

## #51 - Exploring stakeholders' SUDS perceptions as urban flood risk management strategies in Bogotá, Colombia

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### Highlights

- SUDS are studied in Bogotá, relevant city in the underexplored Latin American context.
- Operation and maintenance uncertainties hinder greater acceptance of SUDS implementation.
- Community members are willing to participate in different stages of SUDS development.

### Introduction

Urban flooding is an increasing problem triggered by multiple factors such as climate change, urban growth, changes in land use, mismanagement of spatial planning, and the lack of stakeholders' engagement (Sayers et al., 2013; Chan et al., 2018). Efforts to develop new measures in managing floods have drawn attention to the concept of Sustainable Urban Drainage Systems (SUDS), which stand out as multi-objective strategies to reduce runoff quantity, enhance storm water quality, provide amenity, and increase biodiversity in urban spots (Woods et al., 2015). Australia, Canada, the United States, New Zealand, and England have made progress in deepening their scope, benefits, and challenges (Fletcher et al., 2015). Unfortunately, there is a gap to fill in Latin American countries where the knowledge and, therefore, the implementation of these systems is still quite limited. This study aims to characterize the relationship between urban flood risk management, SUDS implementation, and stakeholder's engagement in the context of Bogotá, Colombia, through the vision of the public, private and community sectors.

### Methodology

This study was developed in the context of Bogotá city, the capital city of Colombia, which in turn is one of the most densely populated cities of the region and the world. Bogotá's urban growth is concentrated in the periphery areas, where there is a lack of employment, educational and infrastructure opportunities (Guzman and Bocarejo, 2017; Inostroza, 2017). These patterns, added to the need to enrich the discussion of SUDS at the city level (Jiménez et al., 2019) in Latin American and Global South contexts (Romero-Lankao et al., 2014; Guzman et al., 2017), make this study of great relevance.

The qualitative approach followed in this study consisted in 10 semi-structured in-depth interviews with stakeholders involving three of the major building construction companies in Colombia, the local water utility company, the local environmental agency (LEA), the urban development institute (UDI), and the Colombian Green Building Council. Furthermore, 13 individual questionnaires were applied to residents of Bosa, one of the twenty administrative divisions of Bogotá, located to the southwest of the city. The selection of this community considered technical, socio-economic, and environmental factors, such as flood proneness and the low drainage capacity in the area, population density, and dwellings proximity to sewer outlets, respectively. Table 1 summarizes all the interviewed stakeholders. The overall aim with this qualitative approach was to identify the SUDS typologies stakeholders are most familiar with, the perceived benefits and barriers, and the willingness to implement these techniques. Although the sample (Table 1) is not statistically representative, the empirical evidence provides valuable insights regarding the multiple visions and multidimensional aspects of urban flood management strategies (Mguni et al., 2015; Sadiq et al., 2019; Carriquiry et al., 2020).

**Table 1.** Summary of the key stakeholders involved in the study.

Stakeholder type	Sector	Interview/Questionnaire	Date
Colombian Green Building Council	Private sector	Interview	19 November 2020
Local water utility – technical professional	Public sector	Interview	27 November 2020
Local water utility – technical professional	Public sector	Interview	30 November 2020
Building construction company #1	Private sector	Interview	14 December 2020
Local environmental agency (LEA)	Public sector	Interview	15 January 2021
Building construction company #2	Private sector	Interview	21 January 2021
Urban development institute (UDI)	Public sector	Interview	21 January 2021
Building construction company #2	Private sector	Interview	25 January 2021
Building construction company #3	Private sector	Interview	28 January 2021
Local water utility – social coordination	Public sector	Interview	20 March 2021
Residents of a flood risk prone area (13 members)	Community	Questionnaire	03 April 2021

## Results and discussion

### Identified SUDS and perceived benefits

In this study, participants were aware of multiples SUDS typologies: public sector is more familiar with tree pits and filter drains, while building construction companies stood out permeable pavements, green roofs, storage tanks, and swales. SUDS design and planning should involve stakeholders from early stages (Maskrey et al., 2020), therefore, the socialization of different urban flood risk management solutions, whether green based or conventional, becomes more important to support the decision-making process.

Benefits indicated by the private sector stakeholders range between the balance between the natural and built environment, improving the client's quality of life, commercial image advantages, and championing projects with social responsibility. Meanwhile, the three public sector representatives persistently mentioned the reduction of runoff volumes and the improvement of water quality, benefits widely highlighted in SUDS literature (O'Sullivan et al., 2017; Carriquiry et al., 2020; Kumar et al., 2020).

### Barriers in SUDS implementation

The most relevant barrier considered by public and private sectors is consistent with the findings of Liu and Jensen (2018) and Drosou et al. (2019): The operation and maintenance of SUDS related to the associated costs and the needed expertise. In turn, constructors also mentioned the lack of clear regulations and weak institutional coordination (Mguni et al., 2015), to the point that one of the informants claimed that "*norms go against SUDS*". Lack of evidence of SUDS effectiveness (Kumar et al., 2020) compared to conventional drainage systems performance was also indicated as a barrier that hinders further implementation.

### Willingness to implement SUDS

The private sector expressed a generalized will to implement SUDS, where the conviction to reduce impacts on the environment is evident. It should be noted that all interviewed companies indicated the existence of a sustainable development department and, additionally, they have already implemented SUDS typologies in building projects. The LEA and the UDI showed the greatest commitment, even working together on pilots with infiltration trenches and tree pits. The local water utility warns that, due to its position as a service provider, it is not easy to get involved in the development of these strategies.

### Community perceptions

The questionnaire was answered by 13 community members, aged between 19 and 34 years (female,  $n=7$ ; male,  $n=6$ ), from different educational backgrounds: secondary school ( $n=1$ ), technical ( $n=3$ ) and professional ( $n=9$ ). The most outstanding SUDS benefit was the use of harvested stormwater for cleaning and irrigation purposes. Mitigation of local floods and the beautification of the environment were also mentioned. On the other hand, barriers were diverse: lack of financial resources, knowledge and interest, government support deficiency, and lack of training with technical support, which is in line with the findings of O'Donnell et al. (2017) and Li et al. (2020). When asked if they would be willing to participate in the different stages of SUDS development, the answer in all cases was positive, as also found in Bon Pastor, Barcelona by Carriquiry et al. (2020), mainly in the planning, implementation, monitoring, maintenance and

surveillance stages.

## Conclusions and future work

This study seeks to broaden the analysis of SUDS implementation in Latin American urban contexts, using empirical evidence and qualitative methods that highlight the importance of including multiple actors in the flood risk management debate. Building construction companies are key stakeholders due to their impact in the natural and built environment and their operative capacity to develop large-scale projects. The results evidenced similarities with worldwide studies in terms of perceived benefits and barriers and the stakeholders' willingness to adopt SUDS. This is relevant for supporting policymaking on urban resilience and to achieve greater acceptance of these strategies. Future work contemplates the analysis of perceived co-benefits and the complementary use of hydraulic modelling tools to assess the impact of SUDS on reducing stormwater runoff in public and private spaces.

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