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Resilience to flow rate variability in a green wall for greywater treatment

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Green and blue infrastructures are an innovative solution to contrast climate changes (SDG 13 of UN 2030 Agenda) and increase cities resilience (SDG 11), using a smarter water management that transform wastewater into a new resource for non-potable reuses. Due to the lack of horizontal surfaces in urban areas, green walls are one of the most suitable nature-based solution to treat greywater (i.e. the portion of household wastewater that exclude toilet flush and kitchen sink). Green walls allow for a multidisciplinary approach, providing multiple benefits such as thermal and acoustic regulation, biodiversity preservation, decreasing heat islands effects and removing CO_2, improving life quality and buildings value.

Green walls have also been proposed for treating the large amount of greywater that is daily produced (e.g. around 100 L/PE/die in Italy), an approach that also provides urban green while reducing the need of irrigation water. Following previous work on a pilot system, this study aims to improve the green walls design and test its resilience to variations in the flow rate of greywater fed to the green wall. Two panels have been built in which synthetic greywater flows by gravity along three levels of pots with different plant species. The 18 pots (arranged in a 3x3 matrix in each panel) have been filled with a mix of coconut fibre and perlite (1:1 in volume) and fed with greywater, and output water samples have been collected almost weekly from June to December 2021. The control panel has been regularly fed with 24 L/die/col (standard flow rate), the other has been fed with different flow rates (standard, underflow, overflow and maintenance) that usually changed after three weeks. Different parameters (e.g. TSS, BOD_5, COD, DO, TN, TP, MBAS), have been monitored in the outflow of each pot and average performances of each level has been evaluated. Results indicate a good efficiency of the green wall in removing contaminants even when the provided flow rate is not constant.

The treatment performances increase along the columns in both panels and the first two levels guarantee a good compounds removal during standard flow and underflow rates. On the other hand, the overflow rate caused a performances decrease in the variable flow panel for many parameters, followed by a visible plant stress. However, one week of standard flow rate was sufficient to reduce the negative effects of the three- weeks-overflow. This demonstrated the resilience of the green wall facing flow variability, that can be caused by seasonal variation or

system failure.