Stress tests on a modular green wall for greywater treatment

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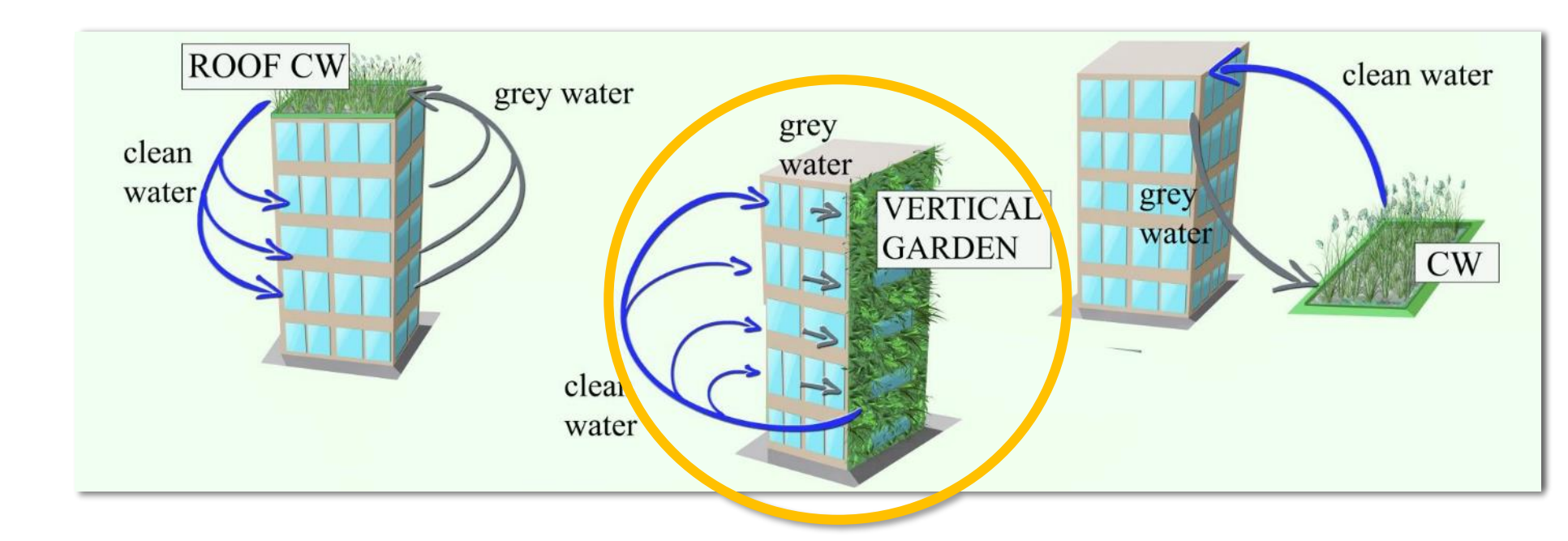www.nice-nbs.eu

Introduction

Light greywater (GW): amount of domestic wastewater that excludes toilet flushing, kitchen sink and dishwasher.
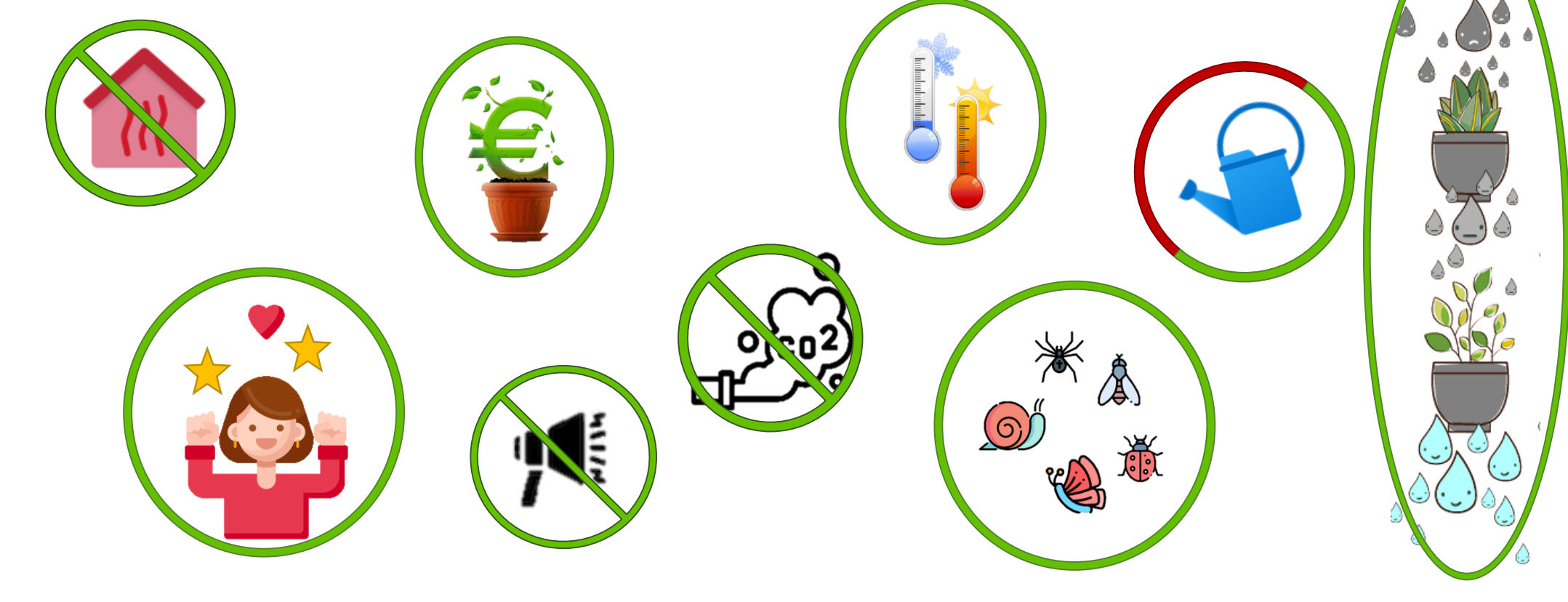
Advantages of water reuse:

- Reduction of potable water consumption up to 50%
- Less of chemicals for wastewater treatment

Nature-based Solutions (NBSs) in urban environment

Multiple benefits and opportunities

Research questions

Is the natural system (plant + biofilm) **resilient** to stressing inflow conditions?

How **aggressive cleaning products** affect the treatment performances?

Methods

Synthetic greywater composition

Standard recipe

Modified from **Diaper et al. (2008)**

- Body cream
- Toothpaste
- Creamy deodorant
- Loundry soap
- Hand soap
- $NaHCO_3$
- Na_2SO_4
- Na_2HPO_4
- Lactic acid
- Boric acid
- Bentonitic clay

Addition of aggressive cleaning products and dosing

- ★ 500 ml bleach, floor cleaner, drain opener
- ☀ 100 g sodium hydroxide

Collecting tank volume

1000 L   500 L   200 L

Concentration at the green wall

★ 500 ppm ☀ 100 ppm		LOW
★ 1000 ppm ☀ 200 ppm		MID
★ 2500 ppm ☀ 500 ppm		HIGH

Experimental setup

- Three pots as **independent replicates**
- Coconut fibre+perlite **(1:1)**
- 24 L d^{-1} per pot (15-min flush, once per hour)
- **HLR 740 L m^{-2} d^{-1}**
- Period: Jun –Sept 2022 (**12 samples**)
- Sampling pots **outflow** (15 pots) + **input** GW
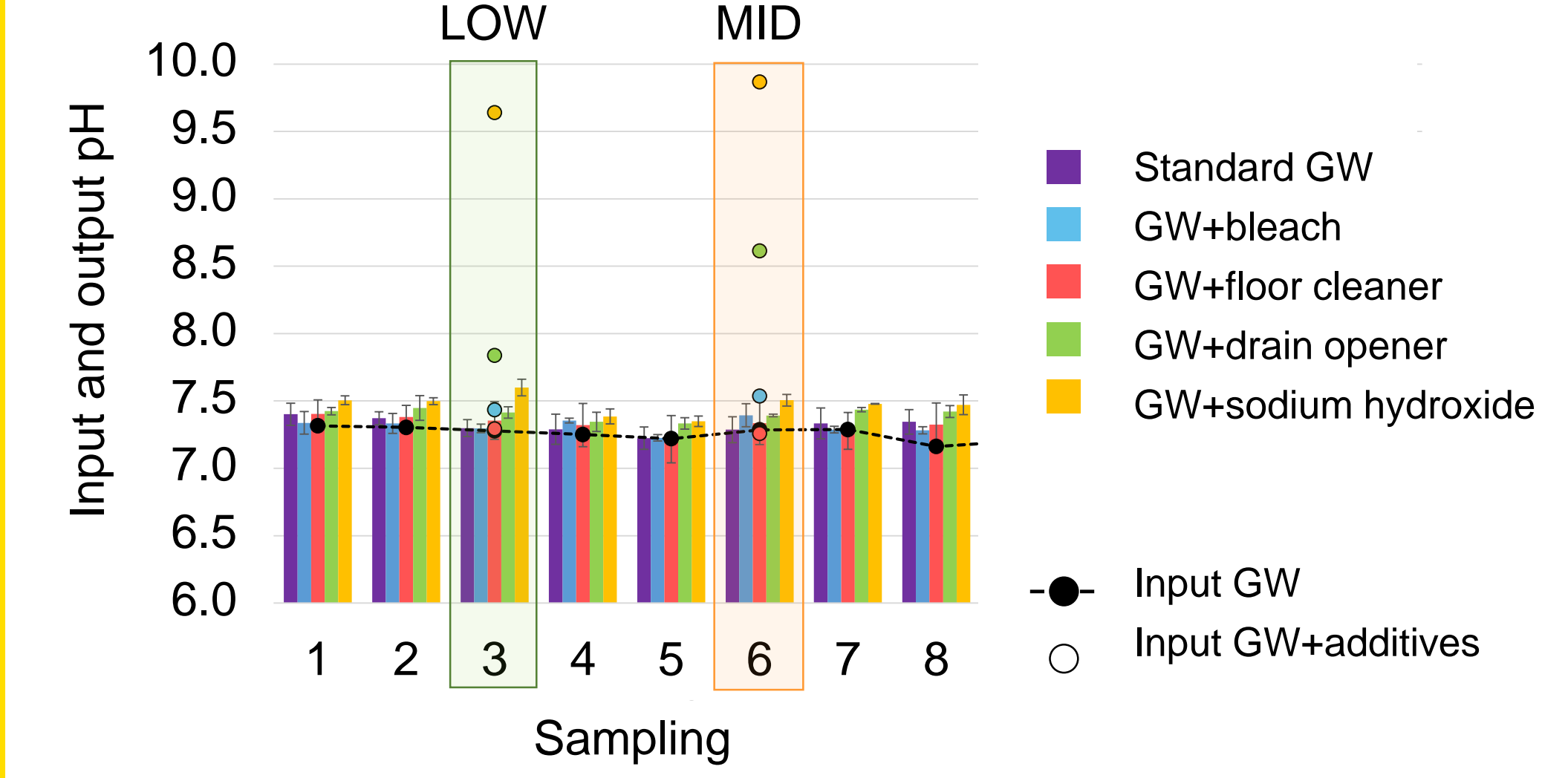
Water sampling analysis

- T
- EC
- pH
- DO
- COD
- BOD_5
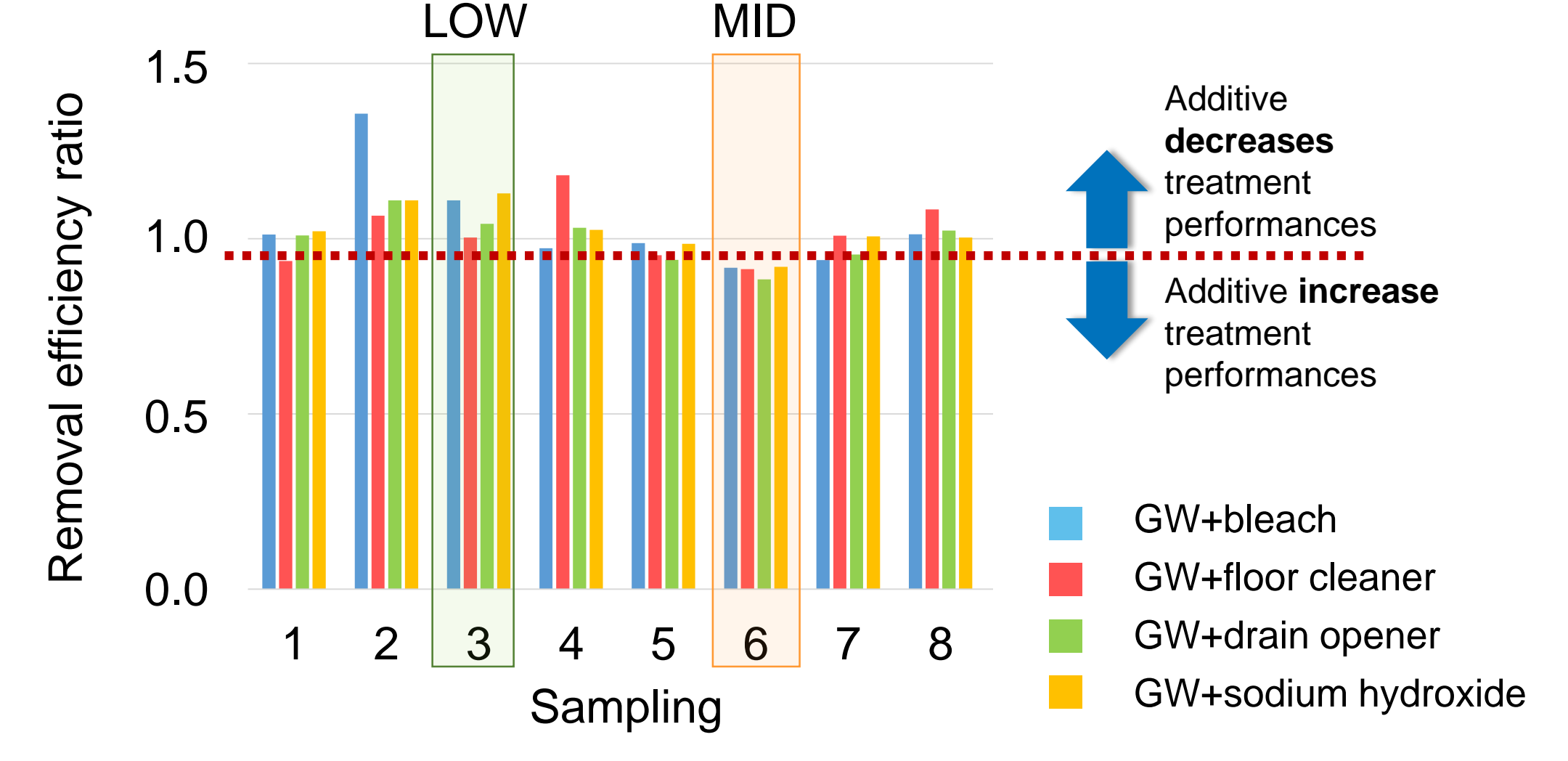- SO_4^{2-}
- MBAS

Data analysis

- Average output concentration
- Removal efficiency
- Removal efficiency ratio

$$RR = \frac{R_0}{R_i}$$

Results and discussion

Input and output pH

COD removal efficiency ratio

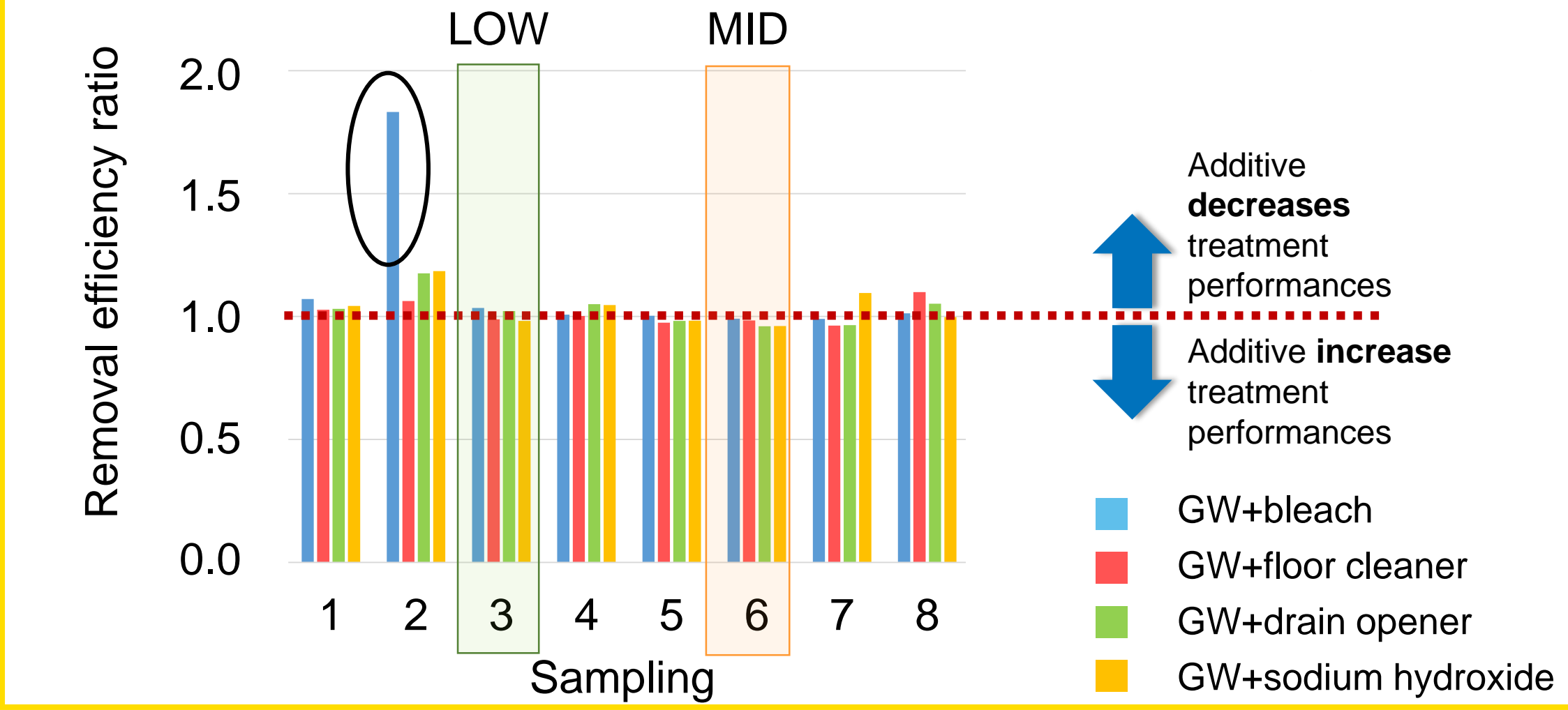**MBAS removal efficiency ratio**
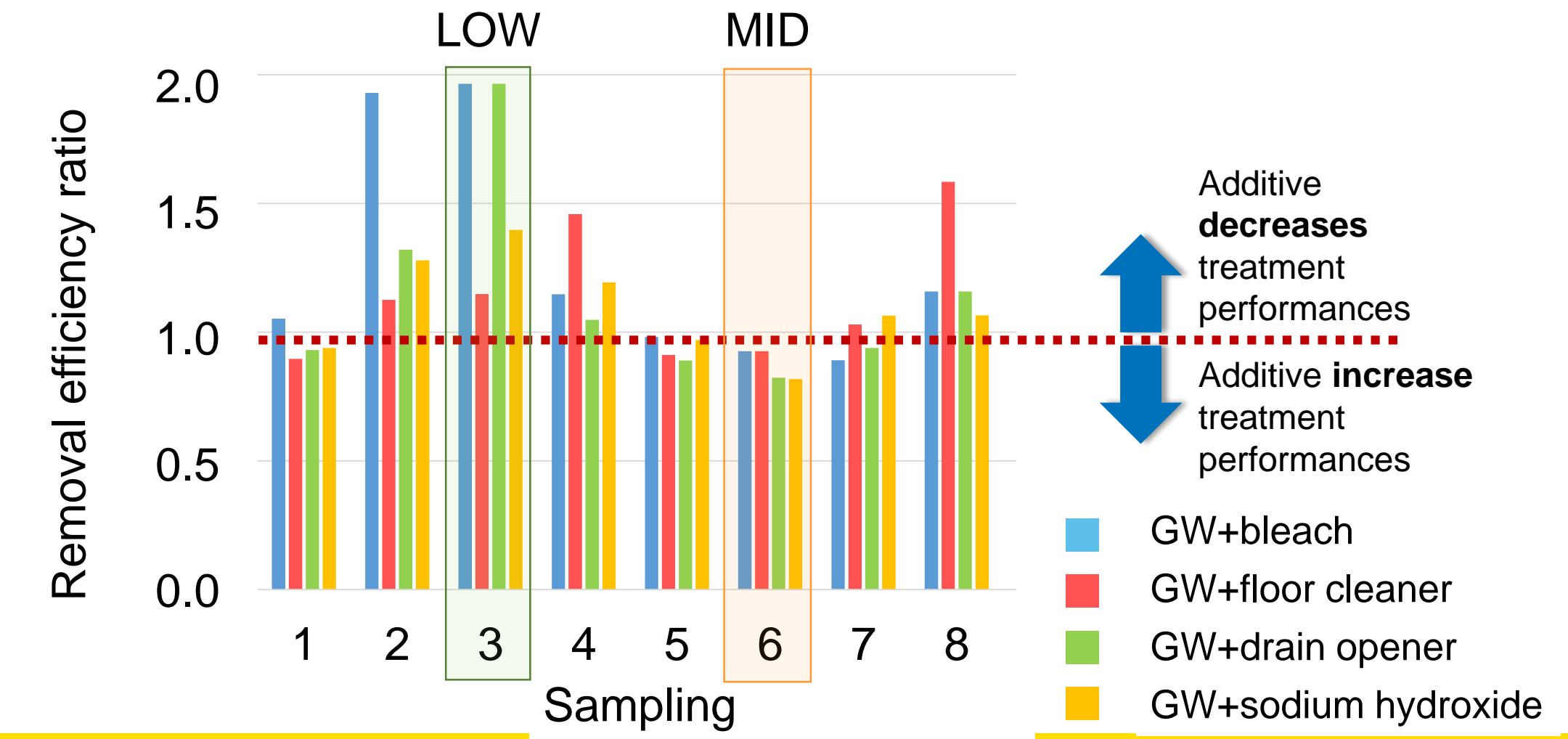

BOD_5 removal efficiency ratio

Removal efficiency

- **BOD** – bleach configuration showed lower average values along the period (around 30%) with peaks of 70% occasionally. The other configuration removed around **40% on average** in the whole period, with peaks of 80% removal

- **COD** – configuration occasionally fed with drain opener reaches 94% of removal during a spike sampling date, all configuration showed a removal around **60% on average** in the whole period

- **MBAS** – average removal efficiency was between **75%-80%** for all configurations

- **Sulphate** – removal and release was mainly in the range **±30%** for all the configurations

Conclusions

- Occasional decreasing in removal performances does **not** seem to be **related to aggressive additives** in greywater composition

- **The system stabilizes pH** even when input values are higher than usual

- High variability in removal efficiency for all the configurations

- Plants showed **good growth** in all configuration, but two died after summer (one from the standard configuration one from the floor cleaner one, thus no direct relation to the treatment itself can be assumed)