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Editorial

Stormwater Management in Urban and Rural Areas

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In past decades, traditional stormwater management in urban and rural areas was associated with a rapid transfer of water to sewage systems or ditches, which resulted in pollutants and large volumes of water being carried to rivers and streams. Such an approach caused negative changes in the hydrological cycle, as well as groundwater resources depletion, deterioration of water quality and damages to ecosystems [1–3]. However, increasing urbanization, along with the intensification of agricultural production and progressive climate change have forced a paradigm shift [3,4]. Thus, a new approach to stormwater concerns increasing retention, infiltration, and groundwater recharge, reducing surface runoff and using stormwater treatment methods that mimic nature. Stormwater is quickly becoming a valuable resource, especially with the risk of drought growing year after year and extreme temperatures becoming more frequent. The holistic approach considers creating resistant functional ecological systems, and in their creation and maintenance economic factors, environment, social wellbeing, and public health are all taken into account [3,5–8].

The literature describes promising water-oriented urban resilience approaches, for example in China in 2014 the Sponge City Concept (SCC) was developed. Consequently, in April 2015, 16 cities out of 130 were chosen as pilot cities with a plan to invest a total of USD 12.2 billion within the next three years. Another 14 cities were selected in 2016, and in the same year the principles of Water Wise Cities (WWC) were announced by the International Water Association. In addition, there are less ambitious approaches with slightly smaller scope, such as Low Impact Development (LID) in the USA, Sustainable Urban Drainage Systems (SUDS) in the United Kingdom and the Water Sensitive Urban Design (WSUD) in Australia [3,7–13]. Moreover, Nature-Based Solutions (NBS), Green Infrastructure (GI), and Blue–Green Infrastructure (BGI) are being used in stormwater management, helping to maintain natural hydrologic cycles, and more broadly to mitigate the harmful effects of urbanization and climate change and to achieve the goals of sustainable development [8,14–16]. Their counterparts for non-urban areas—Rural Sustainable Drainage Systems (RSuDS) and Natural Flood Management (NFM)—are described and used much less frequently [4,17,18]. The authors also note the lack of integrated tools and frameworks to assess urban resilience as well as the need to bridge the gap from theory to implementation in building more resilient urban stormwater management systems [7,19]. It should be pointed out that in regard to rainwater management in urban areas, a plethora of information, technical innovations, case study analyses, proposals for policies, strategies and actions can be found in the literature [7,11,13,20–22], whereas for agricultural areas it is still necessary to fill in the gaps in knowledge and experience in this respect.

Sustainable stormwater management provides ecosystem services and benefits for people from the local environment. In cities, grey, blue, and green infrastructure are combined into an integral whole. Stormwater management has finally become an invaluable part of creating a low-carbon, energy-efficient, healthy, and citizen-friendly city [21,23–25].

Rural Sustainable Drainage Systems are a group of measures that can be created with a minimal loss of agricultural production areas. Their application involves reducing erosion and flooding and the negative impact of agricultural diffuse pollution, as well as increasing biodiversity and limiting water loss [4,17]. All of the above examples partake in solving contemporary water management challenges and thus their implementation should not be individual, but systemic, integrating multiple solutions into one holistic system. Furthermore, attention should be paid to the technical level of the implemented solutions, the effect of their implementation on a larger scale (moving from prototypes to systemic solutions), the economic mechanisms used to finance these solutions and the inclusion of new measures in development and management strategies for urban and rural space.

This Special Issue presents studies linking to different geographical contexts, reflecting a diversity of environmental conditions that we must tackle on global scale via stormwater management. The research of Chapa et al. [26] presents a prototype which consists of a grey-hybrid element for the first flush bio-treatment and runoff detention, adapted to the existing stormwater sewer in conditions of urban areas in Costa Rica (Northern America). Within this experiment, the authors tested the possibility of the local sewer adaptation to function as a temporal reservoir to reduce the effects derived from rapid generation of stormwater runoff. A new technology was also tested by Kupiec et al. [27]. They evaluated the efficiency of innovative sedimentation and biofiltration systems in limiting the inflow of pollutants to a lake in Polish conditions (Europe). Results demonstrate that the system is highly effective in the reduction of such nutrients as nitrogen and phosphorus, and despite the presence of cyanobacteria, the specimens found in most samples were not toxigenic genotypes with a potential to produce microcystins. New solutions can present different performance on a larger scale, therefore, Lee et al. [28] evaluated the effects of technical investments by analyzing the sewer type and spatial distribution of Low-Impact Development facilities, as well as their type on runoff and water quality, using the Storm Water Management Model. In that way they identified effective ways of improving the hydrological cycle and Non-Point Source pollution associated with urbanization based on the case of Seoul (Asia). All interventions and innovative solutions in stormwater management must be financed somehow. Therefore, Novaes and Marques [29] analyzed the participation of the private sector in stormwater drainage and management systems. Their study addresses several aspects related to the attractiveness and participation of private initiatives in urban stormwater management and discusses selected international examples with a special focus on Brazil (Southern America). Finally, once technology is verified in a smaller and larger scale and financial mechanisms to implement them are known, there is a need to enhance a change in local systems by policies. In this Special Issue Kong et al. [30] commented on urban rainstorm waterlogging in one of the fastest urbanizing parts of the world, China (Asia). Based on the analysis of strategies which deal with urban waterlogging around the world, the authors proposed guiding principles for the sponge city concept promotion. We hope that the collected examples will constitute a valuable food-for-thought for many researchers who support local communities in designing and managing their urban and rural space and creating sustainable cities and regions.

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