Sow & Flow

Green wall/vertical wetland to filter wastewater

Guilherme F. Dos Santos, Mees Koppenol, Janaina C. M. Schmittgens, Carolina Gemelli Carneiro, Luewton Lemos F. Agostinho

Introduction

Urban areas around the globe are estimated to suffer greater seasonal fluctuations in precipitation due to climate variation. Droughts and floods has been increasing in the last decades and are expected to increase even more [1]. Muuras, a startup company, came up with the idea of a decentralized water purification system on the facade of buildings, combining the concepts of green walls with vertical wetlands, to reduce the wastewater treatment plants stress and to create more circular cities. Vertical wetlands is a simple secondary treatment method to treat wastewater. It consists of a layer of substrate, such as sand or gravel and macrophytes [2]. The combination of vertical wetlands together with the green walls could improve the microclimate, capture atmospheric carbon, provide aesthetics, thermal and noise insulation and nurture urban biodiversity.

Objective

Design and study the potential usage of a vertical wetland in a green wall concept on building facades, irrigated with greywater, to work as a decentralized wastewater treatment system, and its consequent treatment and reuse evaluation.

Experimental plan

The setup was built with 4 columns, each one with 3 modules. The first 3 columns were fed with greywater and column 4, the control column, was fed with tap water, as shown in Figure 1. The different combinations of substrates used are shown in Table 1. In each module, eight distinct plant species were planted. Samples were collected from each module and from the greywater itself. The effluent parameters measured were total nitrogen, nitrate, phosphate, pH, turbidity, color, electroconductivity, COD, ortho-phosphate, total coliform, faecal Coliforms and anionic surfactants. In addition to that, the plants were monitored via NDVI pictures and the soil from each module was monitored with moisture, temperature and conductivity measurements.

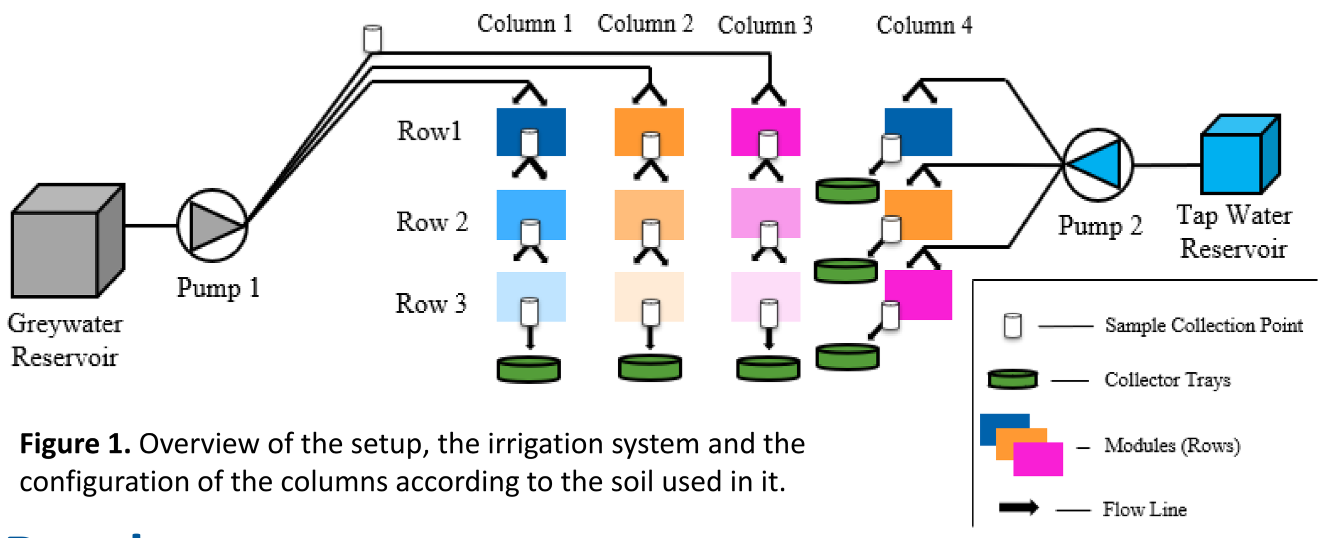

Figure 1. Overview of the setup, the irrigation system and the configuration of the columns according to the soil used in it.

Column 1	Column 2	Column 3	Column 4 - Control
Coco coir: 85% Biochar: 15%	Coco coir: 60% Biochar: 15% Wetland soil: 25%	Seashell: 60% Biochar: 15% Vermiculite: 25%	Row 1= Column 1 Row 2= Column 2 Row 3= Column3

Table 1. Combination of substrates in each column. The ratios are set in volume.

Figure 2. Green wall/vertical wetland setup used to conduct the experiments.

Results

The experimental setup was properly built and it worked as intended, showing that the objective of constructing a system that is, at the same time, a green wall and a vertical wetland is feasible. Results of the greywater treatment have provided a better understanding of the efficiency of this type of system. Each one of the substrates was efficient in pathogens and physico-chemical pollutants removal. Furthermore, with the plants and soil monitoring, the system's hydraulics and biological strength were also better understood. The more detailed results can bee seen in the figures below.

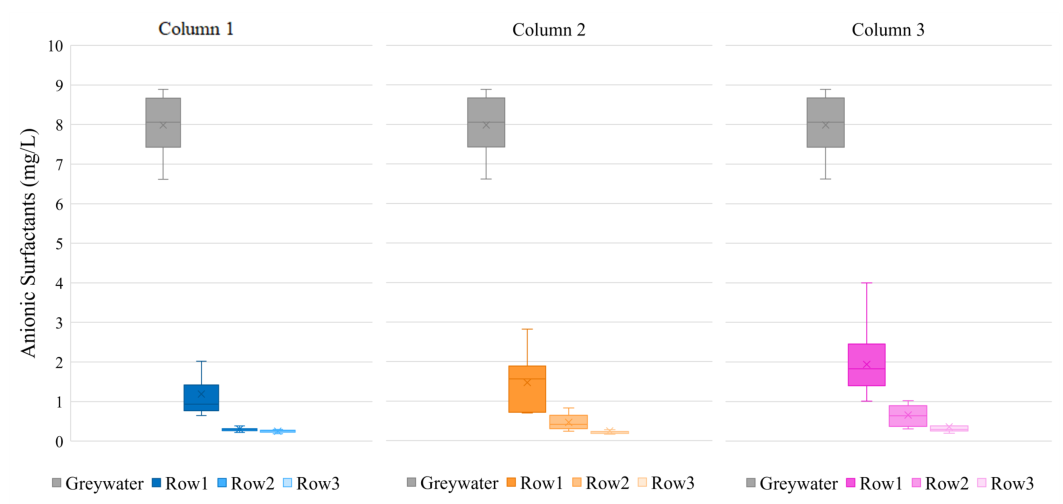

Figure 3. Anionic Surfactants concentration for each module from each experimental column.

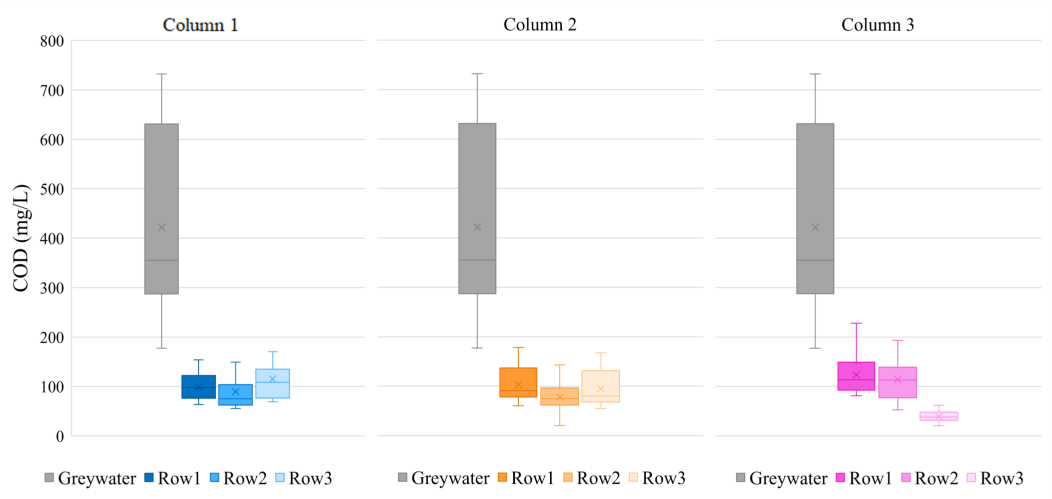

Figure 4. COD concentration for each module from each experimental column.

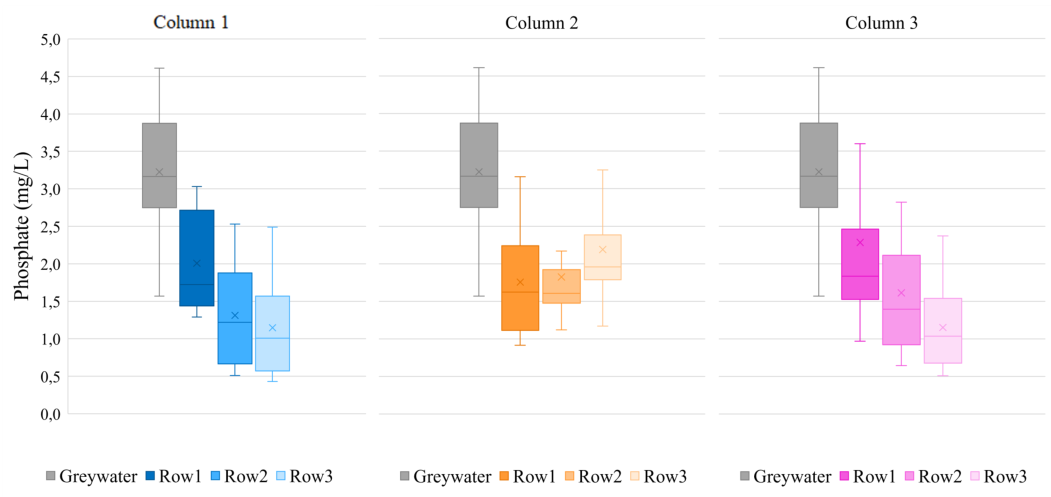

Figure 5. Phosphate concentration for each module from each experimental column.

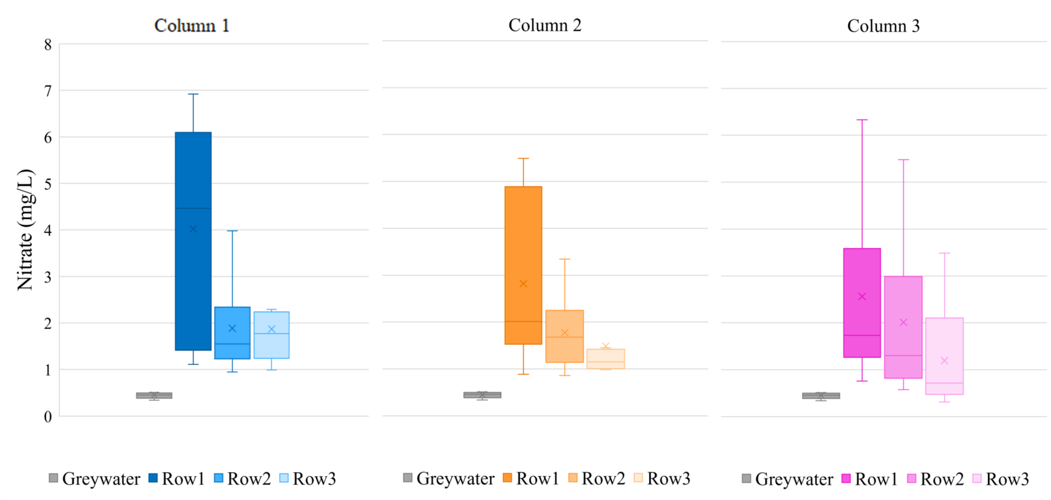

Figure 6. Nitrate concentration for each module from each experimental column.

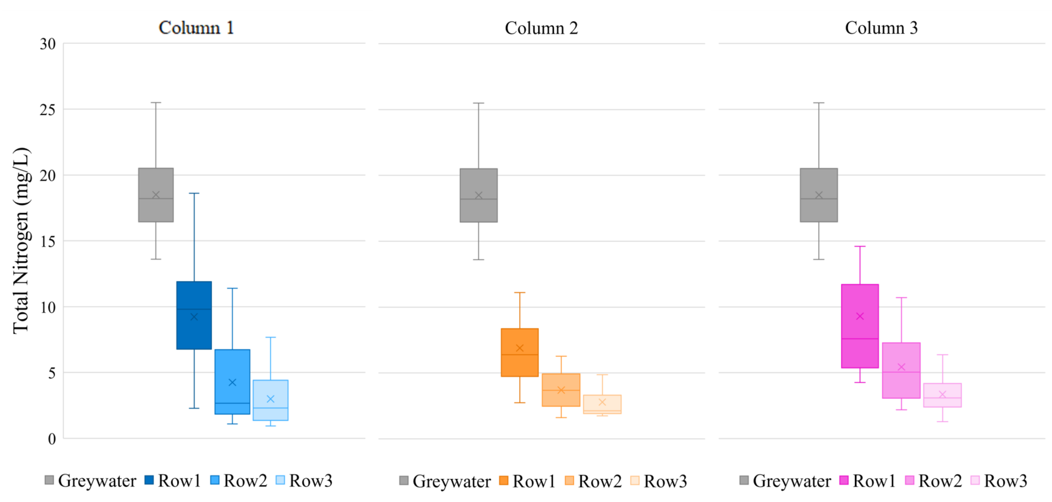

Figure 7. Total N concentration for each module from each experimental column.

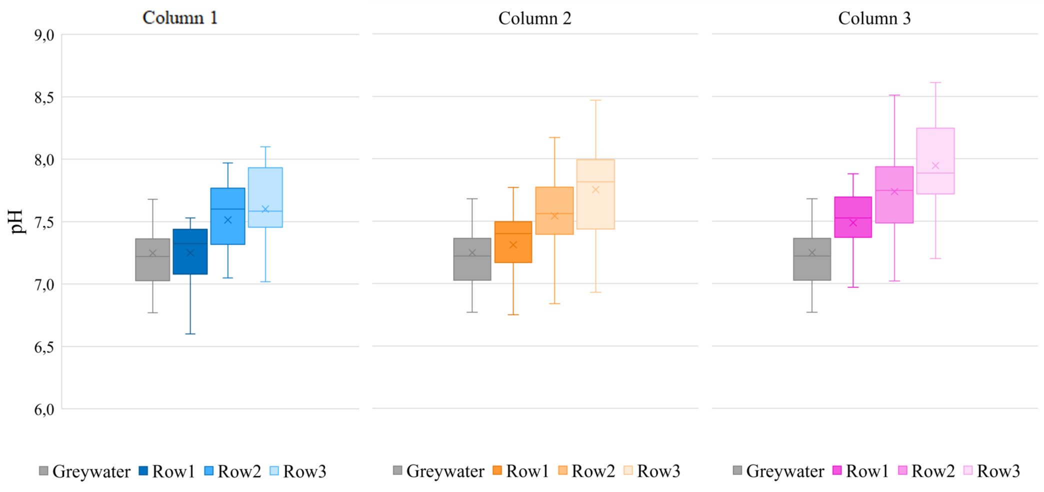

Figure 8. pH levels for each module from each experimental column.

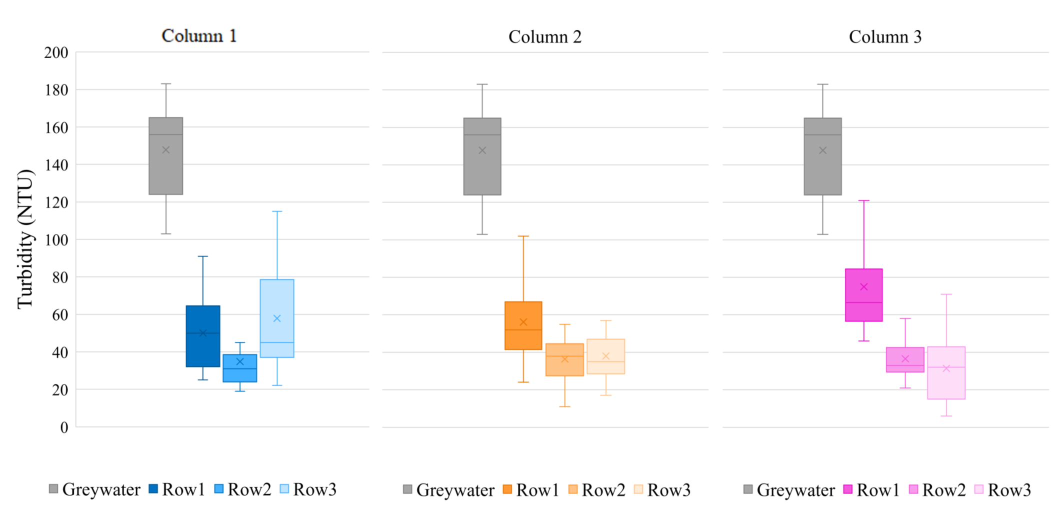

Figure 9. Turbidity levels for each module from each experimental column.

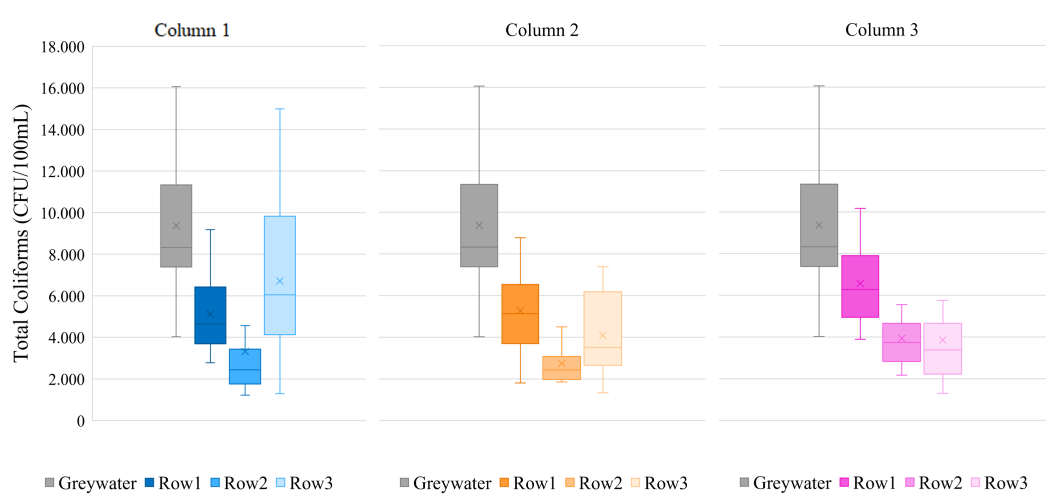

Figure 10. Total Coliform count for each module from each experimental column.

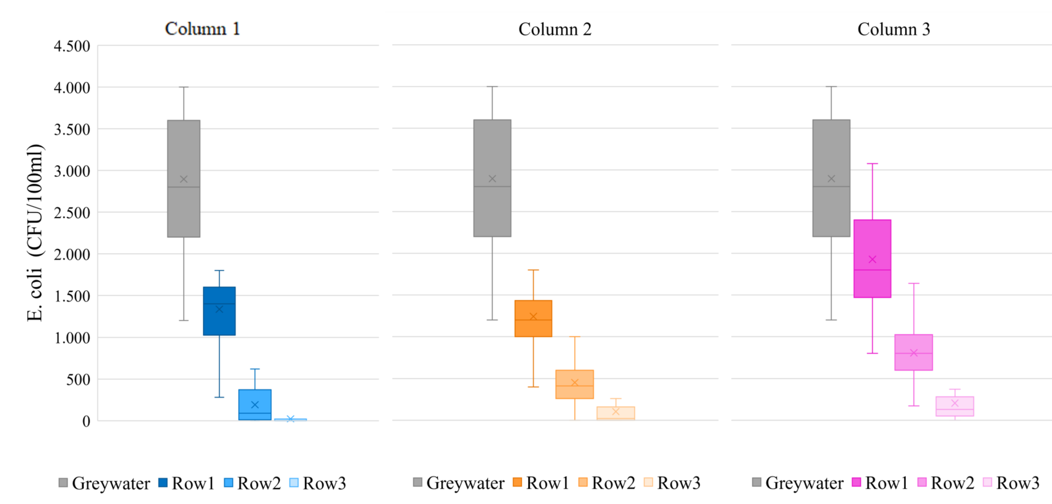

Figure 11. Faecal Coliform count for each module from each experimental column.

NHL STENDEN university of applied sciences

References

[1]- Hoeppe, P. (2016). *Trends in weather related disasters – Consequences for insurers and society. Weather and Climate Extremes, 11, 70–79.*doi:10.1016/j.wace.2015.10.002

[2]- G. Dotro, P. Molle, J. Nivala, J. Puigagut, O. Stein (2017). Treatment Wetlands (1st ed.), 9781780408767, IWA Publishing, London, UK

UFV Universidade Federal de Viçosa

Living Lab Biobased Brazil Education Research Innovation