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A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas

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ABSTRACT

To address challenges associated with climate resilience, health and well-being in urban areas, current policy platforms are shifting their focus from ecosystem-based to nature-based solutions (NBS), broadly defined as solutions to societal challenges that are inspired and supported by nature. NBS result in the provision of co-benefits, such as the improvement of place attractiveness, of health and quality of life, and creation of green jobs. Few frameworks exist for acknowledging and assessing the value of such co-benefits of NBS and to guide cross-sectoral project and policy design and implementation. In this paper, we firstly developed a holistic framework for assessing co-benefits (and costs) of NBS across elements of socio-cultural and socio-economic systems, biodiversity, ecosystems and climate. The framework was guided by a review of over 1700 documents from science and practice within and across 10 societal challenges relevant to cities globally. We found that NBS can have environmental, social and economic co-benefits and/or costs both within and across these 10 societal challenges. On that base, we develop and propose a seven-stage process for situating co-benefit assessment within policy and project implementation. The seven stages include: 1) identify problem or opportunity; 2) select and assess NBS and related actions; 3) design NBS implementation processes; 4) implement NBS; 5) frequently engage stakeholders and communicate co-benefits; 6) transfer and upscale NBS; and 7) monitor and evaluate co-benefits across all stages. We conclude that the developed framework together with the seven-stage co-benefit assessment process represent a valuable tool for guiding thinking and identifying the multiple values of NBS implementation.

1. Introduction

The potential for introducing ecosystem-based approaches into urban planning and policy-making is increasingly gaining attention from both scientists and policy-makers as approaches that offer sustainable and cost-efficient solutions for water management (Armson et al., 2013; Young et al., 2014), air quality (Calfapietra et al., 2015; Wang et al., 2015) urban biodiversity (Connop et al., 2016), and for cross-cutting challenges like biodiversity conservation, public health and well-being (Bennett et al., 2015; Carrus et al., 2015). Researchers are now encouraged to move from ecosystem-based approaches to nature-based solutions (NBS) in order to work integratively with ecosystems to adapt to and mitigate the impacts from climate change, conserve biodiversity and improve human health and well-being (Cohen-Shacham et al., 2016). NBS can be defined as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (European Commission, 2016, p. 1). NBS bring together established ecosystem-based approaches, such as 'ecosystem services', 'green-blue infrastructure', 'ecological engineering', 'ecosystem-based management' and 'natural capital' (Nesshöver et al., 2016; Nature Editorial 2017) with assessments of the social and

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economic benefits of resource-efficient and systemic solutions that combines technical, business, finance, governance, regulatory and social innovation (European Commission, 2015).

The need to protect natural capital and value ecosystem services is increasingly recognised as fundamental to progress towards sustainable development objectives. A prominent example is represented by the European Union (EU) actions towards smart, sustainable and inclusive growth for Europe 2020. The EU Biodiversity[1] and Green Infrastructure[2] strategies are significant contributions to this. Additionally, the EU Thematic Strategy on the Urban Environment[3] recognizes that it is in urban areas that the environmental, economic and social dimensions of the EU Sustainable Development Strategy come together most strongly. NBS, therefore, are directly relevant to several policy areas and through their systemic nature interact with many others, such as land use and spatial planning.

NBS are also seen as open innovations that require engagement with multiple actors, providing co-benefits that bridge social and economic interests and as thus, can stimulate new green economies and green jobs (Kabisch et al., 2017; Raymond et al., 2017). They are increasingly promoted across funding schemes and projects (e.g., European Commission, 2015).

Until now, most researchers have drawn upon the ecosystem services framework for assessing the biophysical or economic value of ecosystem-based approaches in cities (Baró et al., 2015; Green et al., 2016; Liquete et al., 2015), and for examining the potential for synergies and trade-offs between bundles of ecosystem services (Mouchet et al., 2017; Turner et al., 2014). While the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is drawing upon a wider framework of nature's contributions to people, recognizing that different types of values need to be promoted in environmental decision-making, including concepts associated with other worldviews on human-nature relations and knowledge systems (Pascual et al., 2017). The European Commission is assisting its Member States in the process of mapping and assessing ecosystem services, including their economic value and in incorporating these values into EU and national accounting and reporting systems (Maes et al., 2016)

However, important questions remain about how to assess the impacts of NBS within and across different societal challenges. When fulfilling the functions of urban infrastructures using or mimicking natural processes, NBS may simultaneously provide co-benefits for biodiversity and human well-being (Cohen-Shacham et al., 2016), but existing frameworks do not cater for such complexity. Previous work has narrowly framed and assessed (co-)benefits mainly with reference to single indicators or challenge areas, such as ecosystem service values, synergies and trade-offs (Maes 2013; Mouchet et al., 2017), the co-benefits of climate interventions (Bain et al., 2015; Rao et al., 2016), the direct and indirect (including anthropogenic) drivers of environmental change (Díaz et al., 2015), cost-benefit approaches (Ürge-Vorsatz et al., 2014), and resilience frameworks (Adger et al., 2011; Kais and Islam, 2016; Leichenko, 2011).

Furthermore, there is a severe lack of practical, and targeted guidance for the processes that enable the consideration and assessment of co-benefits within and across the stages of implementation and decision-making (Ürge-Vorsatz et al., 2014). A recent review of EU policies found that while the ecosystem service concept is being gradually taken up by policy and planning, it remains confined to natural resource policies (Bouwma et al., 2017). The assessment of environmental impacts was in many cases restricted to single challenge areas (e.g., biodiversity, ecosystems) and rarely addressed cross-sectoral impacts (e.g., links between biodiversity, and the economy). Moving to solution implementation requires decision-making toolkits that simplify and systematize the monitoring and evaluation of co-benefits in decision-support (Ürge-Vorsatz et al., 2014); processes for reflecting, connecting and investigating, modelling and exploring, doing and suggesting solutions (Bell, 2012); and supporting multi-dimensional communication networks for delivering co-benefits in real-world contexts (Spencer et al., 2017). NBS implementation requires political, economic and scientific challenges to be addressed simultaneously by several actor groups (Maes and Jacobs, 2017). Practitioners need to consider elements of urban management, biodiversity, governance and social innovation within a socio-ecological system (Maes and Jacobs, 2017; McGinnis and Ostrom, 2014), and to integrate diverse types and systems of knowledge and values for NBS design and implementation so as to be socially comprehensible and acceptable to a range of stakeholders (Frantzeskaki and Kabisch, 2016; Maes and Jacobs, 2017; Raymond et al., 2017).

In response to these challenges, this paper provides a holistic framework that systematically identifies how NBS may provide both synergies across ecosystem services, but also co-benefits (or costs) in other different elements (socio-cultural, socio-economic system, environment, biodiversity, ecosystems, and climate) particularly in urban areas. The framework is intended to be used by professionals involved in multi-stakeholder and multi-disciplinary teams with expertise and interests in the design, implementation, monitoring and evaluation of NBS during the various stages of NBS action plans. It is a guiding framework that will require further operationalisation and tailoring to city-specific institutional circumstances for a successful implementation of NBS action plans. It provides, however, a holistic and globally applicable approach for multiple stakeholders that can lead and/or be used in the NBS action planning process. In most instances, comprehensive teams from many stakeholder groups such as researchers and academics, policy makers, planners and entrepreneurs from different parts of Europe will be established to design and implement NBS in cities (as in the case of NBS projects currently being funded by the European Commission). Research and academic institutions, corporate bodies and cities can all lead these NBS-oriented teams. City officials, however, will have a leadership role in ensuring that NBS actions align with existing and/or proposed urban planning strategies and governance processes including but not limited to climate change and urban regeneration strategies. We set out briefly the methodology which guided us to the definition of the framework, present the elements of it and then describe and justify a seven-stage process through which local governments and other key actors can assess, choose and implement NBS. We conclude with discussing the strengths and weaknesses of the framework and process, and identifying future research and policy directions for the implementation of NBS co-benefits.

2. A framework for the assessment of NBS co-benefits

Our framework includes four dimensions that may appear simultaneously when implementing NBS in urban areas (Fig. 1): 1) co-benefits for human health and well-being; 2) integrated environmental performance (e.g., the provision of ecosystem services); 3) trade-offs and synergies to biodiversity, health or economy; and 4) potential for citizen's involvement in governance and monitoring (Kabisch et al., 2016). The framework advances current knowledge by highlighting not only the benefits and costs of NBS derived from (existing) ecosystem services (Palomo et al., 2015; Plieninger et al., 2015), but also the benefits and costs of interactions across elements of socio-cultural, economic system, biodiversity, ecosystems, and climate.

We considered 10 key societal challenges faced by cities in the light of global environmental change (Fig. 1, bottom), and we identified for each challenge potential actions and expected impacts of specific NBS objectives; indicators of impact; and potential methods for assessing impact. A rapid evidence assessment methodology (Collins et al., 2015) was used for their identification. The assessment involved a structured search of papers from science and practice and the collection of

[1] EU Biodiversity Strategy to 2020 (COM(2011) 244).
[2] Green Infrastructure (COM(2013) 249 final).
[3] Thematic Strategy on the Urban Environment (COM(2005) 718 final).