Nethmini, A.L.H., Hadiwattage, C., Sivanraj, S. and Mannapperuma, M.M.N., 2025. Shaping regenerative stormwater management: A conceptual framework for blue-green infrastructure. In: Waidyasekara, K.G.A.S., Jayasena, H.S., Wimalaratne, P.L.I. and Tennakoon, G.A. (eds). *Proceedings of the 13th World Construction Symposium*, 15-16 August 2025, Sri Lanka. pp. 1231-1244. DOI: https://doi.org/10.31705/WCS.2025.92. Available from: https://ciobwcs.com/papers/

SHAPING REGENERATIVE STORMWATER MANAGEMENT: A CONCEPTUAL FRAMEWORK FOR BLUE-GREEN INFRASTRUCTURE

A.L.H. Nethmini[1], C. Hadiwattage[2], S. Sivanraj[3] and M.M.N. Mannapperuma[4]

ABSTRACT

Urbanisation and infrastructure development have intensified stormwater-related challenges such as increased runoff, flooding, and ecological degradation. Blue-green infrastructure (BGI) has emerged as a sustainable solution for stormwater management by integrating natural and engineered systems to mimic the natural water cycle. Although the environmental and social benefits of BGI are widely acknowledged, its implementation remains limited due to barriers, including a lack of awareness, funding constraints, fragmented responsibilities, and regulatory uncertainties. Existing literature lacks a comprehensive framework specifically addressing the use of BGI in stormwater management. This study aims to fill that gap by developing a conceptual framework to promote BGI adoption for stormwater systems. A systematic literature review was conducted using databases including Scopus, Web of Science, Engineering Village, and Google Scholar. Manual content analysis was used to explore the benefits, barriers, and strategies related to BGI implementation. Findings reveal that community engagement, inter-agency collaboration, knowledge sharing, and policy integration are essential to overcoming adoption barriers. Based on these insights, a conceptual framework was proposed to guide planners, policymakers, and practitioners in promoting BGI within urban water management. This framework supports the strategic integration of BGI to enhance resilience, sustainability, and multifunctionality in stormwater infrastructure.

Keywords: *Barriers; Benefits; Blue-green Infrastructure; Stormwater Management; Strategies.*

1. INTRODUCTION

The construction industry, a key driver of urban development, has significantly contributed to the rapid urbanisation seen across the globe (Scaroni, 2021; Ahmad et al., 2019). As cities expand, natural landscapes are increasingly replaced with impermeable infrastructure such as roads, pavements, and buildings. This transformation alters land

[1] Undergraduate, Department of Building Economics, University of Moratuwa, Sri Lanka, nethminialh.20@uom.lk
[2] Senior Lecturer, Department of Building Economics, University of Moratuwa, Sri Lanka, chandanieqs@yahoo.com
[3] Lecturer, Department of Building Economics, University of Moratuwa, Sri Lanka, sivanrajs.19@uom.lk
[4] Lecturer, Department of Building Economics, University of Moratuwa, Sri Lanka, mannapperumammn.19@uom.lk

use patterns, disrupts natural hydrological cycles, and intensifies surface runoff, leading to increased incidences of flooding, erosion, and environmental degradation (Barbosa et al., 2012; Kvamsås, 2023; Scaroni, 2021). Traditional stormwater management systems, which prioritise rapid drainage via underground pipes and channels, often fail to adequately address pollution control, source reduction, and ecological sustainability (Gogate et al., 2017; Prudencio & Null, 2018). Consequently, there is a growing need for sustainable, integrated stormwater solutions that can effectively respond to the environmental challenges associated with urbanisation.

In response to these limitations, Blue-Green Infrastructure (BGI) has emerged as a resilient and sustainable approach to urban stormwater management. BGI refers to an interconnected system of natural and semi-natural landscape elements, such as green spaces, wetlands, and water bodies, that serve multiple purposes, including flood control, biodiversity conservation, and water purification (Ghofrani et al., 2017). It represents an ecosystem-based method for managing stormwater quantity and quality through biophysical processes like infiltration, storage, detention, and biological uptake of pollutants (Liao et al., 2017). Among the most commonly implemented BGI systems are rain gardens, bioswales, green roofs, artificial wetlands, and retention or detention basins, all of which integrate environmental and urban design principles to deliver multifunctional benefits.

The potential benefits of BGI extend beyond stormwater control. These systems contribute to improved water quality, enhanced biodiversity, urban cooling, and the creation of recreational and aesthetically pleasing environments (Hamann et al., 2020). One of the primary objectives of BGI is to mitigate urban flooding and reduce Combined Sewer Overflows (CSOs), offering direct economic and environmental advantages (Wilbers et al., 2022). Furthermore, BGI solutions can be more adaptive and cost-effective in the long term compared to conventional grey infrastructure, while delivering co-benefits that support human health, well-being, and urban resilience.

Despite its many advantages, the widespread adoption of BGI in urban stormwater management remains limited. Numerous studies have highlighted institutional, technical, and socio-political barriers to its implementation (Frantzeskaki et al., 2017; O'Donnell et al., 2017;). These include a lack of stakeholder coordination, unclear maintenance responsibilities, insufficient commitment from water professionals, and limited technical knowledge (Suleiman, 2021). Additionally, the absence of standardised guidelines, performance metrics, and long-term monitoring mechanisms hinders confidence in BGI's reliability and cost-effectiveness when compared to traditional stormwater systems (Qiao et al., 2018; Davis et al., 2015). Uncertainty over long-term performance and the lack of institutional capacity to manage BGI facilities further exacerbate resistance to its integration into mainstream infrastructure planning.

Even though many studies have emphasised the importance of BGI, there remains a significant gap in its application, specifically for stormwater management. While the broader environmental and social benefits of BGI are widely recognised, there is a lack of comprehensive frameworks that address its implementation within the context of stormwater systems. Therefore, a comprehensive conceptual model is necessary to promote the effective utilisation of BGI for urban stormwater management. Such a model must incorporate the technical and ecological functions of BGI but also address institutional arrangements, governance structures, public awareness, and long-term maintenance strategies. Without such a framework, efforts to mainstream BGI into urban development processes are likely to remain fragmented and ineffective. Accordingly, this study aims to fill this gap in both academic literature and practical implementation by developing a conceptual framework to promote BGI adoption for stormwater system. The research has two objectives, 1) investigate the role of BGI in stormwater management with benefits and 2) examine the strategies to overcome identified barriers.

2. RESEARCH METHOD

This study was conducted through a comprehensive literature review focusing on BGI and stormwater management to develop a conceptual framework to promote BGI for sustainable stormwater solutions. The review process explored key theories, concepts, benefits, barriers, and strategic approaches relevant to BGI implementation. A similar methodological approach was adopted by Kavamas (2023) and Kaur and Gupta (2022), who also utilized structured literature reviews for framework development.

To retrieve relevant literature, a set of keywords was formulated, including: *"Blue-green infrastructure*" AND *"management*" AND (*"enabler*" OR *"benefit*" OR *"advantage*" OR *"barrier*" OR *"limitation*" OR *"disadvantage*") * AND (*"stormwater*" OR *"storm drainage*" OR *"runoff*" OR *"rainwater*") *. These search terms were applied across several academic databases such as Web of Science, Scopus, Engineering Village, and Google Scholar to ensure a comprehensive and diverse selection of sources. The study involves a few rounds of screening to reduce the initial pool of 163 articles to a final selection of 87 documents consisting of 73 journal papers and 6 conference papers.

Due to the limited number of studies that collectively address these interconnected areas, both combined and separate keyword searches were used. The initial search results were filtered by reviewing titles, abstracts, and keywords, after which a purposive sampling method was applied to select the most relevant and high-impact articles. The final pool of literature included seminal works on BGI benefits and barriers, as well as key contributions to stormwater management practices.

Manual content analysis was conducted on the selected articles, allowing the author to extract critical themes, patterns, and strategies related to BGI implementation. Especially, a three-phase coding approach was employed creating open, axial, and selective codes to systematically identify, organize, and interpret codes within the data. The insights gained from this analysis formed the foundation for the development of the conceptual framework.

3. LITERATURE REVIEW

3.1 CONVENTIONAL STORMWATER MANAGEMENT

Conventional stormwater management typically relies on engineered systems designed to rapidly collect and discharge runoff from urban areas into nearby water bodies (Prudencio & Null, 2018). These systems primarily focus on flood control and public safety, with limited attention to environmental sustainability. Historically, surface runoff was considered a nuisance or waste product rather than a resource, leading to the development of extensive grey infrastructure, networks of drains, pipes, culverts, and channels constructed with impermeable materials such as concrete, asphalt, and steel (Gallo et al., 2020). While effective in reducing urban flooding, such systems increase impervious surface coverage, limiting infiltration and intensifying runoff volume and pollution (Tsegaye et al., 2019).

Grey infrastructure tends to prioritise rapid conveyance of stormwater, often without treating or retaining it, which contributes to water quality degradation and urban heat effects. These systems are usually centralised and space-intensive, making them unsuitable for compact urban settings where green elements are limited (Gallo et al., 2020). Moreover, they fail to replicate natural hydrological processes such as infiltration, filtration, and evapotranspiration (Szeląg et al., 2019). Traditionally, stormwater systems have been managed by sanitation and water departments in a siloed, top-down manner, focusing on quick removal rather than ecological integration (Jean et al., 2021).

Even though urban stormwater management is essential for addressing environmental, economic, and social challenges, such approaches are increasingly seen as inadequate and modern technologies are needed to cope with the increasing demands of urban growth, climate change, and financial limitations (Bohman et al., 2020; Fletcher et al., 2015). In fact, conventional stormwater management systems primarily rely on grey infrastructure, such as pipes and culverts, which effectively control flooding however pose environmental and spatial limitations (Zhou, 2014). In contrast, BGI offers a multifunctional, sustainable alternative that integrates ecological principles, providing benefits such as water quality enhancement, biodiversity, and resilience, while addressing the shortcomings of traditional systems (Kaur & Gupta, 2022; Pochwat et al., 2019).

3.2 BLUE-GREEN INFRASTRUCTURE (BGI)

Blue-green solutions are frequently recommended as a sustainable, multifunctional approach that can help counteract the negative impacts of urbanisation while responding to climate change by regulating water and heat, purifying air and water, and enhancing recreational aspects and biodiversity (Voskamp & Van de Ven, 2015). The multifunctional nature of nature-based solutions such as BGI aligns with a systemic, or "integrated" water management approach, which combines various aspects to enhance resilience against water-related hazards (Fletcher et al., 2015). Integrated blue aspects into the green environment focus on protecting landscapes through a network of blue and green areas, including features such as permeable pavements, rain gardens, bioswales, wetlands and other blue-green aspects (Kaur & Gupta, 2022). Accordingly, there is a requirement in urban planning, design, and management to enhance resilience and sustainable development in BGI (Schewenius & Wallhagen, 2024).

BGI development management is frequently associated with the specialised roles of various professionals, including water engineers, landscape architects, and urban planners, to provide for successful design (Pochwat et al., 2019). Combining specialised professional knowledge with community involvement can improve the long-term effectiveness and flexibility of BGI (Keeler et al., 2019). It is essential to facilitate decision-making, promote enhanced democratic engagement, ensure community satisfaction, and enhance people’s interest in blue-green aspects to the long-term viability of BGI projects (Rahtz et al., 2023). Therefore, community involvement is essential for the successful implementation of BGI and for creating more sustainable solutions (Everett et al., 2023).

BGI can be classified into several types, such as rain gardens, bioswales, green roofs, retention ponds, constructed wetlands, green cover, and sponge city (Hamel & Tan, 2022). Further, BGI types can be categorised into micro-scale, meso-scale, and macro-scale (Ahmad et al., 2019). Interventions in BGI can be implemented at various scales, each with unique advantages and challenges (Everett et al., 2023). Micro-scale measures, such as urban parks and green roofs, offer localized benefits and community engagement but may have limited overall impact (Hamel & Tan, 2022). Meso-scale projects can collectively improve urban resilience but require coordinated planning. Macro-scale initiatives, like sponge cities and urban green corridors, afford significant flood mitigation and environmental benefits, though they demand substantial investment and institutional coordination (Sehrawat & Shekhar, 2024).

3.3 BENEFITS OF BLUE-GREEN INFRASTRUCTURE

The integration of water elements into green spaces enhances the functionality of the whole stormwater management system by creating new experiences for people (Pauleit et al., 2020). Therefore, there are some combined advantages of this holistic approach duo to integration (Pauleit et al., 2020). Accordingly, the implementation of BGI strategies to traditional stormwater management systems has gained environmental, social, and health benefits in recent years (Sharma et al., 2021). Mainly, these are done due to huge environmental and health impacts associated with stormwater in the world (Singh et al., 2023). Therefore, the best stormwater management techniques aim to reproduce natural water cycles by reducing stormwater runoff volume and increasing infiltration (Bell et al., 2018).

Table 1: Benefits of BGI

Benefits	Citations
Carbon sequestration	[1], [8], [9], [14], [16], [17], [4], [14], [18]
Enhance biodiversity	[1], [8], [9]
Climate regulation	[4], [14], [13], [18], [19], [20]
Air quality improvement	[1], [20], [1], [13], [19], [8], [7]
Water quality improvement	[1], [3], [8], [9], [11], [15], [17], [20], [22], [24]
Soil quality improvement	[20], [29], [8]
Water saving	[20], [1], [13], [19], [12], [9], [17], [22]
Reduce flood risk	[8], [9], [17], [5]
Provide recreational activities	[1], [10], [21], [2], [4], [14], [18]
Energy savings	[13], [19],
Aesthetic appearance	[7], [4], [14], [18]
Cost efficient	[23], [11]

[1] (Alves et al., 2019) [2] (Bell et al., 2018) [3] (Brears, 2018) [4] (Depietri & McPhearson, 2017) [5] (Dreiseitl, 2015) [6] (Dushkova et al., 2021) [7] (Everett et al., 2023) [8] (Everett et al., 2023) [9] (Fletcher et al., 2015) [10] (Gascon et al., 2015) [11] (Ghofrani et al., 2017) [12] (Hamel & Tan, 2022) [13] (Haase et al., 2017) [14] (Keeler et al., 2019) [15] (Krivtsov et al., 2022) [16] (Li & Trivic, 2024) [17] (Liao et al., 2017) [18] (Lourdes et al., 2021) [19] (Lund, 2018) [20] (Markevych et al., 2017) [21] (McDougall et al., 2022) [22] (Mguni et al., 2015) [23] (Moreno et al., 2017) [24] (O'Donnell et al., 2017)

As per the benefits identified in Table 1 by referring to the 25 research papers, 13 emphasised that BGI provides water quality improvement by mitigating stormwater and reducing flood through filtration, retention and evaporation of water. Further, through recreational activities, people strengthen their psychological and physical well-being. There is considerable research and literature in many countries with multiple benefits of BGI for improving urban ecosystems (Kim & Song, 2019). This can shift stormwater infrastructure from invisible underground pipeline systems to blue-green stormwater measures, with new opportunities for sustainable urban areas (Sharma et al., 2021). However, there are barriers to the implementation of this approach. Blue-green solutions may be able to address some issues by improving green spaces for the benefit of both people and wildlife (Voskamp & Van de Ven, 2015).

3.4 BARRIERS TO BLUE-GREEN INFRASTRUCTURE

Although BGI systems are gaining recognition and are being adopted in various countries in the world, still, there are many barriers remaining (Raška et al., 2022). A significant issue concerning BGI is that most BGI theories and implementations have been developed in developed countries such as the USA (Meerow, 2020), Sweden (Suleiman, 2021), Norway (Wilbers et al., 2022), Portland (Dlugonski & Szumanski, 2015) and other developed countries. Moreover, the expansion of informal settlements can worsen water management problems through their impacts on ecosystem services in the form of water purification and retention (Harriden, 2012). Although current stormwater research addresses various technical, institutional, and financial barriers to adopting alternative stormwater management strategies, these barriers still prevail (Kvamsås, 2021).

Table 2: Barriers of BGI

Barriers	Citations
Lack of funding	[1], [2], [4], [9], [13], [16], [17], [18], [20], [22]
Uncertainty about the cost	[1], [4], [9], [13], [14], [16], [19], [20]
Lack of awareness	[1], [2], [4], [6], [7], [16], [20], [21]
Reluctant to support new practices	[1], [4], [8], [10], [13], [16], [17], [18], [21], [22]
Legal regulations	[1], [8], [16], [17], [18], [22]
Fragmented roles and responsibilities	[8], [10], [16], [20]
Weather uncertainty	[3], [15], [21]
Implemented on a small scale	[7], [8]
Lack of space	[1], [4], [8], [13], [16], [17], [18], [22]

[1] (Almaaitah et al., 2021) [2] (Ashley et al., 2011) [3] (Caruzzo et al., 2018) [4] (Dhakal & Chevalier, 2017) [5] (Drosou et al., 2019) [6] (Hysa, 2021) [7] (Kaur & Gupta, 2022) [8] (Kordana, 2018) [9] (Kordana & Słyś, 2020) [10] (Mell, 2008) [11] (Neumann et al., 2017) [12] (O'Donnell et al., 2017) [13] (Pregnolato et al., 2016) [14] (Roy et al., 2008) [15] (Sarabi et al., 2019) [16] (Sarabi et al., 2020) [17] (Stec & Mazur, 2019) [18] (Tchórzewska-Cieślak, Rak, et al., 2019) [19] (Thorne et al., 2018) [20] (Wamsler et al., 2020) [21] (Wihlborg et al., 2019) [22] (Zawilski et al., 2014)

Table 2 depicts the barriers to implementing the BGI approach in the world. It indicates that among 22 studies, 50% of the studies identified a lack of awareness and knowledge of BGI practices as the most prevailing barrier. Accordingly, other barriers are raised, including lack of funding, the uncertainty of costs, reluctance to support BGI projects, fragmented roles and responsibilities and legal issues. Therefore, the practitioners are required to identify the financial, knowledge, social, and legal barriers in BGI implementation (Wamsler et al., 2020). For this reason, professionals have to recognise and resolve the new planning issues and change causes, as well as adopt new methods of planning, executing, and collaborating (Kvamsås, 2021).

3.5 STRATEGIES TO OVERCOME THE BARRIERS OF BGI

As discussed earlier, the transition from conventional stormwater systems to BGI is hindered by numerous institutional, technical, and social challenges (Liu & Jensen, 2018). Therefore, it is essential to adopt targeted strategies that can facilitate this transition and accelerate the adoption of BGI. A key strategy involves implementing inclusive flood risk management approaches that promote bottom-up community engagement. This participatory model empowers local stakeholders, residents, planners, and property owners, to actively contribute to BGI planning and implementation (Drosou et al., 2019; Staddon et al., 2018). It also enhances visibility through media and public support, rather than relying solely on political momentum (Cettner et al., 2014).

Incorporating public-private collaborations is crucial, as it bridges the gap between privately and publicly owned land, enabling more integrated and extensive BGI solutions (Wihlborg et al., 2019). Additionally, knowledge sharing and organisational learning are vital for overcoming the widespread lack of awareness about BGI practices. Furthermore, knowledge transfer frameworks can ensure that learning from pilot programs and successful case studies is embedded into routine municipal operations (McCormick et al., 2013; Wihlborg et al., 2019). Countries like Sweden have demonstrated success by facilitating knowledge exchange networks among municipalities, political bodies, and professionals, fostering innovation and regulatory development (Geels, 2011; Wihlborg et al.., 2019).

For emerging economies, similar collaborative models should be established to promote innovation and adaptability. To support long-term implementation, multi-stakeholder collaboration involving community members, water professionals, urban planners, and policymakers is essential throughout the planning, construction, and maintenance phases (Cheshmehzangi et al., 2024; Drosou et al., 2019). Overcoming institutional fragmentation and encouraging interdisciplinary approaches can enhance coordination and sustainability. Furthermore, technological innovation and governance reform should be integrated into existing frameworks to improve stormwater management and foster intelligent, resilient urban development (Cousins, 2018; Holtz et al., 2008). Finally, systematic monitoring and evaluation of BGI systems, including their design, operation, and cost-effectiveness, is needed to generate evidence-based improvements and support future scalability (Read, 2016; Wihlborg et al., 2019).

Additionally, effective BGI implementation requires tailoring strategies by scale. Because micro-scale efforts focus on community engagement and flexible design while meso-scale involve collaboration and stewardship (Hamel & Tan, 2022). Further, macro-scale use master plans, policies, and technology (Wihlborg et al., 2019). Across all levels, aligning with sustainability goals, securing funding, and promoting education and coordination are essential for success and long-term impact (Sehrawat & Shekhar, 2024).

3.6 CONCEPTUAL FRAMEWORK

This section outlines the conceptual framework developed to promote BG infrastructure for stormwater management, emphasising the associated benefits, barriers, and strategies to overcome those barriers. Figure 1 provides the developed conceptual framework. The framework initially presents the existing conventional stormwater management systems, which primarily rely on structures such as culverts, drains, and outfalls to manage stormwater. Transitioning to BGI involves understanding its infrastructure including diverse elements such as rain gardens, bioswales, green roofs, retention ponds, constructed wetlands, green cover, and sponge cities as more sustainable alternative.

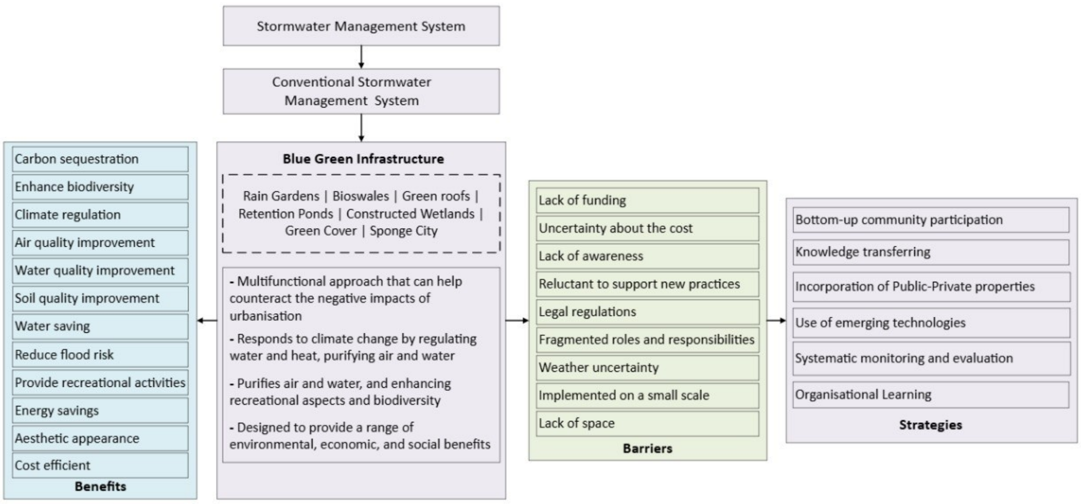

Figure 1: Conceptual framework for implementing BG infrastructure for stormwater management

The framework defines BG infrastructure in terms of its physical components and elaborates on its multifunctional nature, highlighting its role in regulating climate, purifying air and water, and enhancing urban biodiversity and recreational spaces.

Subsequently, the framework highlights key benefits of BGI, including environmental improvements, resilience against climate extremes, and social advantages like recreation and aesthetic value, which are visually represented in the blue-shaded section. These benefits range from carbon sequestration and air quality improvement to reducing flood risks, saving water, enhancing biodiversity, and providing cost-effective solutions.

In parallel, the green-shaded section of the framework captures the barriers that hinder the adoption of BG infrastructure. Critical barriers include lack of funding, uncertainty about costs, lack of public awareness, legal and regulatory challenges, fragmented responsibilities among stakeholders, and spatial constraints, which are critical for planning. Recognising these challenges, the framework proposes strategies for promoting BG infrastructure, including bottom-up community participation, incorporation of public-private properties, knowledge transfer, use of emerging technologies, organisational learning, and systematic monitoring and evaluation.

While prior studies have developed conceptual models for BG infrastructure, proposing a data management framework for strategic urban planning, and adapting to climate change, specific frameworks targeting BG infrastructure for stormwater management remain limited (Almaaintah et al., 2021; Sorensen et al., 2021). The interactions among components form a dynamic process in this framework, understanding barriers informs the development of targeted strategies, which are facilitated by stakeholder collaboration and technology. The continuous cycle of implementation, assessment, and adaptation ensures the framework remains responsive to changing urban contexts. Therefore, this framework offers a valuable contribution to the existing body of knowledge by providing a targeted and practical approach for BG infrastructure implementation in stormwater management.

4. CONCLUSION AND RECOMMENDATIONS

In conclusion, conventional stormwater management systems are seen as inadequate, prompting a shift toward nature-based BGI solutions that integrate ecological design to manage runoff, enhance resilience, and restore water quality and flow restoration. BGI offers a sustainable, multifunctional approach to urban resilience by integrating stormwater management with green spaces, combining expert knowledge with community engagement. Further, it provides key benefits such as carbon sequestration, increased biodiversity, improved air, water and soil quality, water and energy saving, and enhanced recreational spaces. However, several barriers hinder the widespread implementation of BGI in stormwater management, including lack of funding and awareness, cost and weather uncertainties, reluctance to adopt new approaches, and stiffness of legal requirements. Overcoming these challenges requires integrated strategies such as bottom-up community participation, incorporation of public-private properties, organisational learning, knowledge transferring, utilisation of emerging technologies, and systematic monitoring and evaluation. To advance the effective implementation of BGI, future research should evaluate adaptive strategies across the diverse urban contexts to address current barriers and propose models for integrated governance and sustainable financing.

5. REFERENCES

Ahmad, M., Zhao, Z.-Y., & Li, H. (2019). Revealing stylized empirical interactions among construction sector, urbanization, energy consumption, economic growth and CO2 emissions in China. *Science of The Total Environment, 657*, 1085–1098. https://doi.org/10.1016/j.scitotenv.2018.12.112

Almaaitah, T., Appleby, M., Rosenblat, H., Drake, J., & Joksimovic, D. (2021). The potential of blue-green infrastructure as a climate change adaptation strategy: A systematic literature review. *Blue-Green Systems, 3*(1), 223–248. https://doi.org/10.2166/bgs.2021.016

Alves, A., Gersonius, B., Kapelan, Z., Vojinovic, Z., & Sanchez, A. (2019). Assessing the co-benefits of green-blue-grey infrastructure for sustainable urban flood risk management. *Journal of Environmental Management, 239*, 244–254. https://doi.org/10.1016/j.jenvman.2019.03.036

Ashley, R. M., Cettner, A., Viklander, M., Walker, L., Sharp, L., & Westling, E. (2011). Overcoming barriers in the transition from piped to alternative drainage systems. *2nd International Conference on Sustainability Transition*s.

Barbosa, A. E., Fernandes, J. N., & David, L. M. (2012). Key issues for sustainable urban stormwater management. *Water Research, 46*(20), 6787–6798. https://doi.org/10.1016/J.WATRES.2012.05.029

Bell, S. L., Westley, M., Lovell, R., & Wheeler, B. W. (2018). Everyday green space and experienced well-being: The significance of wildlife encounters. *Landscape Research, 43*(1), 8–19. http://dx.doi.org/10.1080/01426397.2016.1267721

Bohman, A., Glaas, E., & Karlson, M. (2020). Integrating sustainable stormwater management in urban planning: Ways forward towards institutional change and collaborative action. *Water, 12*(1), 203. http://dx.doi.org/10.3390/w12010203

Brears, R. C. (2018). Blue-green infrastructure in managing urban water resources. In *Blue and Green Cities* (pp. 43–61). Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-59258-3_2

Caruzzo, A., Belderrain, M. C. N., Fisch, G., Young, G. S., Hanlon, C. J., & Verlinde, J. (2018). Modelling weather risk preferences with multi-criteria decision analysis for an aerospace vehicle launch. *Meteorological Applications, 25*(3), 456–465. https://doi.org/10.1002/met.1713

Cettner, A., Ashley, R., Hedström, A., & Viklander, M. (2014). Assessing receptivity for change in urban stormwater management and contexts for action. *Journal of Environmental Management, 146*, 29–41. https://doi.org/10.1016/j.jenvman.2014.07.024

Cheshmehzangi, A., Sedrez, M., & Flynn, A. (2024). Stormwater management: Issues, opportunities, and challenges in cities and communities. In A. Cheshmehzangi, M. Sedrez, & A. Flynn (Eds.), *Rethinking stormwater management through sustainable urban design* (pp. 1–18). Springer. https://doi.org/10.1007/978-981-97-4924-9_1

Cousins, J. J. (2018). Remaking stormwater as a resource: Technology, law, and citizenship. *WIREs Water, 5*(5), 1-13. https://doi.org/10.1002/wat2.1300.

Davis, M., Krüger, I., & Hinzmann, M. (2015). *Coastal protection and suds-nature-based solutions*. Ecologic Institute. https://www.ecologic.eu/sites/default/files/publication/2017/2723-recreate-pb-nature-based-solutions.pdf

Depietri, Y., & McPhearson, T. (2017). Integrating the grey, green, and blue in cities: Nature-based solutions for climate change adaptation and risk reduction. In N. Kabisch, H. Korn, J. Stadler, & A. Bonn (Eds.), *Nature-based solutions to climate change adaptation in urban areas: Linkages between science, policy and practice* (pp. 29–49). Springer International Publishing. https://doi.org/10.1007/978-3-319-56091-5_6

Dhakal, K. P., & Chevalier, L. R. (2017). Managing urban stormwater for urban sustainability: Barriers and policy solutions for green infrastructure application. *Journal of Environmental Management, 203*, 171–181. https://doi.org/10.1016/j.jenvman.2017.07.065

Dlugonski, A., & Szumanski, M. (2015). Analysis of green infrastructure in Lodz, Poland. *Journal of Urban Planning and Development, 141*(3), 5014001. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000242

Dreiseitl, H. (2015). Blue–green social place-making: Infrastructures for sustainable cities. *Journal of Urban Regeneration and Renewal, 8*(2), 161. https://doi.org/10.69554/LQLW8368

Drosou, N., Soetanto, R., Hermawan, F., Chmutina, K., Bosher, L., & Hatmoko, J. U. D. (2019). Key factors influencing wider adoption of blue–green infrastructure in developing cities. *Water, 11*(6), 1234. https://doi.org/10.3390/w11061234

Dushkova, D., Ignatieva, M., Hughes, M., Konstantinova, A., Vasenev, V., & Dovletyarova, E. (2021). Human dimensions of urban blue and green infrastructure during a pandemic: Case study of Moscow (Russia) and Perth (Australia). *Sustainability*, 13(8), 4148. https://doi.org/10.3390/su13084148

Everett, G., Adekola, O., & Lamond, J. (2023). Developing a blue-green infrastructure (BGI) community engagement framework template. *Urban Design International, 28*(3), 172–188. https://doi.org/10.1057/s41289-021-00167-5

Everett, G., Lamond, J. E., Morzillo, A. T., Matsler, A. M., & Chan, F. K. S. (2018). Delivering green streets: An exploration of changing perceptions and behaviours over time around bioswales in Portland, Oregon. *Journal of Flood Risk Management, 11*(2), 973-985. https://doi.org/10.1111/jfr3.12225

Fletcher, T. D., Shuster, W., Hunt, W. F., Ashley, R., Butler, D., Arthur, S., Trowsdale, S., Barraud, S., Semadeni-Davies, A., Bertrand-Krajewski, J.-L., Mikkelsen, P. S., Rivard, G., Uhl, M., Dagenais, D., & Viklander, M. (2015). The evolution and application of terminology surrounding urban drainage. *Urban Water Journal, 12*(7), 525–542. https://doi.org/10.1080/1573062X.2014.916314

Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., & Bonn, A. (2017). Nature based solutions to climate change mitigation and adaptation in urban areas: Perspective on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and Society, 21*(2), 1-15. https://doi.org/10.5751/ES-08373-210239

Gallo, E. M., Bell, C. D., Panos, C. L., Smith, S. M., & Hogue, T. S. (2020). Investigating trade-offs of green to grey stormwater infrastructure using a planning-level decision support tool. *Water, 12*(7), 2005. https://doi.org/10.3390/w12072005

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., & Nieuwenhuijsen, M. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: A systematic review. *International Journal of Environmental Research and Public Health, 12*(4), 4354–4379. https://doi.org/10.3390/ijerph120404354

Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions, 1*(1), 24–40. https://doi.org/10.1016/j.eist.2011.02.002

Ghofrani, Z., Sposito, V., & Faggian, R. (2017). A comprehensive review of blue-green infrastructure concepts. *International Journal of Environment and Sustainability, 6*(1), 15-36.

Gogate, N. G., Kalbar, P. P., & Raval, P. M. (2017). Assessment of stormwater management options in urban contexts using multiple attribute decision-making. *Journal of Cleaner Production, 142*, 2046–2059. https://doi.org/10.1016/j.jclepro.2016.11.079

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., Brenck, M., Fischer, L. K., Frantzeskaki, N., Kabisch, N., Krellenberg, K., Kremer, P., Kronenberg, J., Larondelle, N., Mathey, J., Pauleit, S., Ring, I., Rink, D., Schwarz, N., & Wolff, M. (2017). Greening cities – To be socially inclusive? About the alleged paradox of society and ecology in cities. *Habitat International, 64*, 41–48. https://doi.org/10.1016/j.habitatint.2017.04.005

Hamann, F., Blecken, G.-T., Ashley, R. M., & Viklander, M. (2020). Valuing the multiple benefits of blue-green infrastructure for a Swedish case study: Contrasting the economic assessment tools B£ST and TEEB. *Journal of Sustainable Water in the Built Environment, 6*(4), 1-10. https://doi.org/10.1061/JSWBAY.0000919

Hamel, P., & Tan, L. (2022). Blue–green infrastructure for flood and water quality management in Southeast Asia: Evidence and knowledge gaps. *Environmental Management, 69*(4), 699–718. https://doi.org/10.1007/s00267-021-01467-w

Harriden, K. (2012). Potential impacts of slum urbanisation on channel bank storage in the Bang Pakong River, Thailand. *Water Practice and Technology, 7*(4), wpt2012071. https://doi.org/10.2166/wpt.2012.071

Holtz, G., Brugnach, M., & Pahl-Wostl, C. (2008). Specifying "regime" — A framework for defining and describing regimes in transition research. *Technological Forecasting and Social Change, 75*(5), 623–643. https://doi.org/10.1016/j.techfore.2007.02.010

Hysa, A. (2021). Introducing transversal connectivity index (TCI) as a method to evaluate the effectiveness of the blue-green infrastructure at metropolitan scale. *Ecological Indicators, 124*, 107432. https://doi.org/10.1016/j.ecolind.2021.107432

Jean, L., Krajewski, B., Bertrand, K., & Jean, L. (2021). Integrated urban stormwater management: Evolution and multidisciplinary perspective. *Journal of Hydro-Environment Research, 38*, 72–83. https://doi.org/10.1016/j.jher.2020.11.003

Kaur, R., & Gupta, K. (2022). Blue-green infrastructure (BGI) network in urban areas for sustainable storm water management: A geospatial approach. *City and Environment Interactions*, *16*, 100087. https://doi.org/10.1016/j.cacint.2022.100087

Keeler, B. L., Hamel, P., McPhearson, T., Hamann, M. H., Donahue, M. L., Meza Prado, K. A., Arkema, K. K., Bratman, G. N., Brauman, K. A., Finlay, J. C., Guerry, A. D., Hobbie, S. E., Johnson, J. A., MacDonald, G. K., McDonald, R. I., Neverisky, N., & Wood, S. A. (2019). Social-ecological and technological factors moderate the value of urban nature. *Nature Sustainability, 2*(1), 29–38. https://doi.org/10.1038/s41893-018-0202-1

Kim, D., & Song, S.-K. (2019). The multifunctional benefits of green infrastructure in community development: An analytical review based on 447 cases. *Sustainability, 11*(14), 3917. https://doi.org/10.1038/s41893-018-0202-1

Kordana, S. (2018). The identification of key factors determining the sustainability of stormwater systems. *E3S Web of Conferences*, 45, 00033. https://doi.org/10.1051/e3sconf/20184500033

Kordana, S., & Słyś, D. (2020). Decision criteria for the development of stormwater management systems in Poland. *Resources, 9*(2), 20. https://doi.org/10.3390/resources9020020

Krivtsov, V., Birkinshaw, S., Olive, V., Lomax, J., Christie, D., & Arthur, S. (2022). Multiple benefits of blue-green infrastructure and the reduction of environmental risks: Case study of ecosystem services provided by a SUDS pond. In: Kolathayar, S., Pal, I., Chian, S.C., Mondal, A. (eds). *Civil Engineering for Disaster Risk Reduction*, (pp. 247–262). https://doi.org/10.1007/978-981-16-5312-4_17

Kvamsås, H. (2021). Addressing the adaptive challenges of alternative stormwater planning. *Journal of Environmental Policy & Planning, 23*(6), 809–821. https://doi.org/10.1080/1523908X.2021.1921568

Kvamsås, H. (2023). Co-benefits and conflicts in alternative stormwater planning: Blue versus green infrastructure? *Environmental Policy and Governance*, *33*(3), 232–244. https://doi.org/10.1002/eet.2017

Li, J., & Trivic, Z. (2024). Impact of "blue-green diet" on human health and wellbeing: A systematic review of potential determinants in shaping the effectiveness of blue-green infrastructure (BGI) in urban settings. *Science of The Total Environment, 926*, 171397. https://doi.org/10.1016/j.scitotenv.2024.171397

Liao, K.-H., Deng, S., & Tan, P. Y. (2017). Blue-green infrastructure: New frontier for sustainable urban stormwater management. In: Tan, P., Jim, C. (Eds), *Greening Cities. Advances in 21st Century Human Settlements*. (pp. 203–226). Springer, Singapore. https://doi.org/10.1007/978-981-10-4113-6_10

Liu, L., & Jensen, M. B. (2018). Green infrastructure for sustainable urban water management: Practices of five forerunner cities. *Cities, 74*, 126–133. https://doi.org/10.1016/j.cities.2017.11.013

Lourdes, K., Gibbins, C., Hamel, P., Sanusi, R., Azhar, B., & Lechner, A. (2021). A review of urban ecosystem services research in Southeast Asia. *Land, 10*(1), 40. https://doi.org/10.3390/land10010040

Lund, D. H. (2018). Governance innovations for climate change adaptation in urban Denmark. *Journal of Environmental Policy & Planning, 20*(5), 632–644. https://doi.org/10.1080/1523908X.2018.1480361

Markevych, I., Schoierer, J., Hartig, T., Chudnovsky, A., Hystad, P., Dzhambov, A. M., de Vries, S., Triguero-Mas, M., Brauer, M., Nieuwenhuijsen, M. J., Lupp, G., Richardson, E. A., Astell-Burt, T., Dimitrova, D., Feng, X., Sadeh, M., Standl, M., Heinrich, J., & Fuertes, E. (2017). Exploring pathways linking greenspace to health: Theoretical and methodological guidance. *Environmental Research, 158*, 301–317. https://doi.org/10.1016/j.envres.2017.06.028

McCormick, K., Anderberg, S., Coenen, L., & Neij, L. (2013). Advancing sustainable urban transformation. *Journal of Cleaner Production, 50*, 1–11. https://doi.org/10.1016/j.jclepro.2013.01.003

McDougall, C. W., Foley, R., Hanley, N., Quilliam, R. S., & Oliver, D. M. (2022). Freshwater wild swimming, health and well-being: Understanding the importance of place and risk. *Sustainability, 14*(10), 6364. https://doi.org/10.3390/su14106364

Meerow, S. (2020). The politics of multifunctional green infrastructure planning in New York City. *Cities, 100*, 102621. https://doi.org/10.1016/j.cities.2020.102621

Mell, I. C. (2008). Green infrastructure: Concepts and planning. *FORUM eJournal, 8*(1), 69–80. Newcastle University. http://www.conservationfund.org

Mguni, P., Herslund, L., & Jensen, M. B. (2015). Green infrastructure for flood-risk management in Dar es Salaam and Copenhagen: Exploring the potential for transitions towards sustainable urban water management. *Water Policy, 17*(1), 126–142. https://doi.org/10.2166/wp.2014.047

Moreno, J. O., Smith, K. M., & Mijic, A. (2017). Economic analysis of wider benefits to facilitate SuDS uptake in London, UK. *Sustainable Cities and Society, 28*, 411–419. https://doi.org/10.1016/j.scs.2016.10.002

Neumann, S. S., Renouf, M., Kenway, S. J., & Low Choy, D. (2017). Connecting land-use and water planning: Prospects for an urban water metabolism approach. *Cities, 60*, 13–27. https://doi.org/10.1016/j.cities.2016.07.003

O'Donnell, E. C., Lamond, J. E., & Thorne, C. R. (2017). Recognising barriers to implementation of Blue-Green Infrastructure: A Newcastle case study. *Urban Water Journal, 14*(9), 964–971. https://doi.org/10.1080/1573062X.2017.1279190

Pauleit, S., Hansen, R., Rall, E. L., & Rolf, W. (2020). Urban green infrastructure: Strategic planning of urban green and blue for multiple benefits. In I. Douglas, H. James, & D. Goode (Eds.), *The Routledge handbook of urban ecology* (2nd ed., pp. 12–25). Routledge. https://doi.org/10.4324/9780429506758

Pochwat, K., Kida, M., Ziembowicz, S., & Koszelnik, P. (2019). Odours in sewerage—A description of emissions and of technical abatement measures. *Environments, 6*(8), 89. https://doi.org/10.3390/environments6080089

Pregnolato, M., Ford, A., Robson, C., Glenis, V., Barr, S., & Dawson, R. (2016). Assessing urban strategies for reducing the impacts of extreme weather on infrastructure networks. *Royal Society Open Science, 3*(5), 160023. https://doi.org/10.1098/rsos.160023

Prudencio, L., & Null, S. E. (2018). Stormwater management and ecosystem services: A review. *Environmental Research Letters, 13*(3), 033002. https://doi.org/10.1088/1748-9326/aaa81a

Qiao, X.-J., Kristoffersson, A., & Randrup, T. B. (2018). Challenges to implementing urban sustainable stormwater management from a governance perspective: A literature review. *Journal of Cleaner Production, 196*, 943–952. https://doi.org/10.1016/j.jclepro.2018.06.049

Rahtz, E., Bell, S. L., Nurse, A., Wheeler, B. W., Guell, C., Elliott, L. R., Thompson, C. W., McDougall, C. W., & Lovell, R. (2023). What is known about what works in community-involved decision-making relating to urban green and blue spaces? A realist review protocol. *Systematic Reviews, 12*(1), 169. https://doi.org/10.1186/s13643-023-02333-y

Raška, P., Bezak, N., Ferreira, C. S. S., Kalantari, Z., Banasik, K., Bertola, M., Bourke, M., Cerdà, A., Davids, P., De Brito, M., Evans, R., Finger, D. C., Halbac-Cotoara-Zamfir, R., Housh, M., Hysa, A., Jakubínský, J., Solomun, M. K., Kaufmann, M., Keesstra, S., Hartmann, T. (2022). Identifying barriers for nature-based solutions in flood risk management: An interdisciplinary overview using expert community approach. *Journal of Environmental Management, 310*, 114725. https://doi.org/10.1016/j.jenvman.2022.114725

Read, C. (2016). The times of Harold Hotelling. In *The econometricians* (pp. 159–163). Palgrave Macmillan. https://doi.org/10.1057/978-1-137-34137-2_16

Roy, A. H., Wenger, S. J., Fletcher, T. D., Walsh, C. J., Ladson, A. R., Shuster, W. D., Thurston, H. W., & Brown, R. R. (2008). Impediments and solutions to sustainable, watershed-scale urban stormwater management: Lessons from Australia and the United States. *Environmental Management, 42*(2), 344–359. https://doi.org/10.1007/s00267-008-9119-1

Sarabi, S., Han, Q., Romme, A. G. L., de Vries, B., Valkenburg, R., & den Ouden, E. (2020). Uptake and implementation of nature-based solutions: An analysis of barriers using interpretive structural modelling. *Journal of Environmental Management, 270*, 110749. https://doi.org/10.1016/j.jenvman.2020.110749

Sarabi, S., Han, Q., L. Romme, A. G., de Vries, B., & Wendling, L. (2019). Key enablers of and barriers to the uptake and implementation of nature-based solutions in urban settings: A review. *Resources, 8*(3), 121. https://doi.org/10.3390/resources8030121

Scaroni, A. E., Sahoo, D., & Wallover, C. G. (2021). *An introduction to stormwater ponds in South Carolina*. Clemson University Cooperative Extension.

Schewenius, M., & Wallhagen, M. (2024). Virtual Reality in planning, design, and management of urban green and blue infrastructure. *Frontiers in Virtual Reality*, 5, 1-14. https://doi.org/10.3389/frvir.2024.1432556

Sehrawat, S., & Shekhar, S. (2024). Global insights, local realities: BGI challenges and opportunities in Indian urbanization. *Eco Cities, 4*(1), 2409. https://doi.org/10.54517/ec.v4i1.2409

Sharma, R., & Malaviya, P. (2021). Management of stormwater pollution using green infrastructure: The role of rain gardens. *WIREs Water, 8*(2), 1507. https://doi.org/10.1002/wat2.1507

Singh, Y. V., Banerjee, S., & Sagar, D. (2023). Integrated blue green infrastructure approach for storm water management. *EPRA International Journal of Climate and Resource Economic Review*, *11*(2), 1–5. https://doi.org/10.36713/epra13053

Sörensen, J., Persson, A. S., & Olsson, J. A. (2021). A data management framework for strategic urban planning using blue-green infrastructure. *Journal of Environmental Management*, *299*, 113658. https://doi.org/10.1016/j.jenvman.2021.113658

Staddon, C., Ward, S., De Vito, L., Zuniga-Teran, A., Gerlak, A. K., Schoeman, Y., Hart, A., & Booth, G. (2018). Contributions of green infrastructure to enhancing urban resilience. *Environment Systems and Decisions, 38*(3), 330–338. https://doi.org/10.1007/s10669-018-9702-9

Stec, A., & Mazur, A. (2019). An analysis of eco-technology allowing water and energy saving in an environmentally friendly house—A case study from Poland. *Buildings, 9*(8), 180. https://doi.org/10.3390/buildings9080180

Suleiman, L. (2021). Blue green infrastructure, from niche to mainstream: Challenges and opportunities for planning in Stockholm. *Technological Forecasting and Social Change*, 166. https://doi.org/10.1016/j.techfore.2020.120528

Szeląg, B., Cienciała, A., Sobura, S., Studziński, J., & García, J. T. (2019). Urbanization and management of the catchment retention in the aspect of operation of storm overflow: A probabilistic approach. *Sustainability, 11*(13), 3651. https://doi.org/10.3390/su11133651

Tchórzewska-Cieślak, B., Rak, J. R., & Szpak, D. (2019). Bayesian inference in the analysis of the failure risk of the water supply network. *Journal of Konbin, 49*(3), 433–450. https://doi.org/10.2478/jok-2019-0066

Thorne, C. R. R., Lawson, E. C. C., Ozawa, C., Hamlin, S. L. L., & Smith, L. A. A. (2018). Overcoming uncertainty and barriers to adoption of blue-green infrastructure for urban flood risk management. *Journal of Flood Risk Management, 11*(S2), S960–S972. https://doi.org/10.1111/jfr3.12218

Tsegaye, S., Singleton, T. L., Koeser, A. K., Lamb, D. S., Landry, S. M., Lu, S., Barber, J. B., Hilbert, D. R., Hamilton, K. O., Northrop, R. J., & Ghebremichael, K. (2019). Transitioning from gray to green (G2G): A green infrastructure planning tool for the urban forest. *Urban Forestry & Urban Greening*, 40, 204–214. https://doi.org/10.1016/j.ufug.2018.09.005

Voskamp, I. M., & Van de Ven, F. H. M. (2015). Planning support system for climate adaptation: Composing effective sets of blue-green measures to reduce urban vulnerability to extreme weather events. *Building and Environment*, 83, 159–167. https://doi.org/10.1016/j.buildenv.2014.07.018

Wamsler, C., Wickenberg, B., Hanson, H., Alkan Olsson, J., Stålhammar, S., Björn, H., Falck, H., Gerell, D., Oskarsson, T., Simonsson, E., Torffvit, F., & Zelmerlow, F. (2020). Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation. *Journal of Cleaner Production*, 247, 119154. https://doi.org/10.1016/j.jclepro.2019.119154

Wihlborg, M., Sörensen, J., & Alkan Olsson, J. (2019). Assessment of barriers and drivers for implementation of blue-green solutions in Swedish municipalities. *Journal of Environmental Management*, 233, 706–718. https://doi.org/10.1016/j.jenvman.2018.12.018

Wilbers, G.-J. J., De-Bruin, K., Seifert-Dähnn, I., Lekkerkerk, W., Li, H., & Budding-Polo B. M., (2022). Investing in urban blue–green infrastructure: Assessing the costs and benefits of stormwater management in a peri-urban catchment in Oslo, Norway. *Sustainability, 14*(3), 1934. https://doi.org/10.3390/su14031934

Zawilski, M., Sakson, G., & Brzezińska, A. (2014). Opportunities for sustainable management of rainwater: Case study of Łódź, Poland. *Ecohydrology & Hydrobiology, 14*(3), 220–228. https://doi.org/10.1016/j.ecohyd.2014.07.003

Zhou, Q. (2014). A review of sustainable urban drainage systems considering the climate change and urbanization impacts. *Water, 6*(4), 976–992. https://doi.org/10.3390/w6040976