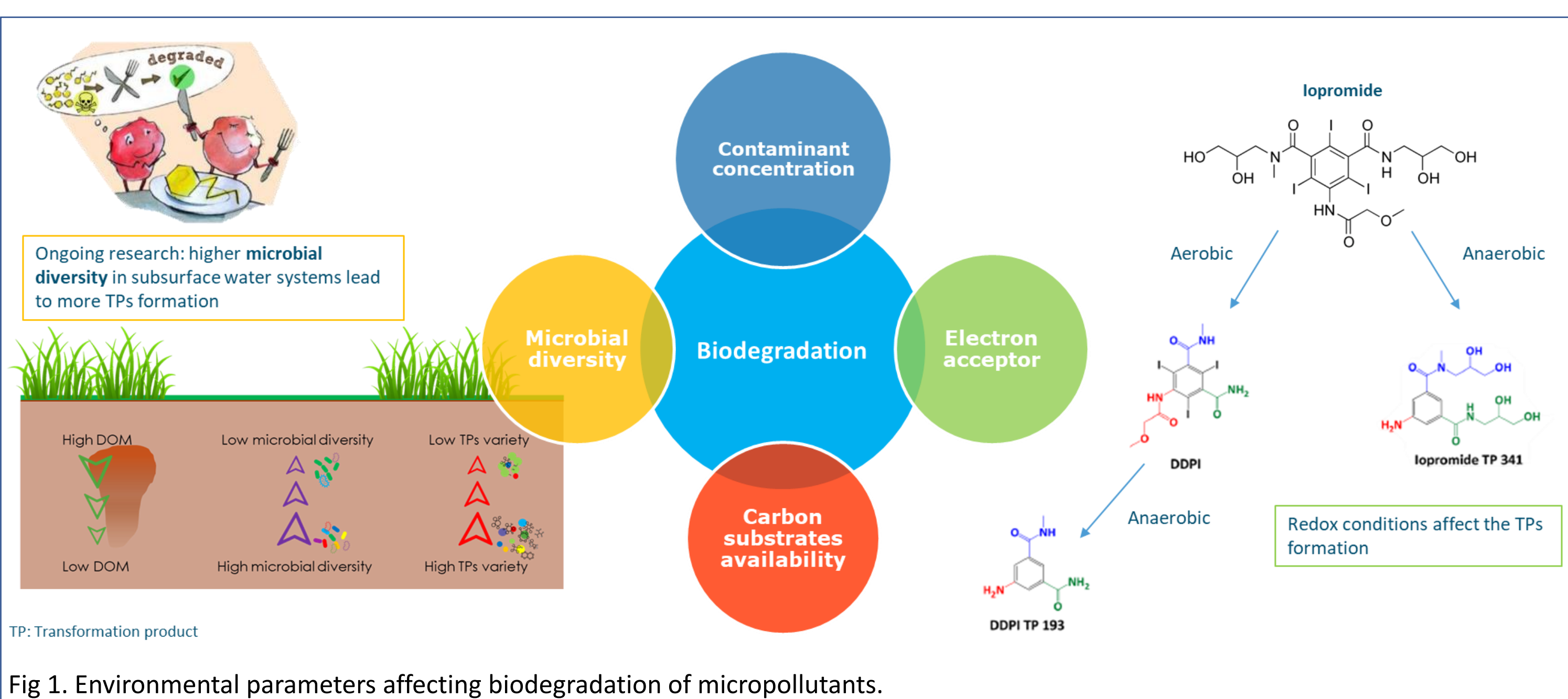
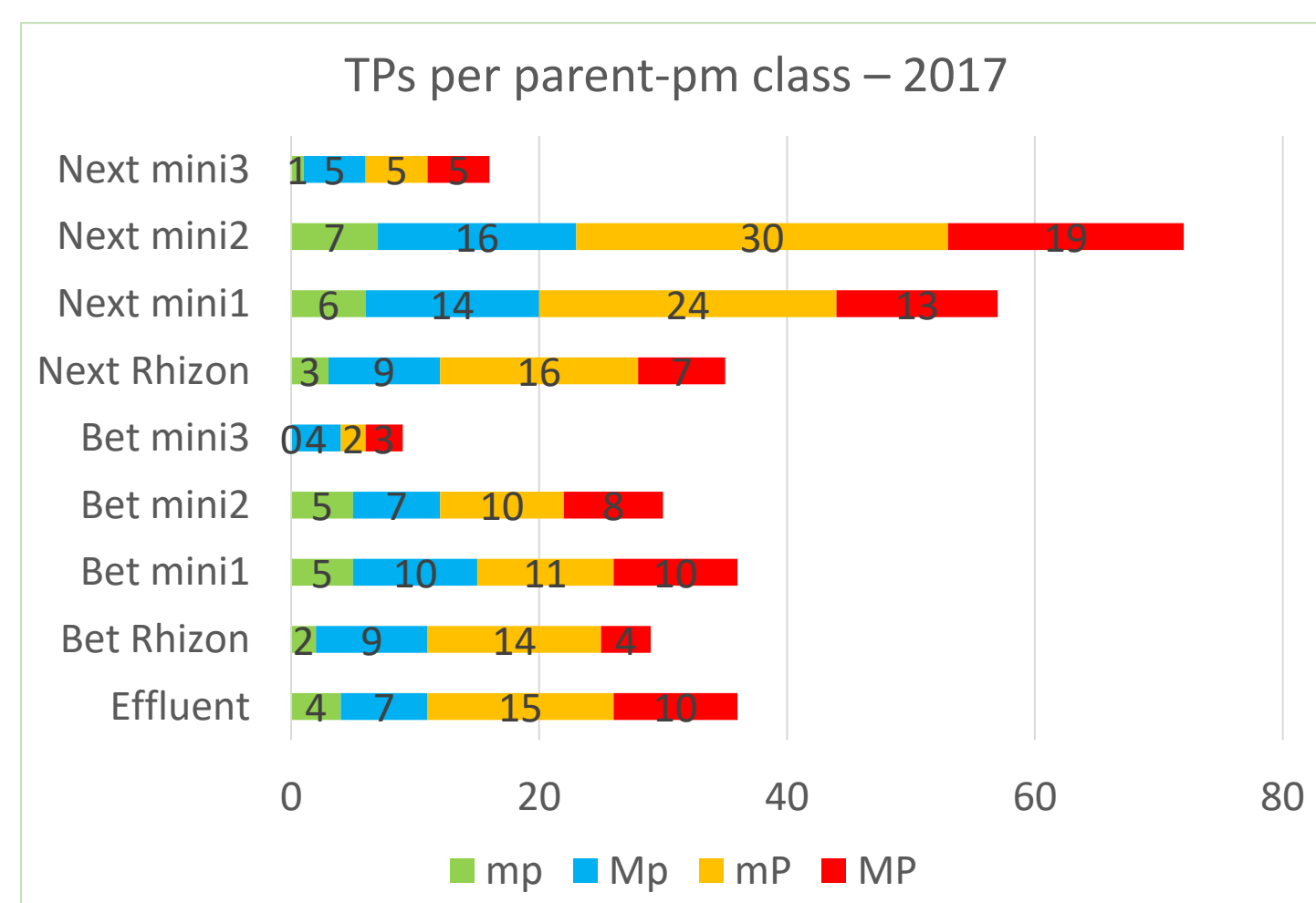
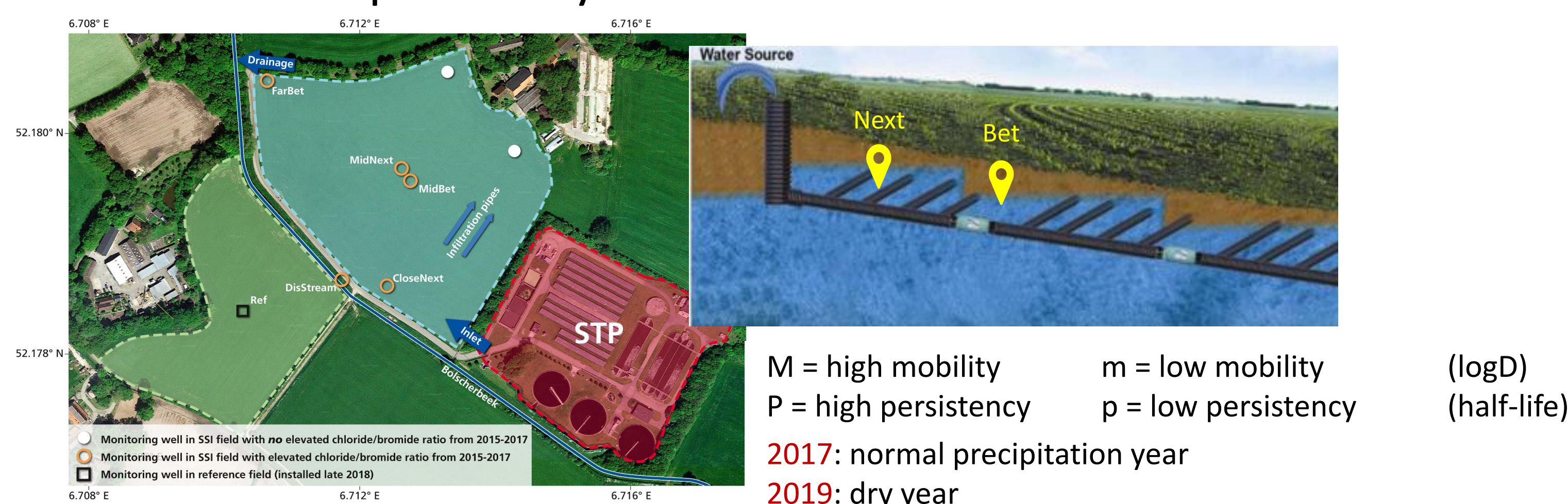


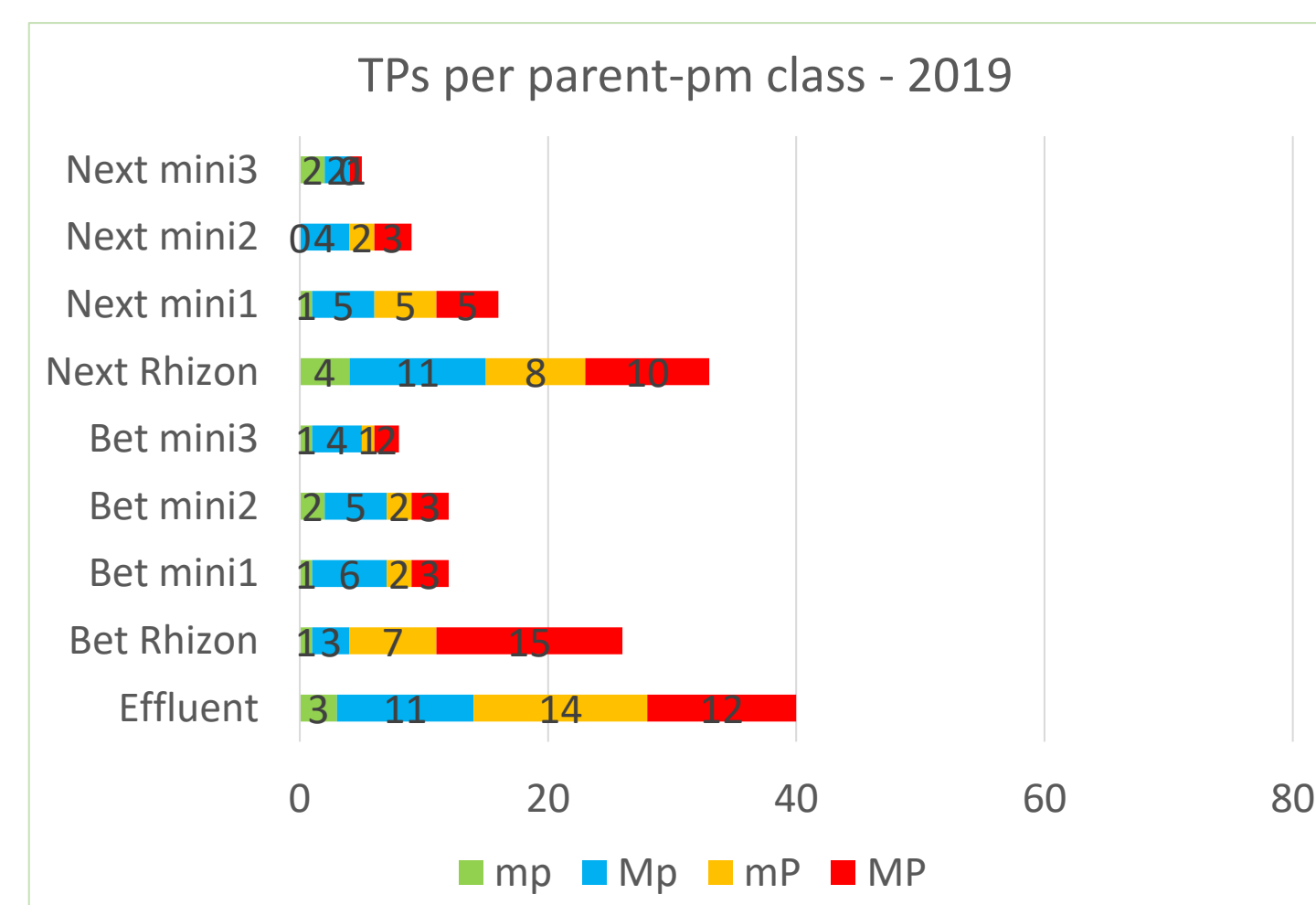
Fig 1. Environmental parameters affecting biodegradation of micropollutants.

## Haaksbergen case study – subsurface irrigation with WWTP effluent

Non-target screening field data analysis with patRoön to assess TPs formation from previously detected PCs.



Ground level  
Rhizon (-0.6 m)  
mini1 (-1.3 m)  
mini2 (-1.8 m)  
mini3 (-2.3 m)

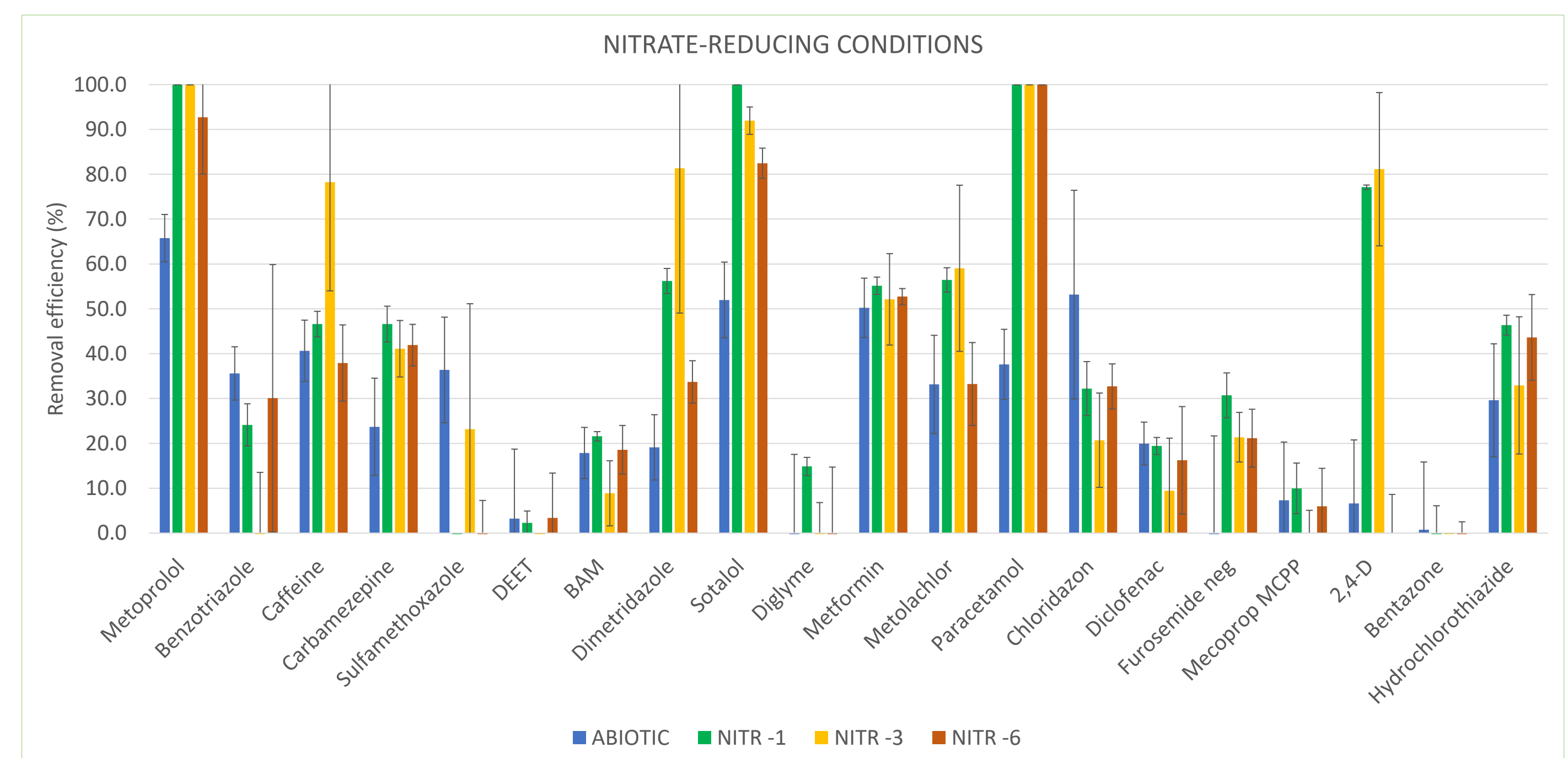
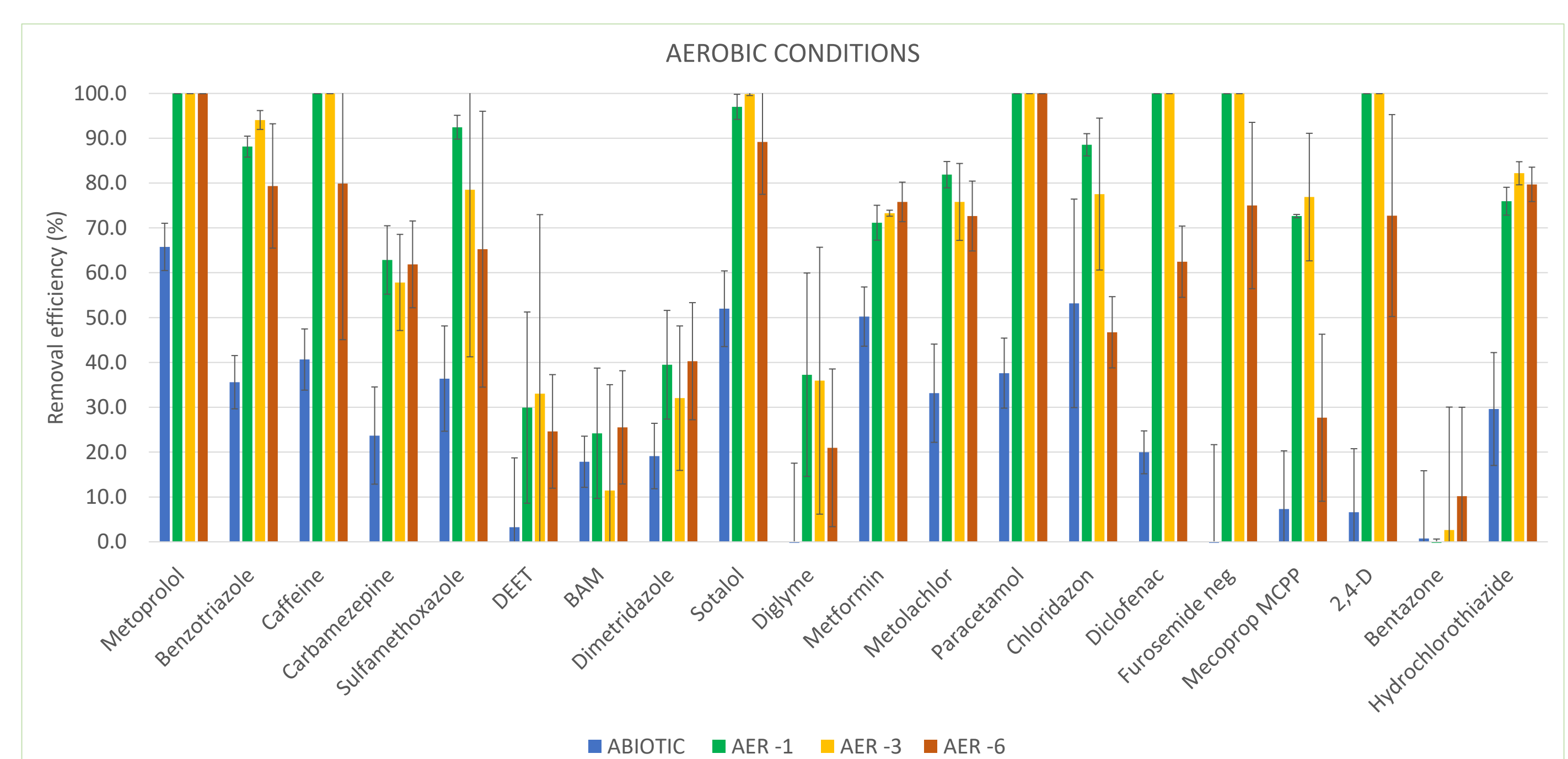


## Results

### Microbial diversity and TPs formation (lab experiment)

The analysis of the target data on PCs consumption shows:

- Positive correlation between microbial diversity on the number of PCs transformed
- Aerobic conditions:
  - Removal efficiency > 50% for 15 PCs at lower dilution levels and 13 PCs at the most diluted level
  - Production of desphenyl-chloridazon
- Nitrate-reducing conditions
  - Removal efficiency > 50% for a maximum of 8 PCs



**Position:** higher number of TPs close to the infiltration pipe

**Precipitation difference:**

- 2019: fewer TPs but reaching points in between the pipes (horizontal movement) and with a more expected trend in relation to the depth
- 2017: PCs & TPs stay close to the pipe and are detected at deeper points (vertical movement)

## Future plans

- What do MPs transform into when biodegraded under different **redox conditions**?
  - Study on the interconnection between redox conditions and TPs formation in a lab experiment
- What MPs and TPs can currently be detected in **Dutch water reuse systems**?
  - Assessment of sample pre-treatment methods for improving TPs detection on field samples (DOW)
  - Analysis of samples from the Eibergen (Vitens) case study, including microbial population investigation

## Take-home messages

Climate change and population growth incentivize the reuse of alternative water sources to provide freshwater. MPs are present and currently well-studied, but their TPs are often unknown and overlooked even though equally important for safe water provision. This research provides insight into TPs identification, their formation, and the conditions that affect the process. The preliminary results show that it is possible to predict the behavior and influence the fate of MPs biodegradation.