Green infrastructure planning: a contemporary approach for innovative interventions in urban landscape management

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ABSTRACT

Green infrastructure has become established as the central approach to landscape planning in the UK, Europe and North America over the past decade. Bringing together a number of disciplines to form a coherent landscape resource based approach to environmental management. By assessing its utility and value this paper addresses the development of this approach in policy, practice and examines its successes and failures. Reviewing alternative approaches that green infrastructure interventions take to meet the challenges of population growth, transport and recreational needs and supporting economic growth is therefore an important assessment. This is discussed in terms of the direction that current and future green infrastructure planning policy is being presented in. Despite the extensive use of its principles in landscape planning in the UK, Europe and North America additional data is required if it is to be embedded fully in policy at the appropriate scale.

Keywords: Green infrastructure, green urbanism, landscape management, urban planning.

INTRODUCTION

Managing the urban landscape is a process fraught with difficulties and conflicting agendas. There is a perceived need in government, articulated through policy, to provide adequate and sufficient housing, transport infrastructure and support commercial development to secure the prosperity of a city or economy. However, this directly contributes to trade-offs between economic needs and the support for ecological resources management. Due to the lack of informed valuations of environmental resources, financially as well as socially, ecological resource bases in urban landscapes are often marginalized. Over the last decade green infrastructure has developed as an approach to landscape planning that addresses the fragmented thinking associated with urban development. The green infrastructure planning agenda brought together planners, ecologists, architects and developers and proposed a
holistic, and functional understanding of the ecology of urban environments. By proposing that ecological resources should form the fundamental building blocks for landscape management the supporters of green infrastructure have advocated its utility to meet a number of planning issues (Benedict & McMahon, 2006; Mell, 2009).

Green infrastructure has been discussed as providing theoretical, policy and practice led solutions to the continued demands placed upon urban areas. Drawing on a number of principles from Landscape Ecology it promotes the maintenance of ecological resources within connected networks of green spaces, watercourses and greenways. Green infrastructure planning also supports the thinking reviewing sustainable transport by promoting alternative solutions to the private motorcar. Furthermore, it directly addresses the need to view urban landscapes as a platform for green investments in the form of street trees, green roofs or in more formal parks and public open spaces (Tyrväinen, 2001; Castleton et al., 2010). The overarching message presented by green infrastructure practitioners is its adaptive capacity to address current issues (housing or anti-social behavior) whilst proposing innovative, and often community led initiatives to address them (Benedict & McMahon, 2006; Tzoulas et al., 2007).

The aim of this paper is to examine the role green infrastructure holds in urban planning practice. Given the potential development opportunities proposed above, green infrastructure is discussed as offering solutions to planning issues at a number of scales. The following sections address how planners and practitioners are working to meet the challenges of growth and development using adaptive green approaches to landscape management. This includes assessments of the role of water, brownfield regeneration and development in high-density areas. CABE Space (2009), Gill et al. (2007) and Williamson (2003) have all discussed the approaches used by planners to create responsive environments, and examine how human interactions with this process are central to the success of green infrastructure investments. They also reflect on the nature of these discussions within landscape planning policy, highlighting where limitations occur in the translation of green infrastructure policy into practice.

GREEN INFRASTRUCTURE: A GLOBAL CONTEXT

Green infrastructure can be considered a relatively new research agenda. Developed over the last decade it has become the most prominent contemporary approach to landscape planning. Whilst the focus of green infrastructure development differs spatially and geographically, there is a growing consensus assessing what it can achieve, and how it should develop. Table 1 highlights the variation in focus of green infrastructure programs suggesting that opportunities present themselves whereby greening projects labeled as ‘green infrastructure’ could provide more effective or joined-up approaches to landscape management (Benedict & McMahon, 2006). The areas proposed in Table 1 are derived from an extensive analysis of the green infrastructure, greenways, community forestry, urban planning and design literature produced in the UK, Europe and North America. The understanding of green infrastructure outlined also draws on its reporting and use in policy produced at a national, regional and sub-regional scale. A review of these discussions can be found in Mell (2010) Primary research undertaken with a broad range of practitioners also informs this discussion. Reference though should be made of the differences in green infrastructure compared to other, i.e. greenways, planning agendas. green infrastructure has adapted the principles of greenways.
(Little, 1990; Fábos, 2004), expanding landscape debates from an analysis of linear or isolated green space management towards a multi-functional and network approach. The utility of green infrastructure in policy and practice thus lies in its ability to integrate the principles of connectivity, multi-functionality and strategic management proposed by greenways to support a more holistic planning approach (Weber et al., 2006; Tzoulas et al., 2007). Moreover, although green infrastructure uses the approaches developed historically in landscape management it applies further characteristics from Landscape Ecology and urban design to focus its use in current planning practice (Mell, 2010a).

<table>
<thead>
<tr>
<th>UK</th>
<th>North America</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Community forestry</td>
<td>i. Climate change adaptation</td>
<td>i. High density urban development</td>
</tr>
<tr>
<td>ii. Sustainable urban design</td>
<td>ii. Micro-climate control in urban areas</td>
<td>ii. Mobility</td>
</tr>
<tr>
<td>iii. Urban renaissance</td>
<td>iii. Biodiversity conservation and assessments</td>
<td>iii. Climate change mitigation and adaption</td>
</tr>
<tr>
<td>iv. Sustainable communities</td>
<td>iv. Sustainable urban design</td>
<td>iv. Sustainable urban design</td>
</tr>
<tr>
<td>v. Climate change adaptation</td>
<td>v. Sustainable drainage systems</td>
<td></td>
</tr>
<tr>
<td>vi. Healthy lifestyles and landscapes</td>
<td>vi. Smart Growth</td>
<td></td>
</tr>
<tr>
<td>vii. Biodiversity and conservation</td>
<td>vii. Water resource management</td>
<td></td>
</tr>
</tbody>
</table>

The variation shown in Table 1 highlights the differences in the historical application of green space planning. The UK established a system that supports ecological, economic and social development. In Europe, due to the compact nature of cities planners have followed an ecological-social approach. Whilst in North America, the fragmented approach to landscape planning, in both policy and practice led to a less well-defined approach to landscape planning. North American research though has focused primarily on water resource management (Dunn, 2010; Fábos, 2004).

The role of green infrastructure in landscape management though is dependent on a number of variables; location, assessed need, governance structure (of policy and funding) and the existing resource base. It does not offer a singular or uniform process that can be applied to all environments. The specific locational context is therefore integral in the application of green infrastructure to ensure that interventions do not negatively impact the landscape. Consequently, green infrastructure has infiltrated the process of policy development by emphasizing its value to a wide range of landscape professionals. This has been achieved by using the language associated with Landscape Ecology, sustainable development and green space planning to express its principles in ways planners and developers can utilize. Through this process green infrastructure practitioners have been able to promote a complex amalgamation of ideas within a coherent and pragmatic approach to green investment. This has brought together an understanding of ecological networks (Ignatieva, Stewart & Meurk, 2011), connectivity (Kambites & Owen, 2007) and multi-functionality (Natural England, 2009) with the sustainable development agenda (Lindsay et al., 2001) in order to frame the innovative and spatial aspects of green infrastructure delivery (Madureira, Anderson & Monteiro, 2011).
URBAN GREEN INFRASTRUCTURE: AGRICULTURE, FORESTRY AND GREENING PROJECTS

The value of urban greening projects to well-being, economic growth and ecological sustainability is well researched. However, there is a lack of economic evidence supporting investments in green infrastructure compared to grey infrastructure. Planning for green investments at a local or neighborhood scale though can provide proportionally greater benefits due to the proximity of residents to investment sites. The rise of urban agriculture, community tree planting and green retro-fitting in urban areas are all ways that green infrastructure can contribute positively to urban sustainability by promoting a localized process of resource valuation.

Community tree planting in England undertaken by the Woodland Trust, England’s Community Forests, and more locally by local authorities, all look to establish the value of trees in urban areas. England’s Community Forest network has been at the forefront of urban tree planting projects aiming to improve local aesthetics and address climatic changes associated with urban development (Gill et al., 2007). Over the last twenty years they have allocated £125 million to create over 12,000 hectares of habitats and 10,000 hectares of new woodlands, (Blackman & Thackray, 2007); a level of green investment unprecedented in England.

Examples of this process include the Community Forests in North-West England who have established a legacy of green investments in the Manchester-Liverpool urban corridor counter-balancing the stagnation of the urban environment and decreases in green infrastructure (Community Forest North-West, 2011). The Red Rose Forest has led a program of neighborhood greening targeting the most socially deprived areas of Manchester. This work promotes community cohesion through environmental outreach work and community management of new green resources (Red Rose Forest, 2010). In a rural context East Cambridgeshire District Council (ECDC) has established the Planting Parishes project to increase woodland cover by 10% across the district. To date ECDC have achieved a 2-3% increase, a major achievement given the difficult political and financial position facing investments currently being felt by local authorities (Mell, 2011).

More recently North America has seen similar growth in community-led greening projects based around the regeneration of urban brownfields as small-scale agricultural plots. Areas of Manhattan and large tracts of central Detroit have been re-imagined as community gardens/farms, rather than as exclusionary spaces (Bull & Edwards, 2010). Schmelzkopf’s (2002) work assessed the role of community gardening in New York’s highlighting the social, ecological and financial benefits of such projects. She noted that community gardens provided spaces for local interaction, whilst also providing an affordable alternative to store bought groceries, thus promoting a greater level of social and financial parity. Schmelzkopf also
supported resident responses when the city attempted to sell these resources. However, $4 million was allocated to buy the land from Operation Green Thumb as the social and ecological benefits provided by community gardens for marginalized Latino and African-American communities were deemed greater than the financial value of development.

Although at a larger scale, Bull & Edwards’ discussions of urban agriculture in Detroit suggests that green infrastructure can also work at a broader, though still local level. They argued that urban agriculture offer communities opportunities to invest and reinstate green infrastructure in areas of greatest need. They also suggested that a development fund budget ($30 million) could be allocated to such work (Bull & Edwards, 2010) to support projects including the Greening of Detroit, Earthworks Urban Farm and the Detroit Black Community Food Security Network. Each of these projects works with local communities developing long-term strategies for social development through localized landscape management. Steel articulated this process stating that planners need to stop viewing cities as large unproductive areas but see them as part of the productive organic framework (Steel, 2008), a notion heavily emphasized in Landscape and Urban Ecology.

**GREEN INFRASTRUCTURE, BIODIVERSITY AND CONSERVATION**

Whilst urban gardening provides one avenue for increasing urban greenery, protecting and enhancing biological diversity in urban areas, regardless of scale, is also a central benefit of urban greening. Whilst many authors including Natural England (2009) have examined the cumulative benefits green infrastructure can provide at a regional or state level, others including Qureshi *et al.* (2010) promote its ecological value at the local or city scale. Within urban areas derelict or brownfield sites therefore provide opportunities for biodiversity enhancement and conservation. The role of urban greening and gardening in New York (Schmelzkopf, 2002) is one example of urban space being re-interpreted as ecologically diverse. Furthermore, the second edition of the Cambridgeshire Green Infrastructure Strategy presents a number of key biodiversity enhancement targets around Cambridge, which aim to establish more diverse resources. This second strategy builds on the original and aims to continue to the development of biodiversity projects from the £21.9 million green infrastructure development fund (Cambridgeshire Horizons, 2011). Each of these projects promotes community involvement in urban biodiversity management by creating a sense of ownership of local resources. They also fostered a long-term engagement with the landscape that potentially supports future conservation.

Whilst research and project work in the UK has focused primarily on community engagement with biodiversity at a local scale, work in North America has taken a broader spatial approach. Given the focus on water management, biodiversity and conservation planning has been developed more frequently at the county or State scale (Benedict & McMahon, 2006). The Conservation Fund has been one of the most vocal agencies in this process working closely with county and state administrations to implement catchment or network scale biodiversity protection projects. Two of the most prominent examples of this practice have been the Seattle Open Space 2100 project and the Maryland Green Infrastructure Assessment (Weber *et al.*, 2006). Both programs identified water and biodiversity resource as principal priorities for protection. Therefore, whilst in Seattle the program looked to increase the density of Seattle’s population it does so in order to allow Green Infrastructure to be
developed across the city (Rottle & Maryman, 2007). The management of people in line with what is deemed most appropriate for the ecology of the city is central to the Seattle plan. A further aspect of the plan is to integrate green alternatives to traditional transport engineering works by changing individual behaviors using innovative infrastructure planning.

GREEN INFRASTRUCTURE AND TRANSPORT

Our understanding that urban areas are over-populated with private cars is well versed (Beatley, 2000). However, there has been some reluctance, particularly in North America, to provide resources (funding or land) for alternative forms of non-motorized or public transport. Whilst growing numbers of people are cycling and walking the spatial configuration of many cities in North America makes it impractical to walk or cycle (Lindsey et al., 2001). This differs drastically from the situation in mainland Europe where from the 1950’s onwards there has been gradual growth in green transport options (Pucher & Beухler, 2008).

Examples from Brazil (Curitiba), the UK (London) and Denmark (Copenhagen) however highlight that green infrastructure, or its principles, can be integrated with large-scale transport systems. Curitiba’s public transport system was organized to provide hubs for buses, trains and bicycles at major intersections with public housing throughout the city. The city’s planners identified that there was a need for infrastructure in residential areas, which could be linked through greenways to provide an integrated transport network for residents and commuters (Rabinovitch, 1992). London has promoted a similar approach to mass transit focusing on the connective nature of green infrastructure planning. The London bicycle hire scheme, (Barclays Cycle Hire Scheme or ‘Boris Bikes’) and the development of cycle super highway network have made cycling increasingly visible, popular and viable in London. Like Curitiba by linking residential areas across the city the cycle routes have acted as safe and accessible spine routes across London. Whilst these developments would historically have been seen as hard or ‘grey’ engineering, because they focus of sustainable transport and health they support a green infrastructure interpretation (Taylor, 2008). The success of the cycle hire scheme also enabled the Mayor of London’s office to leverage an additional £25 million of corporate financing to extend the project further.

Whilst Curitiba and London are examples of green infrastructure being used to promote sustainable transport other cities have been far more successful in adopting this process. In Belgium (Ghent), Denmark (Copenhagen) and The Netherlands (Utrecht) the promotion and adoption of a cycling culture suggests that a step change in behavior is possible at a regional and a national scale. (Beatley, 2000; O’Meara, 1998). Whilst such investment programs are not necessarily feasible in North America, Portland and Seattle are starting to utilize European interpretations of alternative transport to promote greener transport practices that can influence individual, but also work at a city scale.

GREEN INFRASTRUCTURE AND SPATIAL PLANNING

A number of examples exists of green infrastructure providing benefits at a city scale. Boston (USA), Copenhagen (Denmark) and London (UK) all rely heavily on the physical landscape to provide flood protection, alternative transport routes, ecologically important resources and
leisure facilities at this scale. Boston’s use of Olmsted’s Green Necklace provides flood mitigation, climate adaptation/stabilization and recreational resources across a large area of central Boston (Fábos, 2004). Green infrastructure investments at this scale may be rare given their perceived lack of economic value, however, Boston, Montreal and New York City have all prospered from Olmstead’s visionary planning. Smaller scale projects than those in Boston and Montreal have also been developed in Stuttgart (Germany). Stuttgart utilize a range of green infrastructure to control the climate in light of its continuing expansion employing a ‘wind paths’ process to improve its air quality and the city’s climate (Kazmierczak & Carter, 2010). Corridors of open space allow mountain air to move through the city delivering the benefits of cooling the air temperature of the city and improving air quality by disturbing static pollution. Building in these wind paths is prohibited and as a consequence over 60% of the city is planned functional green infrastructure (Masukazu, 2001).

Green infrastructure can therefore be designed to act efficiently at a city-scale, if developers and planners are made aware of the benefits that may accrue. However, they also need to be aware that the connective nature of ecological resources and the impacts of development on natural (air and water), social and economic systems. If a balance can be found between these issues then green infrastructure development can create high quality and environmentally stable cities (Mell, 2010b).

One way of achieving this is through the development of specific funding opportunities promoting green infrastructure development. The governments of The Netherlands and USA have established national level funding for green infrastructure (Beatley, 2000). Canada has developed the Green Infrastructure Fund linked to Economic Action Plans. The UK has created the Green Investment Bank to support economic growth and a move towards establishing a greener economy. Although each of these funds promotes a greener attitude to development and planning they are all linked directly to economic growth. This may prove problematic, as ecological viability and economic growth have been described as being somewhat incompatible (Tyrväinen, 2001). The role of resource management and conservation may also be marginalized in an attempt to achieve growth targets. Consequently, although successful examples of green infrastructure investment programs and funding mechanism suggests governments are beginning to attribute value to green infrastructure in urban environments the policy frameworks supporting them are potentially flawed in terms of delivery. As a consequence there has been a call to mandate policy addressing the value of green infrastructure and outlining a framework for its development (Mell, 2010b).

CONCLUSION: APPLYING GREEN INFRASTRUCTURE PLANNING IN FUTURE PLANNING POLICY

The application of a green infrastructure approach to landscape planning provides planners with a toolkit of options to aid the development of sustainable urban landscapes. The development of urban greening, biodiversity and transport projects can therefore all be supported through the application of green infrastructure principles. However, whilst practitioners have produced compelling evidence of its value there has been a disconnection between its use and articulation in green infrastructure policy. Consequently, green infrastructure is only mandated in a small number of national and regional level planning policies in the UK, Europe and North America, a position that is beginning to be addressed.
The value of green infrastructure, its use and mechanisms for funding have all been discussed at the national scale. However, as the case studies discussed above highlight, green infrastructure is being predominately implemented at a regional or city level. Subsequently, there has been an ongoing debate assessing the value of such policy in translating Green Infrastructure principles into practice. Examples from the North-West in England and Maryland in the USA support this proposal. Whilst policy provides the legislative framework used to assess the viability of green infrastructure development, its articulation in policy may actually dilute the effectiveness of its delivery. Given the nature of policy, i.e. PPS12 (DCLG, 2008) in the UK, to provide wide-ranging guidance it may not provide specific information to lead appropriate investments in green development.

An understanding of the implications of green infrastructure policy in relation to biodiversity, conservation or transport infrastructure is therefore still needed if appropriate development is to occur. The development of the second Cambridgeshire Green Infrastructure Strategy is one example where this process is being achieved (Cambridgeshire Horizons, 2011). Consequently it is possible to pose the questions that it may be more beneficial for legislators at the regional scale in to lead the production of policy and implementation strategies. The revoked Regional Spatial Strategies (RSSs) in England or state assessments (i.e. the Maryland DNR assessments) in the USA may offer the most effective catalyst to translate policy into implementation tackling climate change, transport and urban conservation.

Whilst discussions of policy continue to debate the utility of green infrastructure it is also prudent to assess examples of investments that have provided the maximum ecological and social benefits. The examples discussed previously highlight this process, however, other projects including $1.5 billion allocation by New York City to support the city’s attainment of a greener and more permeable landscape focuses principally on improving water quality and storm water protection (NYC, 2010). Understanding the economic viability of green infrastructure is also important and reports from the Mersey Forest suggest that investments in green infrastructure can provide greater economic returns compared to investments in grey infrastructure. They state that for every £1 invested in greening projects £8 can be expected in returns (Mersey Forest, 2010). Furthermore, the City of Freiburg allocates £800,000 per annum for walking and cycling schemes, whilst there is evidence that Copenhagen supports cycling infrastructure with £9 million per year (Sustrans Scotland & Transform Scotland Trust, 2010). Thus, whilst the focus of green infrastructure may differ depending on location, funding and need, the examples discussed in this paper highlight its multi-functional value. The examples from Copenhagen and New York also highlight that directed investment in green infrastructure can be mandated in policy and delivered without the principles of green development being marginalized.

A green infrastructure approach to planning has provided planners with a far greater scope to review the interactions between people, the landscape and the resource base of a given urban area. There is also scope within this process to produce focused and adaptable policy in order to ensure that green infrastructure remains relevant in future discussions of urban development and sustainability. Thus, by thinking innovatively, and in some cases more holistically, about the form green infrastructure investment takes planners and developers can encourage greater social and spatial interaction with green investments, which in time will
promote a better understanding of ecological resources and decrease the competition between grey and green development.

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