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Competing roles of green roof in rain water harvesting systems: accounting for retention and detention in a behavioural model simulation

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Green roofs are beneficial in urban drainage systems due to their role in mitigating the hydrological response of the largely impervious surfaces to intense rainfall events. Such benefit is often assumed to hold also in case RainWater Harvesting (RWH) is implemented to exploit the collected rainwater for non-potable usages and to save valuable potable water resources. However, the role of green roofs on the RWH efficiency is not obvious and requires detailed investigation by accounting for the local rainfall climatology.

On the one hand, retention of rainwater operated by the vegetation would reduce the total volume of collected water made available for exploitation. On the other hand, rainwater detention in the green roof substrates would add to the storage capability of the RWH system, therefore improving the delayed supply of water during inter-event dry periods. The resulting efficiency at the annual scale depends on the distribution of precipitation within the year (duration of dry periods, intensity of rain events, frequency of extremes, etc.).

In this work, a behavioural model is developed to investigate the impact of the inflow modulation due to an interposed green roof on the efficiency of a generic RWH system located in the Mediterranean environment (Cauteruccio and Lanza, 2022). Various configurations of both the green roof characteristics (retention and detention performance) and the RWH system (rainwater collection area and storage volume) are compared with the collection from impervious surfaces in terms of non-dimensional reliability indices.

Furthermore, the annual usage volume per unit tank capacity is used as an indicator of the economic benefit associated with the exploitation of the resource, and its variation in case of the various green roof/RWH system design configurations is assessed. In particular, the reduction of the significant overflow ratio that is typical of RWH systems in the Mediterranean climate is calculated, which is interpreted as a positive feature since overflow represents the unused portion of the collected water.

Cauteruccio, A. and L.G. Lanza (2022). Rainwater harvesting for urban landscape irrigation using a soil water depletion algorithm conditional on daily precipitation. Water, 14(21), 3468. https://doi.org/10.3390/w14213468.