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Ecosystem-based Adaptation: A review of the constraints

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ABSTRACT

In the international climate policy arena, Ecosystem-based Adaptation (EbA) has become the preferred adaptation approach to climate change in the least developed and developing countries. Its perceived strength lies in the premise that adaptation strategies need to address both ecosystems and livelihoods simultaneously, given these are crucially intertwined and both under a threat from climate change. While EbA has certainly made progress as an adaptation approach, a lack of understanding still exists how EbA approaches contribute to 'effective' adaptation, including the circumstances where they face constraints and limits. Furthermore, implementation of EbA approaches ideally requires a level of understanding about ecosystem structure, productivity and dynamics, and how these are affected by climate change and other direct anthropogenic stressors, that are rarely available in developing countries. This paper aimed to synthesise the current knowledge in the emerging body of EbA specific literature on the kinds of constraints that hamper the use of EbA. Our analysis examined the following constraints: economic and financial, governance and institutional, social and cultural, knowledge constraints and gaps, and physical and biological constraints and limits. The identified constraints demonstrate the complexities in developing, implementing, monitoring and evaluating EbA and propose significant further areas of research, including the need to provide well-documented case studies of EbA, which crystallise the main lessons learned such as practical challenges in designing and implementing EbA projects and research programs.

1. Introduction

In the international climate policy arena, ecosystem-based approaches are argued to be able to "offer cost-effective, proven and sustainable solutions contributing to, and complementing, other national and regional adaptation strategies" (World Bank, 2009, p. 8). Ecosystem-based Adaptation (EbA) in particular is now the preferred adaptation approach to climate change in the least developed and developing countries (Bourne et al., 2016; Pasquini and Cowling, 2015). This is based on the premise that adaptation strategies need to address both ecosystems and livelihoods, given these are crucially intertwined and both under a threat from climate change (Munroe et al., 2012; Roberts et al., 2012; Vignola et al., 2013). Using natural processes and systems can help communities in adapting to climate change (Ojea, 2015; Reid, 2016) while simultaneously conserving biodiversity, which in turn results in increased well-being of communities (Roberts et al., 2012).

A multi-sectoral approach, such as EbA, can deliver adaptation benefits across such diverse fields as disaster risk reduction, food security, water management, land management, and livelihood diversification and simultaneously result in a multitude of economic, social and cultural benefits (Munang et al., 2013). To work on the local scale, EbA is often closely tied with Community-Based Adaptation (CBA). CBA is focused on the community scale and ensures that adaptation efforts work hand in hand with local development goals and community well-being and resilience (Reid, 2016). Both of these approaches are now part of the climate adaptation policy agenda through United Nations Framework Convention for Climate Change (UNFCCC) National Adaptation Plan for Action (NAPAs), the Cancun agreement, and the Nairobi Workplan for Adaptation (Reid, 2016).

While EbA has certainly made progress as an adaptation approach, there is still a lack of understanding of the extent to which EbA approaches contribute to 'effective' adaptation, including the circumstances where they face limits (Doswald et al., 2014; Reid, 2016). This

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is partly due to the very limited understanding of how EbA's effectiveness can be measured (Munroe et al., 2012), and monitoring and evaluating EbA projects and their specific outcomes (McKinnon and Hole, 2015). Many documents do not offer clear examples on how EbA has been implemented in practice or explain the main constraining factors including the kinds of information needs that have arisen in the process (exceptions include Bourne et al., 2016; Roberts et al., 2012). Some of these issues have been noted in recent EbA-specific review papers focusing on Green infrastructure in cities (Demuzere et al., 2014); Mainstreaming of EbA (Ojea, 2015); Progress and challenges for EbA (Chong, 2014); EbA and forests (Pramova et al., 2012); EbA in Europe (Doswald and Osti, 2011); EbA in cities (Geneletti and Zardo, 2016), and conceptualisation of EbA (Milman and Jagannathan, 2017; Scarano, 2017).

While these recent reviews offer useful information on how EbA is being approached in different sectors, there is still a lack of coherent understanding of the specific kinds of constraints, which can hinder in implementing EbA. This paper therefore synthesises the main constraints in the emerging EbA-specific literature. In doing so, we aim to contribute to the broader body of literature on adaptation constraints that describes the technological, physical, ecological, financial, social, cultural, information and cognitive constraints and limits (Biesbroek et al., 2010, 2013; Juhola and Westerhoff, 2011; Klein et al., 2014; Klein and Juhola, 2014; Leal Filho and Nalau, 2018; Reisinger et al., 2014; Simonsson et al., 2011). Understanding constraints and limits in particular is necessary to understand ways to facilitate more successful adaptation approaches and to identify adaptation opportunities (Klein et al., 2014).

This paper presents the main findings of a literature review, which reviewed over 60 papers that were specifically addressing EbA to identify EbA-related constraints. The paper is organized as follows: the next section introduces the research method, including the coding and analysis processes used in the study. The third section presents the on the most common constraints and enablers, which are documented in the literature. The fourth section discusses the importance of the findings, and also proposes some ways forward for EbA-related research.

2. Methods

The aim of the research was to investigate the kinds of constraints that are being reported in the EbA literature. A literature review was conducted, based on emergent qualitative analysis, that used both inductive (bottom-up) and deductive (top-down) analysis (Bazeley, 2007; Miles and Huberman, 1994). This dual approach represents a 'middle of the road', which neither completely relies on existing literature nor only relies on the data itself (Bernard and Ryan, 2010). Qualitative analysis program, NVivo 11, was used to conduct coding of the data.

Constraints in this study were defined as "a factor or process that makes adaptation planning and implementation more difficult" (Klein et al., 2014, p. 906). The initial categories were derived from Klein et al. (2014) but during the analysis several of these were merged (Table 1), with new categories and sub-categories added from the inductive bottom-up coding process. Although many of these constraints interact and overlap, the categorization aimed to provide sufficient level of differentiation. Limits were defined as situations where "there are no adaptation options that can be implemented over a given time horizon to achieve one or more management objectives, maintain values, or sustain natural systems" (Klein et al., 2014, p. 906).

The data extracted for the review was found through Internet searches for peer-reviewed articles using Scopus, Web of Science, and Griffith Online Library with search term 'ecosystem-based adaptation' during August 2016. Papers were included if these referred to ecosystem-based adaptation in the title, abstract, keywords or in the text, and dealt with human adaptation to climate change and/or addressed climate change and ecosystem services/management. The selected material consisted of both peer-reviewed papers and reports from the grey literature and consisted of 65 documents (Supplementary material, Appendix 1). Each output was saved as pdf with citation record to EndNote, and imported into the qualitative analysis program NVivo 11.

Table 1 Categories of Constraints to Adaptation (original categories by Klein et al., 2014, 913–918 and modified categories from this research).

The lead author conducted the analysis and coding with external validation (Warren and Karner, 2010) through frequent discussions and checking with colleagues involved in EbA research. This external validation led to changes, for example in re-ordering lists in tables for more logical sequencing, and in the selection of the key items. This is common practice in qualitative exploratory research where the analysis is conducted by a main author (Pasquini and Cowling, 2015), but is externally validated by other experts (Warren and Karner, 2010).

The study has naturally its limitations. It focused mainly on academic papers and some grey literature reports, which were listed in the databases as search results. It did not specifically use broad search engines such as Google to find EbA and CBA specific project reports in the grey literature. A preliminary online search has revealed that there is increasingly more reports available online with the increase in climate related funding and future analyses would likely benefit from assessing these types of non-academic outputs and comparing them with scholarly peer reviewed research articles.

Also, having multiple people to code the papers could have produced different results to some extent. Yet, one coder has significantly more control in making sure the each node tree for example exhibits similar ideas and that items are classified in the same manner. Ideally, implementation of EbA approaches requires a level of understanding about ecosystem structure, productivity and dynamics, and how climate change and other direct anthropogenic stressors affect these. We did not, however, review publications outside of the EbA literature that focussed purely on ecosystem-climate interactions, as our aim here was to assess consideration of EbA constraints primarily through a social science perspective.

3. Results

The main constraint nodes included Economic and Financial Constraints, Governance and Institutional Constraints (including Participation), Social and Cultural Constraints (including Gender), Knowledge Constraints, Knowledge Gaps, and Physical and Biological constraints and limits (Table 2). Each of these categories will be examined in the proposed order.

3.1. Economic and financial constraints

The main financial constraints related to land prices (Cartwright et al., 2013), funding priorities (Lukasiewicz et al., 2016), lack of specific EbA funding (Chong, 2014; Doswald and Osti, 2011; Grantham et al., 2011), and lack of financial and human resources (Boer and Clarke, 2012; Chong, 2014; Lukasiewicz et al., 2016; Roberts et al., 2012).

In regards to land prices, Cartwright et al. (2013) note that in the case of Durban, land prices can be expensive for governments to purchase land for EbA implementation. Lukasiewicz et al. (2016) in turn discuss that often restoration of degraded lands is not prioritised for funding, as the bulk of the money is spent on protecting existing biodiversity. Of the international adaptation finance available, only a small amount is dedicated to biodiversity and ecosystem services (Ojea, 2015).

The lack of financial and human resources mentioned in the analysed papers particularly related to the implementation of EbA by government ministries (Boer and Clarke, 2012; Chong, 2014). Lack of successful demonstration of EbA benefits meant it was harder to access adaptation funding for EbA projects (Chong, 2014). In the Pacific Islands in particular, lack of human, financial and technical resources