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"Filling gaps and removing traps
for sustainable resource management"

On-Farm Wastewater Treatment Using Biochar from Local Agroresidues Promotes Safer Irrigation Water for Food Production in Developing Countries

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Abstract

In this study, the suitability of an anaerobic biofilter (AnBF) as an efficient and low-cost wastewater treatment for safer irrigation water production for sub-Saharan Africa was investigated. To determine the influence of different ubiquitous available materials on the treatment efficiency of the AnBF, rice husks and their pyrolysed equivalent, rice husk biochar, were used as filtration media and compared with sand as a common reference material. Raw sewage from a municipal full-scale wastewater treatment plant pretreated with an anaerobic filter (AF) was used in this experiment. The filters were operated at 22°C room temperature with a hydraulic loading rate of 0.05 $m\,h^{-1}$ for 400 days. The mean organic loading rate (OLR) of the AF was 194±74 and 63±16 $gCOD\,m^{-3}\,d^{-1}$ for the AnBF. Fecal indicator bacteria (FIB) (up to 3.9 log10-units), bacteriophages (up to 2.7 log10-units), chemical oxygen demand (COD) (up to 94 %) and turbidity (up to 97 %) could be significantly reduced. Additionally, the essential plant nutrients nitrogen and phosphorous were not significantly affected by the water treatment. Overall, the performance of the biochar filters was significantly better than or equal to the sand and rice husk filters. By using the treated wastewater for irrigating lettuce plants in a pot experiment, the contamination with FIB was more than 2.5 log-units lower (for most of the plants below the detection limit of 5.6 MPN per gram fresh weight) than for plants irrigated with raw wastewater. Respective soil samples were minimally contaminated and nearly in the same range as that of tap water.

Keywords: Agricultural residues, anaerobic wastewater filtration, biochar, fecal indicator bacteria, low-cost biofiltration, rice husk, water reuse

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