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Extended Abstract Template

Inclusion of non-market benefits of nature-inspired strategies in urban water management: how far are we?

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Highlights

- Many studies on valuation of NBS are emerging.
- The studies focus on compartmentalized, instead of interconnected, co-benefits.
- Current literature lacks efforts geared towards replicability and up-scaling.

Introduction

Improved water management may be operationalized through the introduction of Nature-Based Solutions (NBS), defined as strategies based on natural processes that meet societal challenges and simultaneously provide human well-being and biodiversity benefits. What makes NBS particularly attractive is their ability to deliver multiple benefits, as they not only provide direct solutions to present challenges (like climate change adaptation), but also enhance the spatial quality of the surrounding area in many direct and indirect ways (Cohen-Shacham et al., 2016). In particular, NBS have often been suggested as a promising solution for contrasting hydro-meteorological risks, standing at the intersection of natural systems and built infrastructure, and they are gaining popularity in urban areas to reduce and/or prevent runoff and flood risk (e.g. green-blue infrastructure, constructed wetlands, SuDS, green roofs, vegetated swales, trees, etc.) (Gunawardena et al., 2020; Ruangpan et al., 2019).

However, NBS have not yet achieved widespread uptake, at least partially due to the challenge of quantifying the complementary, intangible benefits provided by these solutions. In order to quantify NBS impacts, ease their uptake and advocate for them as alternatives to “business-as-usual” infrastructures, there is the need for a comprehensive valuation of their multiple advantages, i.e. not only traditional valuation of tangible assets (e.g. additional water supply and reduced flood risk), but also quantification of non-market, indirect benefits, such as the ones affecting human well-being or biodiversity status (Alves et al., 2019; Venkataramanan et al., 2020). A common approach to value the benefits of NBS projects is a quantification based on the ecosystem services (ESS) framework. However, the single ESS valuation is increasingly seen as unfit for the valuation of NBS benefits, as its approach mainly focuses on the quantification of stocks and flows of ESS and the condition of ecosystems based on their service provision to humans. Instead, assessment studies of NBS should be (i) able to assess a broader range of social, economic and environmental co-benefits, as well as their interconnections, and (ii) easily transferable and comparable, to aid in the creation of a shared NBS evaluation framework (Díaz et al., 2018; Raymond et al., 2017). Therefore, a novel, more comprehensive benefit valuation could contribute to speeding up NBS implementation, and ensuring that the employed NBS strategies do in fact provide multiple co-benefits, both with regards to people (e.g. advancing human well-being) as well as to nature (e.g. healthier ecosystems and biodiversity).

This study contributes to filling this gap by reviewing publications that use stated preference (SP) methods to assess non-market people benefits of nature-inspired strategies, and its aims are to (i) highlight any biases or knowledge gaps in this kind of evaluation, and (ii) determine if and how these methods could be improved.

Methodology

Study selection and review

A paper search conducted on the electronic journal database Web of Science resulted in 585 articles, of which 50 were selected for further analysis based on the following criteria:

- Must be a primary study, i.e. a study collecting data directly from the target respondents;
- Focus on NBS or a nature-inspired adaptation strategy;
- Use a SP method to assess the non-market people benefits.

In order to answer the research question of what are the limitations of the current assessment of non-tangible NBS benefits, the content of the papers was run through a series of filters and coded into standardized definitions that can be grouped into 4 sections:

- 1) Descriptive characteristics (e.g. study year, number of study sites, SP method used, type of nature-based strategy);
- 2) Quantified non-market benefits (e.g. people and/or nature benefits, transferability of the assessment);
- 3) Outcome of the study (in terms of e.g. average WTP, visitation frequency, travel time);
- 4) Socio-demographic characteristics of the study site (average income level of the city/neighbourhood, population density, GDP of the country/region), if reported.

Results and discussion

As it was a necessary condition for the inclusion in the review, all the selected studies ($n=50$) quantified some aspect(s) of human non-tangible benefits for nature-inspired strategies. While some studies only assessed human co-benefits, 30 papers (60%) also quantified nature co-benefits. As for the studies that did assess nature co-benefits, they were almost exactly split in half between transferable and non-transferable co-benefits quantification. The assessment of nature benefits was deemed transferable if it was possible to apply it in any site (e.g. hectares of protected area, status of the ecosystem measured by standardized indicators), while it was considered non-transferable if it was based on unique characteristics not to be found in settings other than the site, or areas identical to the site examined. Most of the studies (up to 70% of those assessing only human benefits) were found relying on an ESS quantification approach. Moreover, the majority (84%) of the studies focused on one single case study only; those studies having more than one case study were more likely to assess only people benefits (Fig. 1).

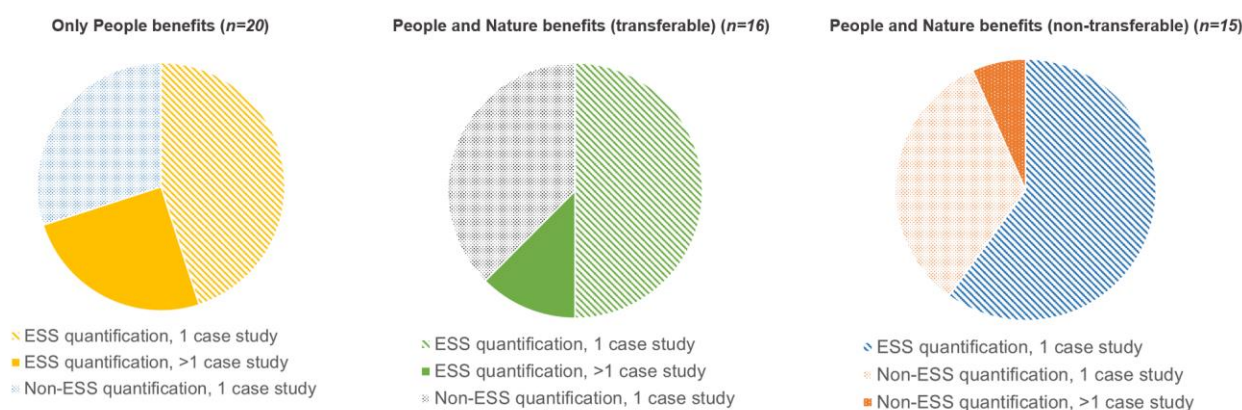


Figure 1. Main features of the papers ($n=51$) regarding the quantification of non-market co-benefits of nature-inspired strategies.

Our findings thus show that most of the research to-date is relying heavily on an ESS-valuation approach, which often leads to an assessment based on compartmentalized services rather than on interlinked co-benefits. This tendency is further strengthened by the fact that ca. 25% of the reviewed articles appeared to assess a single kind of ESS (e.g. provisioning, supporting, etc.), most of which belong to the group of studies assessing both people and nature benefits. Although assessment of both people and nature benefits shows a beginning of integration between the two spheres of impacts, we believe that focusing the quantification on only one kind of ESS for human benefit demonstrates that the opportunity for quantifying related benefits and interlinkages is not taken advantage of to the extent it could be, and

studies seem to settle for assessing isolated impacts. As for the degree to which the examined studies have taken into consideration the replicability of their methods, the results highlight two opposite tendencies. On one hand, slightly more than half (52%) of the articles assessing both people and nature benefits framed the assessed nature benefits in a transferable way. On the other hand, when looking at the number of case studies assessed by the papers, which was used as a proxy to determine if the transferability and comparability of the study were tested in practice, most of the research appeared to be carried out on a single case study. These characteristics (i.e. non-transferable quantification of nature benefits and single case studies) do not completely prevent studies to be replicated in and/or compared to other areas, but they appear to show that easing the up-scaling of benefit assessment is not a priority in the current literature. This could lead to nature benefits assessment to be seen as a limitation rather than required, and shows how we may still lack proper indicators and frameworks for easily transferable and comparable benefit quantification. Therefore, a novel SP-based framework integrating both people and nature indicators could be a desirable step forward to more holistically assess the co-benefits of NBS in compliance with their concept, i.e. in an interlinked, synergistic manner.

Conclusions and future work

Our review analyses relevant non-market valuation studies from around the world and strives to highlight any biases or knowledge gaps of the current evaluation, and identify further research needs. One of the most recognized advantages of NBS is their capacity to provide multiple benefits. Thus, the more recent literature on frameworks for the proper assessment of NBS highlight the need for comprehensive, interconnected approaches (Díaz et al., 2018; Raymond et al., 2017), in order to deliver an exact picture of their interlinked impacts and consequently ease their implementation. Despite these recommendations, our results show that most publications to-date which involve human benefits of NBS tend to rely on compartmentalized ESS-based valuations rather than on comprehensive assessments of interconnected co-benefits. This may result in lost opportunities with respect to valuing nature co-benefits and the way they influence or may be influenced by human co-benefits. Moreover, the analysed studies also tend to use site-specific assessments, and do not explore or explicitly provide paths for replication that could better support upscaling of NBS measures outside of cities. We argue that the current approach could thus ultimately slow NBS uptake by missing opportunities for a full co-benefits assessment. To fill these gaps, we propose the use of tailored contingent valuation surveys as a methodology to allow for both holistic and replicable non-market NBS co-benefit quantification.

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