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Economic analysis of wider benefits to facilitate SuDS uptake in London, UK

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ABSTRACT

Urban water management via Sustainable Urban Drainage Systems (SuDS) has been successfully applied in cities worldwide. This infrastructure has proven to be a cost efficient solution to manage flood risks whilst also delivering wider benefits. Despite their technical performance, large-scale SuDS uptake in many places has been slow, mostly due to reasons beyond the engineering realm. This is the case of England and Wales, where the implementation of SuDS has not reached its full potential. This paper investigates the strategic role of SuDS retrofit in managing environmental risks to urban infrastructure at a catchment level, through an economic appraisal of all benefits (i.e. flood reduction and wider benefits). The Decoy Brook catchment in London, UK, was used as a case study. Average Annual Benefits were used to monetise the value of SuDS in reducing surface flood risk, whilst a Value Transfer approach was used to appraise wider benefits. It was found that by including the latter, their economic feasibility improves considerably. This paper also shows how to split the investment amongst multiple stakeholders, by highlighting the benefits each one derives. Finally, recommendations regarding incentives and policies to enhance the uptake of SuDS are given. The proposed methodology for SuDS mapping and economic appraisal in the planning phase can be used in cities worldwide, as long as general principles are adapted to local contexts.

1. Introduction

The increased frequency of extreme weather events associated with climate change poses a significant threat to the integrity and function of critical urban infrastructure – rail, road, and power and water supply/sewerage networks (Bell et al., 2012; Zevenbergen & Gersonius, 2007). A key threat within the UK is the increased risk of surface water (pluvial) flooding: the conventional approach of channelling runoff to an outfall has proven to be unsustainable during severe storm events. During the winter of 2013/14, twelve major winter storms occurred, resulting in more than 5000 homes, businesses and infrastructure being flooded in Southern England (Huntingford et al., 2014; Kendon & McCarthy, 2015). To address this issue, Lead Local Flood Authorities (LLFA) in UK are required, under section 21 of the Flood and Water Management Act 2010 (Defra, 2012), to maintain a register of structures and features that are likely to have a significant effect on flood risk in their area.

Green infrastructure, in the form of Sustainable Urban Drainage Systems (SuDS), has been proposed as a mean of minimising the risk of urban flooding (Ashley et al., 2002; Ashley, Blanksby, Chapman, & Zhou, 2007; Fletcher et al., 2015). SuDS replicate the natural drainage processes of an area – typically through the use of vegetation-based interventions such as swales, water gardens and green roofs, which increase localised infiltration, attenuation and/or detention of stormwater. Hence, SuDS improve flood alleviation capacity. Moreover, SuDS provide ecosystem service benefits (wider benefits), which include mitigation of heat island effect and noise, improvements in water and air quality, plus biodiversity and provision of sites for recreation or urban amenity, amongst others (Ashley, Faram, Chatfield, Gersonius, & Andoh, 2010; Fletcher et al., 2015).

Abbreviations: AAB, Average Annual Benefits; AAD, Average Annual Damages; AST, Adaptation Support Tool; BCR, Benefit Cost Ratio; BeST, Benefits of SuDS Tool; BGS, British Geological Survey; CAPEX, Capital Expenditure; CDA, Critical Drainage Area; CIRIA, UK Construction Industry Research and Information Association; EA, Environment Agency; FRM, Flood Risk Management; GiA, EA Grants in Aid; LLFA, Lead Local Flood Authorities; MCM, Multi-Coloured Manual; NPV, Net Present Value; ONS, UK Office for National Statistics; OPEX, Operational Expenditure; SuDS, Sustainable Drainage Systems; uFMfSW, EA Updated Flood Maps for Surface Water; WLC, Whole Life Costing.

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Despite their multi-functionality, SuDS implementation has faced various barriers, with institutional and economic factors typically the biggest obstacles (Ashley, Blanksby, Cashman et al., 2007). In the UK, the key barriers to SuDS adoption are the performance and economic uncertainties surrounding their use in Flood Risk Management (FRM) schemes (Ashley, Newman, Walker, & Nowell, 2010). In particular, SuDS often fail the feasibility criteria of FRM cost-benefit analysis because: (a) the multifunctional asset value of SuDS has not been considered; and (b) the full scope and extent of the benefits provided have not been quantified. An additional problem is the potential complexity of a SuDS train (i.e. a set/combination of SuDS) for retrofitting in a specific project area (Charlesworth, 2010), given the wide variety of SuDS that are available. There is a clear need to improve current procedures for quantifying the capacity of SuDS to reduce flood risk and evaluate the economics of SuDS retrofitting, taking into consideration all of their multifunctional benefits.

The aim of this study is to deliver a step-change in the evaluation of proposed SuDS retrofit during the planning phase, to increase its uptake in cities worldwide. This is done by reviewing scientific and industry literature on this issue, and by analysing a case study through a cost-benefit analysis that includes SuDS flood risk reduction and wider benefits. The methodology is defined such that it uses a set of existing tools to perform a detailed analysis of a SuDS retrofit in an urban area. Special attention is given to the appraisal of wider benefits as these values may be a game changer in the economic analysis of SuDS.

2. Background of SuDS implementation in London

Despite industry, governments and researchers' efforts, the uptake of SuDS in London has not been as efficient as in similar cities worldwide (Ashley, Blanksby, Chapman et al., 2007; Ashley, Newman et al., 2010; MWH, 2011). SuDSí technical performance has been analysed in detail, and proved to be beneficial for mitigating the risk of flash flooding and water course pollution (Fletcher et al., 2015; Nickel et al., 2014; USEPA, 2013). Moreover, guidelines addressing the technical challenges have been widely available for nearly a decade (Dierkes, Lucke, & Helmreich, 2015; Lampe et al., 2004; Woods-Ballard et al., 2007). Multiple institutional frameworks have not, however, been updated to accommodate the implementation/use of SuDS and this hinders their development (Ashley, Newman et al., 2010). Economic, financial and planning regulations need to be enhanced to foster the implementation of SuDS.

2.1. Current challenges

In England and Wales, flood management is currently seen as a separate issue to water supply and water quality management (Ashley, Blanksby, Cashman et al., 2007; Ashley, Blanksby, Chapman et al., 2007; Thames Tunnel Commission, 2011). This hinders the possibility of merging efforts and budget across these domains to maximise outputs, through solutions such as SuDS, which simultaneously address several challenges in a cost-efficient way. In addition, because quantification and monetisation of wider benefits is a complex process, SuDS tend to be undervalued by stakeholders (MWH, 2013). Several tools have been developed to appraise/quantify these wider benefits (Ashley et al., 2012; MWH, 2015; Natural Economy Northwest et al., 2010; Technology & Rivers, 2010). However, they are yet to be widely accepted and used. It would be desirable that a methodology merging flood risk reduction and wider benefits appraisal was consolidated as general practice within the industry and government.

Furthermore, in the UK water utilities have been privatised. This makes it difficult to differentiate the responsibilities of infrastructure development between companies and government (MWH, 2011), but also may hinder coordination between them (Ashley, Blanksby, Chapman et al., 2007). In addition, in most cities in the UK, direct and indirect incentives are low, therefore few private investors have supported SuDS development (MWH, 2011). However, these have been key stakeholders in successful examples of green infrastructure developments worldwide.

Water utilities are often criticised for their low involvement in SuDS projects (Environment Agency, 2013a; Thames Tunnel Commission, 2011), however, this may be related to current institutional frameworks. Indeed, strict industry regulations have been identified as another constraint to SuDS implementation in the UK. Due to considerable economic and legal penalties, fewer companies may be eager to invest in SuDS, because, as with any other innovative solution, there is still uncertainty surrounding the viability of proposed solutions (Thames Tunnel Commission, 2011). Developing an *"environment that can accommodate failure"* would reduce negative perceptions among stakeholders, as it would share, among all of them, the potential risks associated with SuDS (MWH, 2011).

The ownership and maintenance of SuDS is another issue, as its performance is dependent upon provision of appropriate maintenance (Dierkes et al., 2015; Lampe et al., 2004). However, as several stakeholders are expected to fund SuDS (e.g. Water Utilities, Local Boroughs, users, etc.), regulations should be updated to clearly define the allocation of ownership of these assets across stakeholders (Environment Agency, 2013a). This would allow; (1) SuDS inclusion in financial statements, which is essential for regulated water utilities; and (2) the identification of stakeholder responsibility for maintenance and management.

2.2. Benchmarking current situation

When benchmarking UK cities against major cities worldwide, some differences arise. One of them is the lack of generous incentives for promoting the participation of private investors in SuDS schemes. Worldwide, these incentives have included subsidies from cities or regional governments to support the investments, support with maintenance expenses and abatement of surface water charges/fees, among others (Ando & Freitas, 2011; Keeley, 2007; Ngan, 2004; Shuster & Rhea, 2013; Thurston, 2006; USEPA, 2013; Valderrama, Levine, Yeh, & Bloomgarden, 2012). The success of these programmes is facilitated by clear guidance on the technical requirements for obtaining and keeping incentives.

In addition, before granting fees abatement, successful incentive schemes have sometimes involved reforming stormwater drainage charges to be proportional to the size of the impermeable area of a property draining to the network (Keeley, 2011; Ngan, 2004; Nickel et al., 2014; Thurston, 2006; Valderrama et al., 2012). This institutional change is important to achieve an equitable charging system based on the impact to the stormwater network, rather than based on water supply, following the ípolluter paysí principle.

In the UK, the Environment Agencyís Grants in Aid (GiA) are a direct incentive to reduce flood risk (Environment Agency, 2010). However, there are few efficient abatements of fees, or other incentives, to complement this and increase the feasibility of projects. Fees reduction of many utilities is small, and most of them still use traditional charging methodologies where calculations are independent of the propertyís impermeable area.

In addition, interventions worldwide tend to tackle several issues at the same time, which means that they promote active engagement from several institutions and citizens. In (Kazmierczak & Carter, 2010) the authors explain how to successfully deliver catchment-wide projects that generate wider benefits, including flood management, water quality improvement, increasing green