

Commentary

Green infrastructure as *panacea*, *deus ex machina*, or both?

The concept of ‘green infrastructure’ gained prominence within urban planning as decision-makers attempted to create more sustainable and multi-functional places. However, as the concept gained traction its advocates engaged in a process of terminological exploration which led to divergencies in praxis. The result has been an ongoing debate regarding what green infrastructure ‘is’ and whether alternative terms are better placed to address contemporary planning issues. The wider debates regarding green infrastructure have been framed as a ‘solution’ to complex and often historical landscape and urban planning problems. We argue that situating green infrastructure as a *panacea*, a *deus ex machina*, or *both* undermines understanding of the concept’s principles and application in practice. However, there is a value to these debates if, and where, they facilitate consensus on how, what and where investments should be made by decision-makers.

Keywords: urban planning, terminology, consensus, stakeholders, urban greening

Introduction

The Covid-19 pandemic crystallised a rethinking of our relationship with the environments around us. The location, composition and functionality of local parks, green spaces, waterways and urban woodlands/forests all became increasingly important components of the lives of people globally (Ugolini et al., 2020; Mell, 2020). For example, most parks in the UK remained open and accessible throughout government-enforced lockdowns and were one of the few locations that people were legally able to use (Gore et al., 2021). In like manner, in many cities in the USA, parks remained accessible, though with some modifications to the availability of facilities; a process that allowed residents in high-density areas to continue to access fresh air in a ‘natural’ setting¹ (Larson et al., 2022; Rice et

- ¹ There remain contestations regarding what ‘natural’ green spaces are. These arguments focus on both the composition and function of space, as well as for whom it is perceived to be for or of benefit. Thus, natural green spaces can be sites that are managed from an ecological perspective, sites that are visibly green, or locations that blend landscape elements with the needs/uses of people. Moreover, natural landscapes vary due to the diversity of geographical and societal meanings attributed to the environment. Natural, as noted by the quotation marks, is a construct – conceptually, culturally and in practice, requiring a broader assessment of its meaning.

Ian Mell is Professor in Environmental & Landscape Planning in the School of Environment, Education & Development at the University of Manchester, Humanities, Bridgeford Street, Manchester M13 9PL, UK; Meredith Whitten is Fellow in Environment in the Department of Geography & Environment at the London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK; e-mail: ian.mell@manchester.ac.uk; m.whitten@lse.ac.uk.

al., 2020). We also witnessed parks and green spaces being framed as locations for socially distanced interactions with family, friends and peers due to their capacity to simultaneously support multiple activities for a range of people. Throughout 2020, green spaces acted as a metaphorical sponge through which individuals and communities interacted (Bristowe and Heckert, 2023).

It follows, that the Covid-19 pandemic promoted an appreciation of parks and their use as public resources within broader discussions of green infrastructure (hereafter GI),² with some arguing that nature is a solution or *panacea* that overcomes the limitations placed on individuals and communities in urban areas, e.g. health issues associated with nineteenth-century UK cities. Furthermore, GI, in its myriad forms (see Mell, 2022, Table 1), offers access to a diverse range of spaces which transcend a single location or environmental type; providing opportunities to engage with both nature and other people. In urban areas this is of particular importance due to the inequalities that exist with regard to access to private gardens and/or neighbourhood spaces of high quality (Public Health England, 2020; Natural England and Landuse Consultants, 2009). For example, 21 per cent of households in London and 12 per cent of households overall in Great Britain had no access to a private garden during Covid-19 lockdowns, with the result that their interactions with nature were potentially compromised (Office for National Statistics, 2020). Moreover, throughout 2020–2021 we witnessed the UK government acknowledge the added value that GI provides to society in terms of health, economic prosperity and ecological resilience to climate change. This rhetoric situated GI as the solution to a complex and interconnected set of socio-economic and public health issues, and potentially as a *panacea*.

GI has thus been framed as the solution to global health pandemics, urban storm-water flooding, biodiversity loss, recreation and social inclusion. However, there are limitations to this argument that potentially identify GI as a *deus ex machina*. We define a *deus ex machina* as an unexpected action used to provide solutions to an ongoing issue that has hitherto not been discussed; the promotion of parks by central government as ‘essential infrastructure’ during Covid-19 lockdowns, for example (Heckert and Bristowe, 2021; Mell, 2020). Within this context, *panacea* is used to denote the ongoing justification of GI as a solution to complex urban problems; GI as a *deus ex*

2 The definition of green infrastructure includes the principles of connectivity, access to nature, the creation and management of networks, multi-functional and integrated socio-economic and ecological approaches to land management (Mell, 2016; Benedict and McMahon, 2006). Since its initial development from approximately 2000–2005 onwards, a contestation of when GI was first used and in what context has developed, influencing its position as a ‘go to’ approach to landscape and urban planning (Matsler et al., 2021). Initially developed in European and North American contexts, GI is now employed globally as one of a suite of terms, approaches and practices used to deliver environmental planning (Austin, 2014). The rise of GI as a *concept*, and subsequently, as a *delivery mechanism* has not, though, been linear. Variations in geographic, scalar, temporal and disciplinary engagement with GI has led to an ongoing debate of what it is, what it should do, and how we should deliver and manage it (Wang and Banzhaf, 2018; Koc et al., 2017).

machina implies the potential for it to become a politicised false remedy parachuted into debates without robust processes of evidencing – GI as a catalyst of regeneration, provision of greenspace to all communities or as a facilitator of economic development (Mertens et al., 2022; Zuniga-Teran et al., 2020).

The tenure of GI within existent research and practitioner literature argues that it addresses complex ecological issues associated with urban systems whilst simultaneously delivering socio-economic improvements (Koc et al., 2017; Garmendia et al., 2016). However, caveats are placed on the efficacy of GI to a) address these issues in totality, b) examine how different cities apply their understandings of GI, and c) quantify the values which various communities of interest find in GI (Matsler et al., 2021; Mell, 2016). Consequently, although GI can be framed as a ‘solution’ – and indeed the concept and Nature-Based Solutions (NBS) are reported extensively in the literature as specifically leading to positively received change – this view is not necessarily supported empirically in all scenarios (Mell et al., 2022; O’Sullivan et al., 2020). Proposals for GI to act as a panacea to Covid-19, climate emergencies, or even economic uplift may therefore be imprecise, and, in fact, GI may be a *deus ex machina* that only superficially addresses socio-economic and ecological needs. Where GI is viewed as a ‘quick-fix’ the wealth of evidence supporting its use, and the knowledge found in academic and practitioner experiences, may not be effectively integrated into decision-making (Washbourne and Wansbury, 2023).

The contention we make in this commentary is that GI can act as a panacea, a *deus ex machina*, or both, depending on circumstance. Assessing the lineage and subsequent applications of GI allows us to better understand the complexities of promoting it as either a panacea or a *deus ex machina*. To examine this premise, we discuss divergent understandings of GI and reflect on whether, and if so, how, they have been successfully communicated within urban development debates. This is contextualised by the changing appreciation attached to the value of the environment within practice when government messages constantly shift regarding the value of GI, for example in the use of GI by city governments in 22 different US cities examined by Grabowski et al. (2022). This was also visible within the UK in 2022 when central government shifted its development agenda from ‘build back better’ to ‘build build build’ (Holman, 2020). The emphasis placed on the value of the environment in the former was undermined by the overt pro-development stance of the latter. Subsequently, an examination of GI within such discussions offers insights into whether it remains a delivery option, a solution, or represents just another problematic set of ideas.

Situating green infrastructure

To address variations in interpretation, Mell (2010) proposed that GI did not require a universal definition to support its mainstreaming in praxis. Over the following

decade this statement was validated, as GI diversified via a terminological flexibility associated with a diverse set of spatial, geographical and disciplinary perspectives (Reimer and Rusche, 2019; Cilliers et al., 2019). The lack of a singular approach has directed GI advocates in policy, practice and academia to consider not only the concept's direction of travel, but also to reflect on whether diversity in its form, function, framing and specifically its definitional meaning provide a supportive platform for development (Mell and Clement, 2020). Within this lineage, continuing references to the principles proposed by Benedict and McMahon (2006) can be identified, illustrating a continuity of approach. However, their framing evolved to be contextually appropriate to alternative landscapes in the USA, whilst simultaneously incorporating a growing range of thematic interpretations within their use of GI in planning. An emerging consensus has therefore developed that situates the concept within both policy/practice and academic discourses (Mell, 2016). Despite this, a fluidity to its use remains visible, as the terminological and practical utility of GI continues to be tested to meet alternative planning scenarios (Wang and Banzhaf, 2018; Koc et al., 2017). The rise of alternative terminology, most noticeably ecosystem services, natural capital, and NBS provide examples of this process in which competing discourses have emerged but remain located within the same conceptual and practitioner space as GI, with NBS and GI at times used interchangeably (Escobedo et al., 2018; Scott et al., 2016). It follows, that there is a need to question whether the tenure of GI, as the most frequently used nomenclature, remains appropriate or indeed effective in addressing urban and environmental planning needs (Parker and Zingoni de Baro, 2019).

The exploration of the tolerances embedded within GI (and other terminology) conceptually, and in practice, has been tested during the Covid-19 pandemic and through the growing emphasis placed on praxis responses to the climate crisis. As a direct consequence of lockdown/stay-at-home regulations, the consensus surrounding what GI *can* and *should do* increased as green/blue spaces gained primacy within political discourses (Mell & Whitten, 2021). Throughout 2020, a critiquing of GI was visible in the UK government's support for nature as 'essential infrastructure' which supported personal and communal well-being. Moreover, 2021 witnessed increasing instances of extreme weather, e.g. extreme heat in the UK, causing significant health, social and economic damage. Unfortunately, the consideration of GI as 'essential infrastructure' failed to be cemented in practice during these events despite its visibility within discussions of Covid-19. This was noticeable given the visible discourse which focused on the provision of tree canopies in urban areas and the subsequent impacts that the same would have on both climate change and public health (Kondo et al., 2020; Ziter et al., 2019). Furthermore, we cannot dissociate the knowledge that Local Planning Authorities (LPAs) in the UK, and internationally, are diverting resources away from GI to other services due to ongoing austerity policies (Whitten, 2019).

When aligned with contemporary discussions of environmental policy deregulations, a form of cognitive dissonance is visible within the UK government's approaches.³ This, in turn, casts doubts over its claims that GI is a critical part of the solutions to public health crises, i.e. Covid-19, or climate change, especially when it continues to remove the financial support networks used to maintain or enhance environmental resources (Mell, 2020).

The limitations placed on the public due to Covid-19 appear to have fast-tracked government action, at least rhetorically. The transition from protracted evidence-based policy formation to the presentation of a clear public health mandate utilising GI developed rapidly and positioned it as a solution – a potential panacea – to the impacts of Covid-19 (Public Health England, 2020). Moreover, as the public, as well as academics, practitioners and government, become increasingly aware of the limitations of existing landscape design, development and management practices, especially in response to growing concerns about air pollution, flooding and the abundance (or lack thereof) of urban nature, we should reflect more frequently on whether GI is *the* solution to *all* urban problems (Dushkova and Haase, 2020). However, we caution against presenting GI as a panacea without considering its 'fit' to the given socio-cultural, economic and environmental context; especially where a bastardised form of GI as a catch-all solution for the problems of planning praxis is presented.

Terminology as consensus

The terminology used to underscore GI has a long and varied history. Drawn from green space and landscape planning traditions across the UK, Europe and North America (Escobedo et al., 2018), and more contemporary practices from Asia, Latin America and African nations (Shackleton et al., 2021; Zhang et al., 2020), GI developed to meet a multitude of issues. It also arrived at a critical juncture in the early 2000s, one that remains primary in the progression of environmental thinking. GI was framed to align with the resurgence in governmental appreciation of 'landscape' via regeneration and conservation efforts which viewed them as valuable societal assets (Mell, 2022). By association, landscape-led regenerative efforts were co-opted – to some extent – into the neoliberal debates of the 1990s, e.g. under the New Labour administration in the UK, and commodified (Rosol et al., 2017; Rosol, 2011). The emphasis placed on 'infrastructure' as a facilitator of investment in built and environmental resources is visible in such debates. However, the role of GI as a tool of economic

3 In 2022 the UK government announced it was considering removing protective EU regulations focused on environmental protection. They argued that EU environmental legislation was bureaucratic, time-consuming and placing adverse limitations of development in the UK. This view was widely criticised as undermining the quality and function of the UK rivers, greenspace and wider ecological networks. At the time of writing this proposal has not been reversed and changes are still being debated.

investment undertaken via commercial or entrepreneurial activities runs counter to the environmental consciousness developed from the 1960s onwards within the political ecology and sustainability literature (Robbins, 2012), and skewed the narrative of ‘landscape’ value away from socio-cultural and ecological perspectives towards its utility as a financial resource. In some ways this shift has been valuable in allowing environmental advocates to promote GI within political debate, but it has also raised concerns that the commercial value of GI as an ‘asset’ has been prioritised as a *deus ex machina* over an understanding of its ecological benefits (Chenoweth et al., 2018). This has been particularly prominent when GI has been linked to property valuations or used to justify investment in nature (De Bell et al., 2021; Vivid Economics and Barton Willmore, 2020). A level of balance has subsequently been required to integrate this knowledge into such discussions with GI advocates working to align its meaning via project work; increased knowledge exchange has led to an emerging acceptance of GI in policy-orientated environments (Mell, 2016).

Despite the legacy of GI within academic and practitioner literature, there is a continuing divergence in the terminology used to structure reactions to environmental change (Benton-Short et al., 2019; Wright, 2011). This reflects the positionality of specific research themes and indeed academic thinking that have embedded GI within their disciplinary specificities (Matsler et al., 2021). Geographical variation can also be identified as a consequence of this process. The rise of NBS, ecosystem services, sponge cities and calls for blue-green infrastructure (B-GI) have led to a potential cleavage of consensus, as advocates move towards the use of alternative terminology in policy, projects and communication (Ambrose-Oji et al., 2017; Connop et al., 2016). A form of terminological territorialisation can, as a consequence, be identified that promotes specific greening terminology to maintain disciplinary specificities rather than positioning GI as an effective boundary object that brings commentators together across disciplines (Washbourne and Wansbury, 2023; Mell and Clement, 2020). The result is a visible divergence between practitioners, politicians and most significantly academics in their uses of specific terminology for categories of people that could be considered to be sub-set of GI thinking and vice versa.⁴

Robust longitudinal studies of GI policy implementation and practical application have been slow to occur; as a result, evaluation has been limited to short- to medium-term impacts (Mell and Clement, 2019; Willems et al., 2020). A lack of data

4 The authors acknowledge their complicity in the process of maintaining the use of specific language, i.e. GI or greenspace, when others may be more appropriate (especially in an international context). However, there are increased instances of specific disciplines, notably water and ecological specialists, who argue that GI does not represent their views because terminology common to their work, e.g. ecosystems or water, is not noted in the name GI. This is countered if the definition of Benedict and McMahon (2006) is used, as it includes reference to water and conservation; a more detailed examination of GI, its research, its typologies and benefits was undertaken which illustrated the breadth of the inclusivity of options, characteristics and outcomes associated with the concept drawn across natural and built environment thinking and practices.

and relevant case studies in some regions, such as sub-Saharan Africa, has limited the evidence available to integrate GI into policy and practice (du Toit et al., 2018; Lindley et al., 2018). Moreover, when large-scale data sets are used to evaluate added-value GI they have tended to focus on discrete ecological issues in specific cities rather than presenting a more holistic and overarching perspective on changes associated with GI planning (Mumtaz, 2021; Leal Filho et al., 2021). Consequently, the concept has not had sufficient time to become effectively embedded in planning processes in a manner which ensures that GI is not simply considered to be a conventional approach with a new label. If such caution is not taken, then planners are at risk of repeating unsuccessful efforts to integrate additional knowledge with existing practices. Indeed, GI can be delegitimised by a quickness to either conflate it *with* or *as* green space more generally or diversify its meaning with additional terminology (Matthews et al., 2015). Such approaches have had the following impacts:

1. It has provided scope for advocates to apply more specific terminology (and associated meanings, techniques and practices) to their work, (for example, stormwater management) and elevate environmental thinking within planning activities.
2. It has given rise to the use of alternative language which has diluted the core message being presented as an increasing breadth of terminology has impacted the presentation of a coherent (or singular) narrative of 'environment' in policy and practice.
3. It has not resulted in the taking up of a more holistic or systems perspective to policy/practice but the use of increasingly discrete language has located discussions within narrower framings. This runs counter to the key tenets of GI of interconnected, networked and multi-functional development.

Two examples of these impacts are the use of ecosystem services and NBS terminology. The former employs cultural, provisioning, regulating and supporting services to structure diagnostic assessments of landscape functionality useful to scientific enquiry (Escobedo et al., 2018), whilst NBS have shifted the focus to application and innovation via significant trans-governmental funding for 'solutions' within a European context (Kabisch et al., 2016). Both terms offer valuable insights into how 'nature' can be integrated into planning policies and project design yet divide opinion as to how this thinking should be applied in subsequent delivery. The latter, for example, could be classified as an *empty signifier* that lacks a substantive conceptual or evidence base due to its relatively short tenure within the green space lexicon⁵ (Swyngedouw, 2010; Whitten, 2020). However, contemporary discussions of NBS are addressing this issue by establishing a grounded framing that integrates conceptual, practical and

5 The use of this terminology to denote the vacuous nature of terminology is significant in this instance as the framing of a term and acceptance of its definitional boundaries purports to legitimise its use and application, even though a supportive evidence base may be absent.

collaborative understandings of what NBS are, how they integrate people, place and society simultaneously into delivery mandates, as well as their location within broader networks of terminology (Kabisch et al., 2022).

The growth of emerging terminology raises further questions regarding how we develop a conceptual, policy and implementation space without experimentation. This asks what the potential impacts are of retrofitting ideas into existing terminology when we are attempting to generate new evidence bases to shape praxis at the same time (Bulkeley and Castán Broto, 2013). To retain GI as the only viable term would potentially be arrogant and unresponsive to emerging evidence and developments in environmental praxis. One approach that may offer a pathway to address these issues is to structure debates around the three Cs: *consistency* in policy/practice, *clarity* of expression and definition, and *continuity* of theory/practice (while also considering the fourth c – *contestations* between key thematic issues), as an evaluative framing for new terminology. This enables us to question whether there is a consensus framing GI as a ‘solution’ to the impacts of landscape and urban development (Whitten, 2019; Weber et al., 2006; Davies et al., 2006). If not, it provides scope for new ideas, terms and practices to fill the space. Such a scenario also facilitates us as academics, as well as GI advocates, to examine what progress is needed, and to explore whether comparable terminology, i.e. NBS, is more appropriate in supporting delivery (Escobedo et al., 2018). A recognition that newer terminologies may be empty signifiers that, in practice, lack substance until they develop a conceptual foundation nevertheless remains pertinent. Cumulatively, therefore, although ecosystem services, NBS, greenways, garden cities, sponge cities, low-impact development (LID) and other terms (see for example Koc et al., 2017; Mell, 2010) share an epistemological genesis and are concurrently applied within the landscape/urban planning nexus, they continue to promote alternative theoretical, policy and practice discourses which may – at some point – need to be aligned more effectively.

Variations in approaches are expanding. Although GI remains central to discussions of NBS and other terms – potentially as an umbrella term under which others including NBS are the delivery aspects or vice versa – it can be used as a starting point, and not the only framing for implementation. We may not be in a post-GI era, as illustrated by the breadth of GI papers currently being published (see for example Hermoso et al. (2020), Zuniga-Teran et al. (2020), Mulligan et al. (2020), Zepp et al. (2020) and Benton-Short et al. (2019)), but in a period of greater fluidity that employs terminology interchangeably to facilitate the most politically, spatially and disciplinary positive outcomes. This remains problematic when terminology is promoted as a solution – a panacea – without the same emphasis being placed on its conceptual and evidence-based development. Moreover, the traditional role of terminology to rationalise the synergies that exist between evidence and abstract learning that populate the development of new processes may be overlooked. When terms are

elevated at the macro-level and supported by strong political frameworks, i.e. NBS, they may bypass the initial period of knowledge production and exchange. However, this leaves them vulnerable to challenge from practitioners and decision-makers if or when their conceptual foundations are interrogated. The recent explorations of NBS (see Al Sayah et al., 2022; Kabisch et al., 2022; Kotsila et al., 2020), consider this by enhancing the empirical and theoretical evidence within these debates. The outcome has been a series of increasingly refined examinations of what NBS are and what they do both academically and practically. In practice this means that other terms such as sponge/forest cities, for example, are being presented as a panacea for urban development problems, but could be considered *deus ex machina*, as they do not have sufficient grounding in the theories or practices of GI (or green space planning more generally). The growth of NBS research has addressed this issue – to some extent – with significant evidence emerging that links theory, policy and practice.

However, if alternative terms are addressing significant socio-environmental issues, does the lack of a conceptual grounding matter? Academically, *yes*, as the application of any approach without sufficient examination of its knowledge base or integrity as best practice may lead to long-term negative consequences, e.g. misuse in practice. However, as approaches to implementation, the answer would be *no*, in cases where researchers are delivering innovations in design or management through experimentation (Bulkeley and Castán Broto, 2013). This is a subtle but critical difference. The evolution of a concept via the development of an academic evidence base allows for trial and error which aids the identification of best practice. This differs from research and development (R&D)-led concepts where the driver(s) may be political or financial (O'Sullivan et al., 2020). Furthermore, working within this more nuanced framework can become complicated when stakeholders fail to transition new terminology through the exploration, expansion, and consolidation phases proposed for GI by Mell (2016). This process proposed that academics should track new concepts as they are explored within specific disciplinary and conceptual boundaries, redefined as engagement from the research community grows, and then become consolidated around a small number of key terms. The process also mirrors the ways in which innovations in technology or infrastructure develop and become mainstream, and helps to interrogate the tolerances of new terms in theory and practice, and may emphasise new approaches as panaceas for urban enhancement without sufficient evidence (Kotsila et al., 2020; Dushkova and Haase, 2020). The incremental refinement of GI terminology, as supported by the Conservation Fund in the USA, England's Community Forests, and the European Union, are examples of this in practice, and remain integral to integrating a robustness into its application. It also decreases the likelihood of terminologies passing like 'ships in the night', as their academic credentials are more effectively mapped onto practice and policy-making (Vogt, 2018).

Language as clarity of approach

Language continues to play an integral part in the framing, use and success of GI and its associated synonyms. How we phrase investment for GI, what cultural and practice-based approaches we appropriate, and the subsequent actioning of these by divergent advocates is of critical importance. Moreover, the use of language in GI discourse is politically loaded with some terminology deemed acceptable in policy-making, whilst others have been superseded, for example, NBS compared to sustainable communities (Wang and Banzhaf, 2018; Koc et al., 2017). Ensuring that advocates are able to leverage political, and by association socio-economic buy-in for investment in GI is centred on the balancing of various agendas, a process which can both promote and hinder consensus building (Mell, 2014; Wright, 2011). This is apparent in discussions of water within GI debates. Water Sensitive Urban Design (WSUD), Sustainable Urban Drainage Systems (SuDS), Combined Stormwater Overflow Management (CSO), and LID are all used to address comparable issues. The language used, though, is specific to the geographic investment contexts of Australasia, the UK and North America respectively, and is effective in aligning environmental knowledge with technical implementation activities (Keeley et al., 2013; Bowman et al., 2012). It also needs to be recognised that each of the terms – especially stormwater management – are explicitly implemented within GI practices rather than as wholly separate practices (Hoover and Hopton, 2019). Thus, the rationale for a shift in terminology to B-GI could be considered redundant if we acknowledge that water is an explicit thematic aspect of GI praxis. It follows that a currency exists for the use of favourable or prominent language that focusses attention if collaborations between actions, politics and environmental experience are to be developed; B-GI may, therefore, present greater opportunities for collaboration if it frames GI as a boundary object that can integrate thinking and practice from engineering, hydrology and planning (Mell and Scott, 2023; Washbourne and Wansbury, 2023).

Moreover, if we accept that terminology is politically meaningful within planning, we must also accept that definitions are loaded with evidence and nuance. This can provide linguistic scaffolding for advocates to have confidence in their use of specific definitions, for example GI, because they are engaged with a concept that is grounded within a known evidence base or set of practices. Such a position allows GI advocates to present assessments of the concept in praxis without the need to explain the principles, scalar applications, socio-economic benefits or ecological values attributed to it. Thus, we can once again ask whether we require a singular approach to GI, or whether we can make use of the range of existing as well as untested conceptual and practices which support other terminology being brought into the GI lexicon? If we employ the second approach, it requires supporters to think carefully about the lines of communication needed to promote new terms to non-specialists to ensure consistency and coherence in practice (Kabisch et al., 2022).

Geographical application as continuity of delivery

A key critique of GI has been the persistence of geographical variations in its use. Such variations are reflective of the economic and ecological priorities of given locations, and are also linked to socio-cultural understandings of the value of GI and its location within specific political and investment structures (Gomes Sant'Anna et al., 2023; Tzoulas and James, 2010). Praxis in the USA, the UK, Germany, India and China identify clear variations in the situating of GI in specific locational, scalar and delivery scenarios (Mell, 2016). In practice, this has led to piecemeal investments that purport to establish ecological networks and landscape connectivity but often remain spatially fragmented. In many cities, GI continues to be actualised as isolated projects or pockets of nature in seas of urban expansion. GI variation is, therefore, a product of the diversity in sovereign planning systems and the selection of specific typologies, benefits and beneficiaries within GI discourses (see Table 1 in Mell and Whitten, 2021, 2-3 for further details). Factors considered to be of critical importance in framing development include the need for investment to be appropriately scaled, focused and functional. However, as landscape and urban planning becomes increasingly globalised through the exchange and interaction of knowledge (and teaching/training), personnel and practice, there is a growing awareness that a homogeneity of GI form could be created (Hoyle et al., 2017; van der Walt et al., 2015). Effective translation into practice is, however, more variable as gaps remain between the rhetoric of investment presented by decision-makers and the ways in which decision-making addresses inequalities in the provision, quality and quantity of GI (Whitten, 2022). Any singular rationalisation of GI may potentially restrict integration of local cultures, politics and practices, leading to internationalised but distinctive descript places (Andersson et al., 2014). The January 2023 release of the National GI Standards Framework in England as an overarching standard for GI design, development and management will provide a real-world test of this proposition (Houghton et al., 2023).

The proposition of homogeneity has a dual influence on GI planning. It can facilitate consensus building, and promote the technical exchange of expertise. However, a singular vision for GI could, in reality, undermine the integration of that local knowledge which is crucial to effective design and management if inappropriate choices in design, species or management are made (Pauleit et al., 2019). Where this latter process of 'parachuting in' – a *deus ex machina* – has been applied, we can identify the creation of identikit places that show only limited respect to the nuance of local contexts, e.g. GI within urbanising cities in China, the Middle East and suburban North America. Moreover, as with rapid urbanisation from the mid-1950s onwards, uniform development precedes long-term socio-economic and ecological problems. Within Europe, the European Union has attempted to circumvent such problems by promoting strategic policies for both GI and NBS that enable nations to retain

sovereignty within practice that is explicitly sensitive to local environmental conditions (European Commission, 2012). Moreover, from a definitional standpoint, the EU has established a framework for GI which is not only anchored in landscape practice focused on specific principles but also supports localised approaches to biodiversity, climate change and urban planning. The retention of a suite of delivery options has led to a more socio-ecological responsive set of GI investments that have addressed specific micro-scale issues rather than being focused on strategic or generic ones (Mazza et al., 2011). Thus, although Mell (2010) called for a universal appreciation of GI in terms of definitional grounding, but *not* a singular definition, delivery mechanisms should potentially remain reflective of the fluidity of local needs.

The focus on stormwater management in the USA, NBS in Europe and WSUD in Australia are examples where the framing of GI has been spatially refined. In addition, within each of these approaches explicit reflections on scale are visible. A significant proportion of WSUD work is focused on the micro, as were the initial swathe of EU-funded allocated NBS projects (although these were located within multi-partner and locational consortia). Stormwater management is multi-scalar, but retains a prominence of site-based work, although these are scaled up into a network/system approach (Beatley, 2009). Isolating investments in specific spatial contexts has, however, limited the exposure of advocates to other disciplines, i.e. landscape architecture, engineering and health, which could provide support to knowledge exchange and project work (Sinnott et al., 2015). Consequently, we continue to identify locally specific idiosyncrasies within GI praxis. The extrapolation of such localised evidence may be subject to administrative, geographical and legislative blockages due to the lack of a 'world view' within localised GI thinking (Mell, 2016).

Conclusion

The shift in GI thinking from a land use/zoning categorisation process to a nuanced examination of landscape and urban planning discourses is central to discussions of whether it is a panacea, a *deus ex machina*, or both. This mirrors debates associated with the acceptance of sustainable development post-1987 and the ongoing unpacking of sustainability and resilience discourses (Zuniga-Teran et al., 2020; Meerow and Newell, 2017). A key aspect of this debate is the framing of GI, and its aligned terminology, as a *solution*; this is especially prominent within debates regarding NBS. However, to date we have not defined an overarching environmental question that is addressed by a single response. This remains problematic as landscape and urban resource management is a dynamic and complex system of socio-cultural, economic and ecological elements that compete, complement and interact with each other to ensure that urban systems function effectively (Perrotti and Stremke, 2018; Beatley and Newman, 2013). Indeed, it was as a response to these changes that GI gained

prominence (Benedict and McMahon, 2006). However, as GI is increasingly proposed as ‘the fix’, questions continue to be asked as to what problems GI is the solution to? Although we can identify a suite of comparable issues that GI addresses, they remain located within complicated temporal, spatial, geographical and disciplinary articulations of GI (Mell and Clement, 2020). In addition, the subsequent approaches taken to address these issues illustrate the ongoing constraints that have been placed upon GI planning as it attempts to align development and management options which are acceptable politically, as well as deliverable in practice.

Is, therefore, GI a panacea for landscape and urban planning? Put simply, *no*. Could GI, and its synonyms, be seen as a *deus ex machina* that is conveniently promoted to save the day? In some senses, *yes*. However, viewed more holistically, GI is neither a panacea nor a *deus ex machina*, because it is neither *the* solution to all socio-economic or environmental problems found in urban areas, nor can it be parachuted into all situations as an easy fix. Nevertheless, the variabilities of its form, function and scale, as well as its costs, benefits, and beneficiaries does provide GI with scope to adapt to any given context. It follows that, as planners, urban designers, architects, environmental specialists and engineers, we need to retain an awareness that GI, and the thinking that supports it, has been drawn from over a century of reflection on the roles of landscape within discussions of environmental security, capacity, societal change and economic improvements.

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