Journal of Environmental Management 147 (2015) 184–193

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Green infrastructure as a climate change adaptation policy intervention: Muddying the waters or clearing a path to a more secure future?

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ARTICLE INFO

Article history:
Received 10 March 2014
Received in revised form
2 September 2014
Accepted 4 September 2014
Available online 1 October 2014

Keywords:
Green infrastructure
Climate change adaptation
Biodiversity
Ecosystem services
Multifunctionality
Interdisciplinary

ABSTRACT

As dangerous climate change looms, decision-makers are increasingly realising that societies will need to adapt to this threat as well as mitigate against it. Green infrastructure (GI) is increasingly seen as an ideal climate change adaptation policy response. However, with this research the authors identify a number of crucial knowledge gaps within GI and, consequently, call for caution and for a concerted effort to understand the concept and what it can really deliver. GI has risen to prominence in a range of policy areas in large part due to its perceived ability to produce multiple benefits simultaneously, termed 'multifunctionality'. This characteristic strengthens the political appeal of the policy in question at a time when environmental issues have slipped down political agendas.

Multifunctionality, however, brings its own set of new challenges that should be evaluated fully before the policy is implemented. This research takes important first steps to developing a critical understanding of what is achievable within GI's capacity. It focuses on one of GI's single objectives, namely climate change adaptation, to focus the analysis of how current obstacles in applying GI's multifunctionality could lead to the ineffective delivery of its objective.

By drawing on expert opinion from government officials and representatives from the private, non-government organisation (NGO) and academic sectors, this research questions GI's ability to be effectively 'multifunctional' with an inconsistent definition at its core, deficiencies in its understanding and conflicts within its governance. In light of these observations, the authors then reflect on the judiciousness of applying GI to achieve the other objectives it has also been charged with delivering.

1. Introduction

Central to the preservation of our environmental spaces is the acknowledgement of the environment's role in the maintainence and enhancement of our way of life. Amidst a history of similar concepts failing to communicate our ever more scientific and complex understanding, green infrastructure is a recent environmental policy intervention it is hoped can bridge the divide between scientific robustness and civil society application.

At its most simple, the concept can be defined as *'a network of green features that are interconnected and therefore bring added benefits and are more resilient'* (EEA, 2011, p30) than if they remained isolated. These additional benefits are numerous and include climate change mitigation, climate change adaptation, biodiversity conservation, water management, food provisioning and improving recreational space, to name a few. Possessing this capacity to be multifunctional enhances the concept's political appeal at a time when environmental issues are widely considered to have slipped down political agendas. So far, however, there has been little consideration of what some of the challenges of delivering GI's multifunctionality effectively are, and if the concept is in a position to implement them and maximise its potential.

This research takes a first step in this discussion by critically assessing GI's potential ability to deliver one of its individual benefits – climate change adaptation (CCA) – and in doing so, comment on the state of its ability to deliver numerous benefits simultaneously. Choosing CCA as the lens for this assessment is pertinent given that in their latest report, the international governing research body on climate change, the Intergovernmental Panel on Climate Change (IPCC), predicted that if we continue along our current emissions pathway, global temperatures could rise by as much as 4.8°C by 2100 (IPCC, 2013). A number of influential

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http://dx.doi.org/10.1016/j.jenvman.2014.09.003
0301-4797/

institutions have echoed this sentiment, suggesting our chances of limiting climate change to the internationally agreed target of 2°C, are becoming increasingly slight (PWC, 2012; IEA, 2012; World Bank, 2012). Also playing into this decision is the waning belief that a meaningful international mitigation agreement can be achieved. Consequently, it is logical, if not essential that academic and political attention now considers measures for adapting societies.

2. Research methodology

At its deductive core this paper tests the hypothesis that GI is a concept that can effectively deliver multifunctionality, by assessing its potential to deliver CCA. However, this is complemented by an inductive component – exploratory observations and discussions are made to theorise what GI can and can't achieve more broadly.

A combination of literature review and desk-based analyses of secondary data – with a strong focus on current policy landscapes and academic literature – along with semi-structured interviews, were utilised in the research methodology. The 'snowball sampling method' (Biernacki and Waldorf, 1981) was prominent in this methodology, in that within each article, a wealth of relevant studies exists in its bibliography that were followed up where appropriate.

Qualitative document analysis (QDA) was used for analysing key policy, academic articles and interview notes. QDA refers to the *'method, procedure and technique for locating, identifying, retrieving and analysing documents for their relevance, significance and meaning'* (Altheide et al., 2008, p 128). This involves developing a 'protocol' and testing it on each unit of analysis, e.g. each article, and revising it based on the quality, quantity and likely efficiency of the results (Altheide et al., 2008). The protocol was formed of key words and phrases organised by category and were shaped by the analytical purpose required. In completing this method of analysis, however, there is a threat of bypassing important contexts or paraphrased descriptions. Consequently, where possible, the entire article or report would be reviewed.

The selection of interviewees focused on achieving a sample that reflected the range of perspectives from high level governance institutions responsible for theorising GI and ground level GI practitioners. To achieve this, a list of stakeholder groups relevant to the themes likely to emerge under analysis was drawn up, followed by a long-list of possible interviewees to prepare for the difficulties of capturing interviews.

The names of interviewees have been concealed in Table 1 for confidentiality purposes, but the sector in which they operate is divulged to highlight the breadth of areas captured by this analysis. This is represented by a code assigned to each interviewee. Reference 'A' indicates an EU level government official, 'B' represents a national level government official, 'C' local/regional level government official and 'D' aspects of civil society including private sector, academia and not-for profits all within the UK.

Table 1
Categorisation of interviewees.

Interviewee reference	Sector	Position/perspective
A1	European Commission Official	Green infrastructure
A2	European Environment Agency Official	Vulnerability of the territorial environment and natural systems
B1	UK Government Official	Adviser on green infrastructure
B2	UK Government Official	Adviser for strategic environmental planning
C1	Local Government Official	Green infrastructure manager
C2	Regional Government Official	Greening team leader
D1	Private Sector	Environment consultant
D2	UK Academic	Sustainable water management
D3	Regional Project Director	Director
D4	Regional Environmental NGO Official	Deputy CEO
D5	UK Academic	EU Project leader

3. Background: the problem with green infrastructure – what is it?

The term green infrastructure is relatively new; however, the concepts that underpin it can be traced back to the beginnings of environmentalism, nature conservation, landscape architecture and planning (Pankhurst, 2010).

The first signs of GI arose when the urban planning and nature conservation/environmental awareness merged for the first time with the Boston 'Emerald Necklace' at the end of the 19th Century, described as a *'complex multi-functional environmental design solution'* which linked areas by green corridors (Engleback, 2009, p24). Planning and conservation were once again brought together in the garden city movement towards the turn of the 20th Century and in the UK's New Town movement after the Second World War.

The evolution of these movements and the lessons learned from them were key factors in the run-up to the first explicit use of the term 'green infrastructure' in the 1980–90s in the US for which the expression was used to emphasise the importance of nature's ecological services (Engleback, 2009). This brief history illustrates that GI is a relatively new concept in name, but not in theory. It also illustrates that GI has always had a multi-disciplinary basis, a factor considered later.

Now, as the broad range of GI's capabilities have become more widely understood, the concept has been adapted and broadened further. In their research, the EEA (2011) identified eight classifications of applications for GI - biodiversity protection, CCA, climate change mitigation, water management, food production, recreational benefits, land values and cultural benefits. These disciplines have each co-opted GI towards their own objectives. Due to such breadth, there is a risk of inconsistency and uncertainty in the understanding of what GI actually is, which could undermine its ability to deliver the objectives of these various proponents.

3.1. Green infrastructure and climate change adaptation

One benefit GI has been charged to deliver, and the focus of this paper, is climate change adaptation. It is through this lens that GI and it's effective multifunctionality will be assessed. GI achieves three main CCA benefits, as identified by the European Environment Agency (2011): mitigating the urban heat island effect; flood risk management; and ecosystem resilience.

3.1.1. Urban heat island effect

When assessing 16 capital cities of Europe, the WWF (2005) found that the mean temperatures of 13 of them had risen by at least 1°C since the 1970s. There are two main reasons for the disproportionate heating of urban areas – most urban buildings are built with impermeable materials, so moisture is not available to help dissipate heat and a significant presence of dark materials serve to collect and trap more of the sun's energy (Gartland, 2008). This poses a significant threat to the functionality of urban ecosystems, the provision of their services, and the safeguarding of human life.

Bowler et al. (2010) research observed that urban greening cooled the average park by 0.94°C in the day. Gill et al. (2007) corroborate these findings by stating that, depending on the emissions scenario, adding 10% more green space to urban areas