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Integrating Concepts of Blue-green Infrastructure to Support Multidisciplinary Planning of Sustainable Cities

Integracja koncepcji niebiesko-zielonej infrastruktury jako narzędzie wspierania interdyscyplinarnego planowania Zrównoważonych Miast

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Abstract
Currently, there is a tendency to apply nature-based landscape components as an important element in decentralised stormwater management, an essential part of sustainable urban development. The term *blue-green infrastructure* (BGI) is now used for many planning solutions of sustainable cities. Using thematic analysis of 27 studies and documents between 2006-2019, we identified 6 types of approaches to BGI. We then reclassified the six observed approaches into three basic categories of conceptual approaches to BGI. We distinguished four basic guidelines for the development of science and practice, aimed at promoting of an integrated concept of BGI to support multidisciplinary planning of sustainable cities. Based on the benefits of BGI presented in studies and documents, we show the importance of BGI from the perspective of the 2030 Agenda for Sustainable Development.

Key words: blue-green infrastructure, BGI, stormwater management, sustainable cities, urban planning, Sustainable Development Goals

Streszczenie
Obecnie istnieje tendencja do wykorzystywania naturalnego krajobrazu jako ważnego elementu w zdecentralizowanej gospodarce wodami opadowymi, będącej istotnej części zrównoważonego rozwoju obszarów miejskich. Termin *niebiesko-zielona infrastruktura* (BGI) jest używany w wielu rozwiązaniach planistycznych miast zrównoważonych. Korzystając z analizy tematycznej 27 badań i dokumentów z lat 2006-2019, zidentyfikowaliśmy 6 typów podejść do BGI. Następnie dokonaliśmy ich przeklasyfikowania na 3 podstawowe kategorie podejść koncepcyjnych. Wyróżniliśmy 4 podstawowe wytyczne dotyczące rozwoju nauki i praktyki, mające na celu promowanie zintegrowanej koncepcji BGI wspierającej interdyscyplinarne planowanie miast zrównoważonych. Opierając się na korzyściach płynących z BGI przedstawionych w omówionych opracowaniach i dokumentach, pokazujemy znaczenie BGI z perspektywy Agendy na rzecz zrównoważonego rozwoju 2030.

Słowa kluczowe: infrastruktura niebiesko-zielona, BGI, gospodarce wodami opadowymi, zrównoważone zrównoważone miasta, urbanistyka, Cele Zrównoważonego Rozwoju

1. Introduction and theoretical background

Sustainable water management associated with approaches to the vegetation elements within the urban landscape is considered a key issue of urban planning in cities all over the world (Morison & Brown, 2011; Giordano et al., 2013). Urban green infrastructure has played an important climate change mitigation role, along with water resources in the urban landscape (Sussams et al., 2015; Howe & Mitchell, 2012; Mrowiec et al., 2018). Nature-based solutions such as green roofs, bioswales or rain garden help to reduce local flooding and thermal discomfort. The EU Commission defines nature-based solutions (NBS) as *solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience* (EEA, 2015; Kabisch et al., 2017). Nature-based solutions can be considered as an umbrella for the other concepts: Green infrastructure, Ecosystem-based adaptation and Ecosystem services (Pauleit et al., 2017).

Green infrastructure is understood both in the sense of the ecosystem functions of urban green infrastructure – climatic and hydrological functions, support of biodiversity and air quality or noise regulation – and part of the urban social environment: recreational, aesthetic, cultural and community functions (Pauleit et al., 2019; Young et al., 2014; Voskamp & Van de Ven, 2015; Mell et al., 2017; Giordano et al., 2013). The need for economic evaluation of ecosystem functions has also brought about the development of the concept of ecosystem services (Escobedo et al., 2019; Hegetschweiler et al., 2017; Vierikko & Niemelä, 2016; Elmqvist et al., 2015). It is necessary to increase knowledge about how ecosystem services contribute to society from economic, social, environmental aspects of urban sustainable development (Edlund, 2020; Zaręba, 2014).

Sustainable water management is a major challenge of urban development agenda worldwide (Mrowiec et al., 2018). Current trends have been made evident by a number of systematically-introduced urban water-management schemes (Howe & Mitchell, 2012; Woods Ballard et al., 2015; Mrowiec, 2016; Hoang et al., 2017). Urban green infrastructure systems associated with elements of stormwater management have now advanced under the umbrella term *blue-green infrastructure* (BGI) in the current environmental and political context of planning urban adaptations to climate change (e.g. Voskamp & Van de Ven, 2015). The term is currently used in various contexts internationally, and it is applied at national levels of sustainable urban development planning (Ghofrani et al., 2017). For example, blue-green infrastructure (BGI) is defined as *a naturally-oriented water cycle contributing to the amenity of the city by bringing water management and green infrastructure together* (Thorne, 2016). The use of terms *green-blue-grey infrastructure* (Alves, 2020), *hybrid or mixed infrastructure* (Depietri & McPhearson, 2017) shows the need for the combination of measures in practice.

The question is whether BGI is simply a new term used for many different meanings of urban green infrastructure or whether it constitutes a new thematic approach to sustainable urban planning. In urban planning, new approaches to water management are introduced in the concept of Blue-green cities (Thorne, 2016) or as variants of Sustainable cities, Eco-cities (De Jong et al., 2015; Bai et al., 2012), Healthy cities (de Leeuw et al., 2014), Biosensitive cities (Schandl et al., 2012) or Smart cities (Louda et al., 2016; Neirotti et al. 2014) with emphasis on a key role for BGI. The implementation of BGI is in line with The Shenzhen Declaration on EcoCity Development (Blewitt, 2008).

The Sustainable Development Goals (SDGs) are 17 global objectives to guide efforts towards addressing sustainable development worldwide by 2030 (United Nations, 2015; Woodbridge, 2015). Cities have been the drivers of innovative sustainable development at the local level (Condon, 2020). Our goal is to analyze the approaches to BGI and show their links to the SDGs.

This contribution strives to achieve the following tasks:

i) to identify currently applied thematic areas of BGI and to classify basic types of approaches to BGI,
ii) to present an integrated concept of BGI to support multidisciplinary planning of sustainable cities
iii) to assess the benefits of BGI in achieving the SDGs

2. Research design

In the first part of the research, we carried out a thematic analysis of studies and documents. We selected twenty representative studies from the preceding frequency analysis dataset for this part of the research. For each team of authors to publish several articles using the same methodological approach, only one representative study was selected. In addition, seven major project documents that show BGI approaches in practice were included in the research. This way were selected studies and documents differed in their focus and represented different national or international project teams. It was not the aim to determine the number of documents, but to look for different types of hits.

Our aim was to identify thematic areas, key terms and definitions of BGI. Our methodology follows established procedures of thematic document analysis (Sussams et al., 2015; Alholjailan, 2012; Fugard & Potts, 2015; Bowen, 2009). It is based on putting keywords, definitions, phrases, and ideas into a rubric organized by differences in definitions

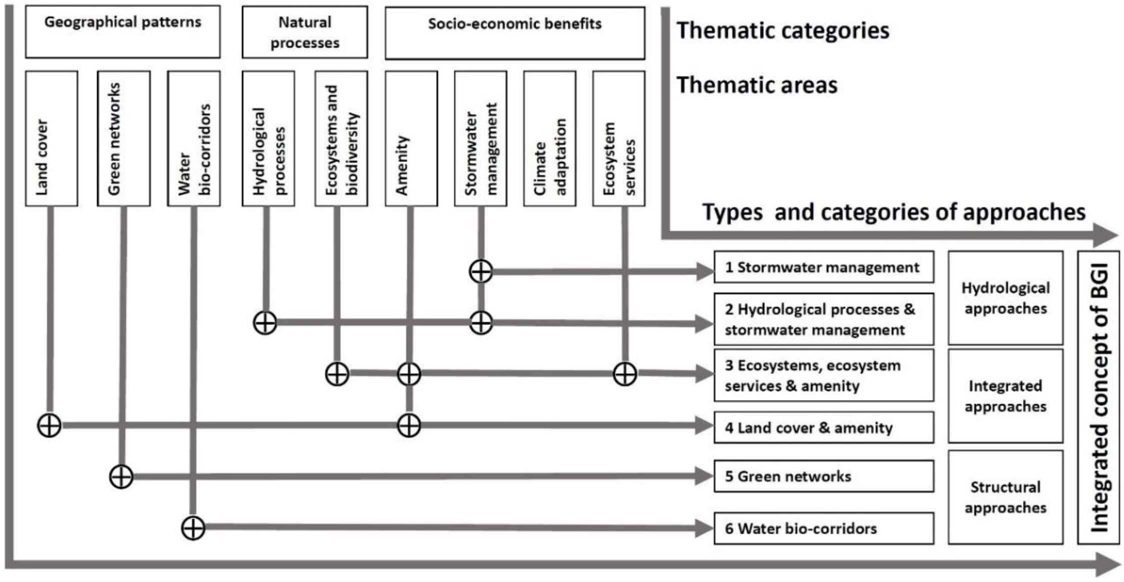

Figure 1. Review methodology – from thematic categories and areas of BGI studies focus to typology of approaches and integrated concept of BGI, source: prepared by the authors

Table 1. Typology of approaches to BGI based on thematic analysis of studies and documents, source: authors' analysis of the studies and documents cited

Studies and documents	Thematic areas									Typology of approaches to BGI	
	Geographical patterns			Natural processes		Socio-economic benefits					
	Land cover	Green networks	Water bio-corridors	Hydrological processes	Ecosystems and biodiversity	Amenity	Stormwater management	Climate adaptation	Ecosystem services	Types of approaches	Categories of approaches
Wörlen et al., 2016				•	•	•	••	•	••	1 Stormwater management	Hydrological
Voskamp & Van de Ven, 2015	•			•	•		••	••	•		
Center for Neighborhood Tech., 2010				•	•	•	••	•	••		
DELWP, 2017		•	•	•	•	•	••	•			
Sexton & Jeremiah, 2017	•		•	•		•	••				
Van Timmeren et al., 2016			•	•	•	••	••	•	•		
Bacchin et al., 2016				•	•	•	••		•		
Wouters et al., 2016				••		•	••	•	•	2 Hydrological processes & stormwater management	
Thorne, 2016	•			••		•	••	•	•		
Hoang & Fenner, 2016	•			••	•	•	••		•		
UK Green Building Council, 2015	•	•			••	••			••	3 Ecosystems, ecosystem services & amenity	Integrated
Vierikko & Niemelä, 2016	•			•	••	••	•		••		
Vlaamse Landmaatschappij, 2015	•	•	•		••	•		•	•		
Gehrels et al., 2016	•		•		••	••	••	•	••		
Elmqvist et al., 2015	•				••	••			••		
Bozovic et al., 2017			•		••	••	•	•	••		
Kazmierczak & Carter, 2010	•	•			•	••		••		4 Land cover & amenity	
Planning Department HKSARG, 2016	••				•	••		•	•		
Pötz, 2016	•	•	•		•	••		•			
Völker & Kistemann, 2015	••		•		•	••			•		
Wagner et al., 2013		••	••	••	•		•			5 Green networks	Structural
Ghofrani et al., 2017		••	•	•		•	••	•	••		
Frischenbruder & Pellegrino, 2006		••	•		•	•					
Chicago Dept. of Transportation, 2007		••		•		•	••	•	•		
Schrijnen, 2000	•	••			•						
Perini & Sabbion, 2017		•	••		•	•	•	•	••	6 Water bio-corridors	
Philadelphia Water Department, 2009			••	•	•	•	••		•		

•• key theme, • theme is taken into consideration

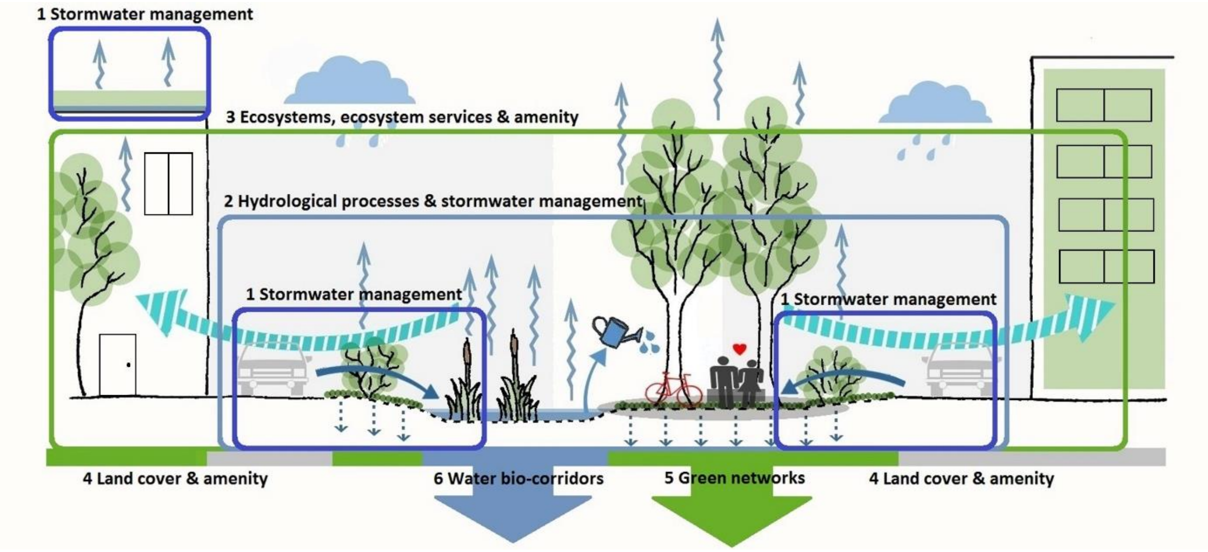

Figure 2. Schematic depiction of approaches to BGI in the urban landscape, source: authors' depiction based on the typology in Tab. 1 and Fig. 1; drawing of the urban landscape by Kopp et al. (2017) and Faltermaier, et al. (2016)

and uses of key terms. Our analysis focused on whether a given theme of BGI in a study was central to the study or not. On the basis of observed key themes, BGI definitions and variations of the BGI terminology, we were able to describe several types of approaches to the BGI concept (Fig. 1). Based on our frequency and thematic analysis we created an integrating concept of BGI in hopes of a more standardized and systematic use of the term.

In the follow-up section, we used the results of the thematic analysis to compare the BGI to the 2030 Agenda for Sustainable Development framework. The nexus between the BGI and the SDGs has been documented based on contingent target records inspired by relevant studies (Freyling, 2015; Sørup et al., 2019; Allen et al., 2017).

3. Results

3.1. Thematic analysis and typology of approaches

We selected twenty-seven studies and documents using BGI (Tab. 1). Our analysis confirmed that the definition of BGI is not stable in the international context, rendering the individual studies and projects thematically different in content definition (Perini & Sabbion, 2017; Fletcher et al., 2015; Silva & Wheeler, 2017). A more comprehensive concept of terminology can sometimes be ascertained at the national level (e.g. Vlaamse Landmaatschappij, 2015; Gehrels et al., 2016; Elmqvist et al., 2015), although this constitutes an exception rather than a rule and individual urban documents may still differ at the municipal level (Center for Neighbourhood Technology, 2010; Chicago Department of Transportation, 2007; Philadelphia Water Department, 2009).

Despite the terminological inconsistency described above, we identified nine thematic areas which were frequently mentioned relating to BGI (Fig. 1; Tab. 1). Following studies that categorize similarly green infrastructure focus (Koc et al., 2017; Szulczewska et al., 2017; Wang et al., 2018), we created the following three thematic categories of BGI studies focus: (a) geographical patterns (land cover, green networks, water bio-corridors), (b) natural processes (hydrological processes, ecosystems and biodiversity) and (c) socio-economic benefits (amenity, stormwater management and climate adaptation, and attempts to introduce ecosystem services). These categories are not mutually exclusive or exhaustive, but they cover all key BGI aspects.

3.2. Typology of approaches to BGI

Considering nine thematic areas related to the BGI concept described above, further analysis of the contents of the studies and documents was undertaken, resulting in the determination of six basic types of approach to BGI: 1. Stormwater management, 2. Hydrological processes & stormwater management, 3. Ecosystems, ecosystem services & amenity, 4. Land cover & amenity, 5. Green networks and 6. Water bio-corridors (Fig. 1, Tab. 1).

Proposed types of approaches can be classified into three basic conceptual categories: (a) hydrological approaches (Stormwater management, Hydrological processes & stormwater management), (b) integrated approaches (Ecosystems, ecosystem services & amenity, Land cover & amenity) and (c) structural (Green networks, Water bio-corridors). This classification into three basic conceptual categories is inspired from the categorisation of green infrastructure approaches in cities (Szulczewska et al., 2017; Wang et al., 2018).

The resulting types show that some studies and documents from a range of national environments and different planning contexts are related in terms of concept. The defined types are best interpreted as fuzzy sets that aid orientation in an otherwise unclear terminological environment, an area that lacks a unified definition of basic concepts in the field of BGI (Fig. 2).

3.3. Benefits of BGI to sustainable urban development

Sustainable urban development uses BGI to deliver maximum benefits for the provision and control of water quantity, quality, amenity, and biodiversity (Bacchin et al., 2016). The benefits of BGI to sustainable urban development were categorized under four broad domains: flood resilience, natural resources management, liveability, transition, and innovation (Sørup et al., 2019). Each type of approach to BGI emphasizes some of the listed benefit categories.

3.3.1. Flood control

Flood control is a key service of BGI for stormwater management. The largest number of documents studied perceives BGI primarily in terms of a stormwater management tool (Tab. 1, Type 1), in which ecosystem approaches are preferred, and water management measures are linked to the urban green infrastructure system (Voskamp & Van de Ven, 2015; DELWP, 2017). Urban green infrastructure intrinsically and naturally fulfils significant hydrological functions, facilitating interception, retention and evapotranspiration. On the other hand, the new ecosystem approaches are an important element of the water management concept of urban development, while BGI concepts integrate water management and other environmental benefits (Van Timmeren et al., 2016; Wouters et al., 2016; Kopp & Preis, 2019). A related concept was differentiated as a separate type (Tab. 1, Type 2), in which BGI is perceived as a tool for stormwater management but particular attention is also paid to the study, assessment and support of hydrological or more general fluvial processes in the urban landscape, including flood protection in river floodplains (Wouters et al., 2016; Thorne, 2016). These studies, as well as the first type, also refer to the need to adapt cities to climate change.

3.3.2. Liveability

New approaches to stormwater management are a great opportunity to transform urban space and promote the liveability of the cities. Any assumption that the term *BGI* is associated with emphasis on ecosystem functions as economic benefits for urban residents via the term *infrastructure* was only partially confirmed in the studies classified as belonging to the third type on the basis of thematic analysis (Tab. 1, Type 3). The third type includes the studies and project documents that tend largely towards linking BGI with the ecosystem approach to urban green infrastructure, supporting biodiversity, further making significant efforts to document and, if possible, expressing ecosystem services in economic/financial terms (Vierikko & Niemelä, 2016; Elmqvist et al., 2015). The socio-economic benefits that are associated with amenity BGI functions – recreational, cultural, and psychosocial and health concerns – play an important role in this concept (Gehrels et al., 2016; Elmqvist et al., 2015; Bozovic et al., 2017).

3.3.3. Transition and innovation

One of the rules of sustainable urban development is: *Invest in lighter, greener, cheaper, smarter infrastructure* (Condon, 2010). Many BGI approaches such as green roofs and semi-permeable surfaces, or new designs of recreational space for exercise and social activities in cities may be considered good examples of such smart infrastructure (Wouters et al., 2016; Lamond & Everett, 2019). BGI implementation requirements are a new impetus for the technological innovations and the growth of the green economy.

Blue matters of BGI appear rather to be perceived as background water ecosystems that, fulfil certain socio-cultural functions in the urban landscape. A typical example are revitalized riverfronts (Perini & Sabbion, 2017). New parks, squares, and riverfronts with BGI elements support social interaction and social integration (Lamond & Everett, 2019; Wouters et al., 2016; Edlund, 2020). These amenities help to improve human physical and mental health (de Leeuw et al., 2014).

3.3.4. Natural resources management

BGI applications in the urban landscape enhance groundwater recharge, improve runoff quality, and reduce runoff quantity. BGI is a vital component of natural resources management and therefore urban planning supports the functioning of BGI networks. In some approaches (Tab. 1, Type 5), the more general *green infrastructure* concepts are followed (e.g. EC, 2013a; EU, 2016), involving the urban landscape as well as stressing the roles of functional planned greenery systems (Wagner & Breil, 2013; Schrijnen, 2000). *Green corridors* may run alongside waterways in the urban landscape (Frischenbruder & Pellegrino, 2006) or verges may provide *green strips* alongside streets (Chicago Department of Transportation, 2007; Newell et al., 2013). The urban ecohydrology specialization promotes a spatially interconnected system of the BGI elements (Wagner et al., 2013), an approach that prioritises and integrates the roles of waterways and hydrological processes at the same time. The studies in which the concept of water bio-corridors prevailed over that of green corridors were classified as a separate type (Tab. 1, Type 6). Fluvial bio-corridors are presented as *green infrastructure* (Philadelphia Water Department, 2009; Strickland et al., 2010) or as a fundamental part of the *green and blue infrastructure* (Perini & Sabbion, 2017). In this concept, BGI functions appear very loosely, with the emphasis on water management and ecosystem matters, together with the creation of recreational axes within the urban landscape.

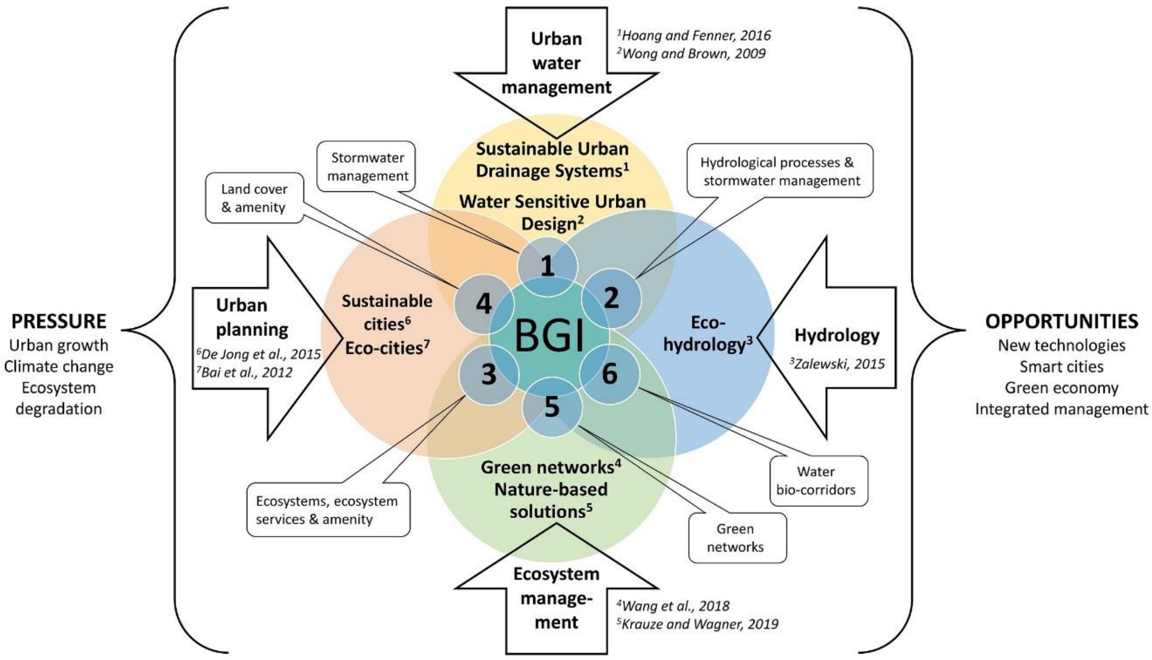

Figure 3. Integrating multidisciplinary concept of BGI based on the analysis of approaches and cited studies, source: prepared by the authors

Table 2. Nexus between specializations in the BGI field and benefits to relevant SDGs,s: Prepared by authors, based on: United Nations, 2015

SDGs	Disciplines and progressive specialization in the BGI field				SDGs targets (UN, 2015)
	Urban water management	Urban planning	Ecosystem management	Hydrology	
	SUDS & WSUD	Sustainable cities & Eco-cities	Green networks & NBS	Ecohydrology	
3	●	●●	●		3.4, 3.9
6	●●●	●		●●	6.3, 6.5, 6.6, 6b
7		●●			7.3
8		●			8.2
9	●●	●●	●		9.1, 9.4, 9.5
11	●●●	●●●	●●	●	11.3, 11.5, 11.6, 11.7, 11b
12	●	●●			12.2, 12.8
13	●●	●●	●●●	●	13.1, 13.2, 13.3
14	●		●	●	14.1
15	●		●●●	●●	15.1, 15.3, 15.9
17	●	●			17.6

SDGs: 3 Good Health and Well-being; 6 Clean Water and Sanitation; 7 Affordable and Clean Energy; 8 Decent Work and Economic Growth; 9 Industry, Innovation and Infrastructure; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 13 Climate Action; 14 Life Below Water; 15 Life on Land; 17 Partnerships to achieve the Goal
Prioritizing the benefit to relevant SDG targets: ●●● key benefit, ●● important benefit, ● marginal benefit

3.4. Integrated concept of BGI

Despite the differences in terminology we found many intersections in BGI approaches indicating a substantial need for deeper multidisciplinary integration. We suggest the BGI integrating concept to bring together the approaches of individual disciplines. Each discipline declares BGI to be a tool for progress in its area (Fig. 3), but their approaches to BGI vary in thematic analysis of documents. We see numerous intersections and interconnections between the types of approaches to BGI and between disciplines, not only in academia, but also in the practice of urban development. We can distinguish four basic guidelines for the development of science and planning practice, aimed at promoting of an integrated concept of BGI: urban water management (Hoang & Fenner, 2016; Wong & Brown, 2009), urban planning (de Jong et al., 2015; Bai et al., 2012), hydrology (Zalewski, 2015), and ecosystem management (Wang et al., 2018; Krauze & Wagner, 2019).

3.5. Benefits of BGI in achieving the SDGs

Based on the analysis and typology of BGI approaches, the benefits of BGI for urban development were presented in the Section 3.3. We will now use the integrating multidisciplinary concept of BGI (Fig. 3) as a starting point for classifying the benefits of BGI for relevant SDGs (Tab. 2) (United Nations, 2015). This overview shows that there are several objectives that BGI can support.

The development of urban water management, represented by the City State Continuum concept, is determined by the development of social needs, changing as a result of economic, technological, and environmental progress (Water by Design, 2009, Howe & Mitchell, 2012). In this way, the basic needs of cities in the area of water management (water supply, wastewater treatment) are gradually met (→*Goal 6: Clean Water and Sanitation*; United Nations, 2015). These include protection against floods and improved environment (water corridor quality, water quality). Moreover, tools for adaptation to climate change are widely used, such as the effective use of rainwater, and the amenity function of water in the city (recreational, social, aesthetic, cultural) are strengthened, in their mutual synergy, to form an ideal *water-sensitive city* (Wong & Brown, 2009) (→*Goal 9: Industry, Innovation and Infrastructure*; United Nations, 2015). The concept of sustainable cities (De Jong et al., 2015; Baynes & Wiedmann, 2012), based on the balance between environmental, economic and social development, is the most comprehensive, frequent, and broadest concept of environmental urban modernization (Epstein, 2008; Edlund, 2020; UN, 2012) (→*Goal 11: Sustainable Cities and Communities*; United Nations, 2015).

The increasing need to address the environmental problems associated with water management and to link ecological and landscape-ecological research methods with hydrological methods led to the establishment of ecohydrology at the end of the 20th century (Zalewski, 2000; Zalewski, 2015). Ecohydrological approaches are currently being applied also in the urban landscape. The main impetus for introducing new ecohydrological tools into urban management is the global impact of climate change (Farrelly & Brown, 2011), which is to be addressed with the support of BGI ecosystem functions *(→Goal 13: Climate Action*; United Nations, 2015). Projects supported by ecohydrological research focus on revitalizing urban water flows, building BGI, utilizing wastewater for bioenergy production and promoting urban cooperation among professionals from various industries, the general public and the business community (Wagner et al., 2013; Zalewski, 2015). Urban climate adaptation planning studies use the term BGI only sporadic (Kazmierczak & Carter, 2010; Voskamp & Van de Ven, 2015). The climatic effect of water elements and urban greenery is often presented separately (Giordano et al., 2013; Lehnert et al. 2020)

Support for the ecological stability of the landscape can only be achieved by ensuring the functional spatial coherence of the BGI elements. Considering the prevailing sustainable design of communities in cities, BGI is the vital framework of urban ecosystem planning (Condon, 2020). The spatial organization of urban green infrastructure has shifted from the creation of bio-corridors or greenways to the planning and creation of green networks (Wang et al., 2018). The role of bio-corridors and greenways is fulfilled in many cases by natural water streams and their floodplains or waterfront zones in urban areas (Perini & Sabbion, 2017). It is important to build these corridors as a systematic part of BGI, as watercourses are both a source and recipient of water in the surrounding landscape) (→*Goal 15: Life on Land*; United Nations, 2015).

4. Conclusions

Studies using the term BGI have increased dramatically in the last five years. We identified six basic types of approaches to BGI, mentioning nine basic thematic areas: land cover, green networks, water bio-corridors, hydrological processes, ecosystems and biodiversity, amenity, stormwater management, climate adaptation, and ecosystems services (Fig. 1; Tab. 1). We classified the six types of approaches into three basic concepts: (a) hydrological approaches (1. Stormwater management, 2. Hydrological processes & stormwater management), (b) integrated approaches (3. Ecosystems, ecosystem services & amenity, 4. Land cover & amenity) and (c) structural (5. Green networks, 6. Water bio-corridors).

Two important conclusions emerge from the typology of the BGI approaches. First, BGI is crucial to most aspects of sustainable urban development. Second, the design and planning using BGI calls for multidisciplinary and integrated concepts consistent with sustainable development goals. Our content analysis clearly demonstrates the importance of BGI to urban sustainability (Purvis et al., 2019; Browder et al., 2019).

BGI addresses environmental improvements in a number of spheres such as clean water, dampening climate extremes, and enhancing biodiversity (Fig. 4). BGI can boost infrastructure system resilience due to its natural adaptive and regenerative capacity (Browder et al., 2019). From a social point of view, BGI has the potential to empower communities through participation in projects such as designing new community and recreational spaces in cities. The impact of BGI elements on improving public health in cities is significant. Economically, BGI provides opportunities for cost-effective stormwater, flooding, water quality solutions, and other ecosystem services (Edlund, 2020). The BGI solutions bring a new technological innovations and support the growth of the green economy.

The implementation of BGI develops cities towards strengthening their sustainability. Our analysis demonstrates the importance of a clearly defined, integrated, and multidisciplinary BGI concept framework (Fig. 3) as an important component of achieving urban sustainability as defined by the UN SDGs. From the perspective of the 2030 Agenda for Sustainable Development, there are supported especially SDGs 6 Clean Water and Sanitation, 9 Industry, Innovation and Infrastructure, 11 Sustainable Cities and Communities, 13 Climate Action and 15 Life on Land (Tab. 2). It is clear that the importance of BGI varies according to the environmental, economic and social conditions of specific cities.

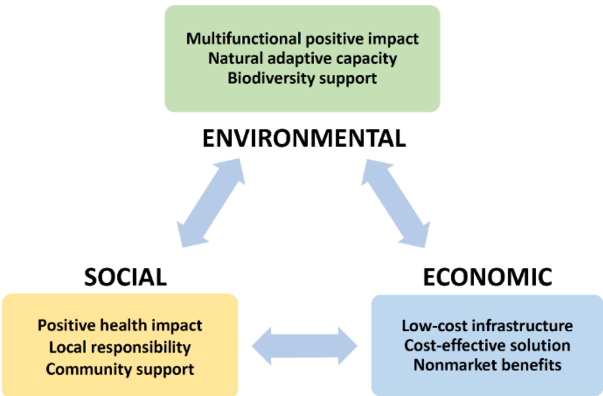

Figure 4. BGI benefits from a three-pillar conception of a sustainability perspective

Multidisciplinary support for new sustainable urban development measures can be not only in the category of normative and economic instruments, but also in the level of ethical tools aimed at changing thinking. This can be demonstrated by the example of progress in urban water management at the level of application of new technologies (e.g. green façades, household water recycling), on the organisational level (e.g. building water-decentralised neighbourhoods, organisational integration of the topic of water in urban administration and management), but also at the level of systemic change of thinking.

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