Ecosystem-based Adaptation to Climate Change: Review of Concepts

Dr Johanna Nalau

Professor Susanne Becken

Griffith Institute for Tourism
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Griffith University, Queensland, Australia

About this report:

This report provides a baseline for further work in the Social and Policy Analysis component of the EcoAdapt in the Pacific research project. For more information on the EcoAdapt project see here: https://www.griffith.edu.au/research/research-excellence/ecoadapt-in-the-pacific. The report synthesises literature on ecosystem-based adaptation, and specifically examines the concept of ecosystem-based adaptation and related assumptions, its multiple benefits, constraints in implementing EbA options, and the kind of knowledge deemed necessary for EbA-related project design and decision-making.

Disclaimer:

Executive Summary

In the international climate policy arena, it has become increasingly recognised that ecosystem-based approaches "can 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) is often advocated as a particularly well-suited climate adaptation approach especially in developing and least developed countries (Bourne et al., 2016; Pasquilini and Cowling, 2015; World Bank, 2009). Its perceived strength lies in 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).

Many recent reviews have tried to better understand what exactly EbA is, what its current challenges are and what opportunities it offers (Chong, 2014; Doswald et al., 2014; Ojea, 2014; Reid, 2015). While these recent reviews provide useful information on how EbA is being approached, there seems to be a tacit assumption that people generally agree and know what 'ecosystem-based adaptation' means. This may not be the case, and this review seeks to contribute to clarifying the concept.

The purpose of this report is to provide analysis of the key concepts included and embedded in EbA discourse, and examine what exactly forms the essence of 'EbA-ness' in adaptation policy and research activities. More specifically the review focused on identifying different EbA definitions, and on differentiating assumed benefits, and the enablers for effective EbA. Specific analysis of the constraints is presented elsewhere (Nalau et al., under review) although we touch upon some generic issues regarding constraints and limits also in this report.

The report found that overall the discourse in regards to preferring EbA as an adaptation approach includes such concepts as co-benefits and trade-offs, which all relate also to the ways EbA is constrained and/or enabled as an option for climate change adaptation. The main constraints related mostly to issues of governance systems and hierarchies, social and cultural constraints, knowledge-related issues and gaps, and physical constraints and limits. In contrast, the enabling factors related mostly to governance and knowledge aspects, with heavy emphasis on multi-stakeholder participation, and using diverse sets of knowledges, which are seen to enable a more equitable and just approach to climate change adaptation in particular in the Pacific region.

Recommendations put forward include the need to provide well-documented case studies of EbA in the region, which crystallise the main lessons learned, including the practical challenges in designing and implementing multi-stakeholder projects, and how EbA can be measured and monitored to ensure it is delivering the expected benefits. Increasing the evidence base for EbA, while remaining realistic about the political and governance systems and capacity to adapt, is an important next step. More research should also examine the decision-making processes and to identify the main influencing factors when making decisions on adaptation options, and examine the robustness of EbA 'heuristics' in use.

TABLE OF CONTENTS

Tables

Figures

1. Context

1.1. Background

In the international climate policy arena, it has become increasingly recognised that ecosystem-based approaches "can 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) 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). Global organisations, such as the International Union for Conservation of Nature (IUCN) and United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC), are now working on how to firmly integrate EbA in the implementation of the Paris Agreement.

Finding solutions that work at local scale is critical given that the practical implementation of climate adaptation is in the end 'local' (Nalau et al., 2015b; Preston et al., 2015). This partly explains why 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, 2015). These two approaches, namely EbA and CBA, are often implemented together, and 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, 2015).

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). The concept has also high relevance to tourism industry as many of the coastal tourism infrastructure and activities are ecosystem-based.

Although EbA has become part of the current approaches to climate adaptation, there are still significant gaps in our understanding how it contributes to successful adaptation to climate change (Doswald et al., 2014; Reid, 2015). Many recent reviews have tried to better understand what exactly EbA is, what its current challenges are and what opportunities it offers (Chong, 2014; Doswald et al., 2014; Ojea, 2014; Reid, 2015). While these recent reviews provide useful information on how EbA is being approached, there seems to be a tacit assumption that people generally agree and know what 'ecosystem-based adaptation' means. This may not be the case, and this review seeks to contribute to clarifying the concept.

1.2. Aim

This report is a deliverable of the Social and Policy (S&P) Analysis component of the EcoAdapt research project in the Pacific. The aim of the S&P component is to examine the current policy and sociological constraints to the uptake of ecosystem-based approaches and identify how they can be overcome. This complements other research components on micro-economic analysis, ecological and coastal modelling, and risk assessment of alternative adaptation responses.

The specific aim of this report is to synthesise information gathered during a literature review, which focused on providing a baseline understanding of ecosystem-based adaptation (EbA). More specifically the review focused on identifying different EbA definitions, and on clarifying assumed co-benefits and trade-offs relating to the implementation of EbA projects, and the enablers for effective EbA. The report concludes by examining the kinds of knowledge and information that are seen as essential for the effective design of EbA projects, the decision-making around them, and successful implementation.

2. EbA: Concepts, Co-Benefits and Trade-offs

This section explores the different concepts that are often attached to EbA. It firstly reviews the conceptual and disciplinary background of EbA, and then discusses co-benefits, trade-offs and enablers for effective EbA implementation.

2.1. Conceptualising EbA

Conceptual and disciplinary background

A range of concepts underpin the EbA discourse and its definition (Figure 1). These assumptions were often prominent in the reviewed literature and provided a further justification to structure the report around these themes. In the developing world, EbA is for example often implemented together with Community-based Adaptation (CBA) and hence the community level, context and scale are relevant to understanding effective EbA (Munang et al., 2013; Ojea, 2014; Reid, 2015).

Likewise, the concepts of co-benefits and trade-offs offer interesting research avenues around how such benefits can be measured, and who decides what trade-offs can or should be made between different goals and outcomes. The literature on constraints, limits and enablers further examines the broader issues that either enable or limit EbA's feasibility as an adaptation option. Another issue that most authors address is the issue of scale, and its impact on how EbA can be understood and implemented.

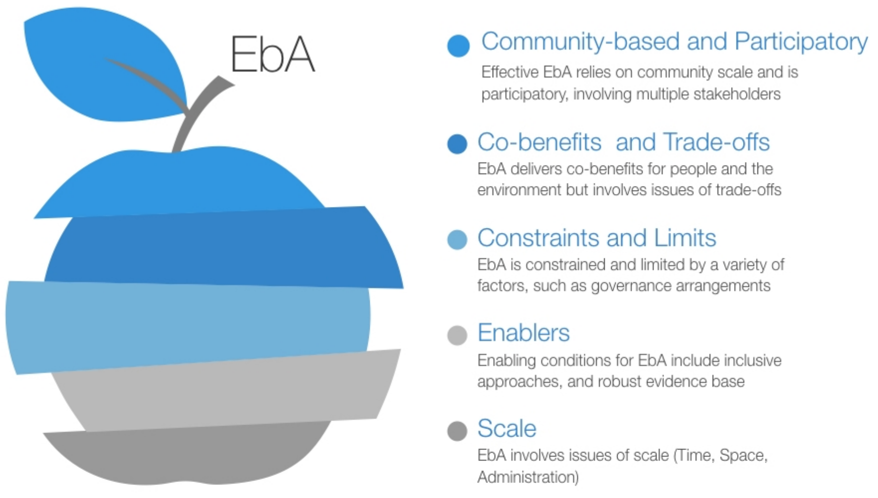

Figure 1. Main concepts relating to EbA (Source: authors).

These concepts are reviewed in this report in more detail, as they provide insights into the conceptualisation of EbA, and its dominant framings. It is, however, also important to understand the disciplinary background for EbA, which has impacted on the kinds of scientific traditions and assumptions that are the building blocks of the definition of EbA. As can be seen in Figure 2, EbA is closely related to community-based adaptation (CbA), and both are informed by climate change adaptation theory and science (Munang et al., 2013; Ojea, 2014; Reid, 2015; Roberts et al., 2012). At the same time, EbA and CbA rely heavily on earlier conceptualizations, such as ecosystem services or natural resource management, both of which gave rise to a more ecosystem-centred way of managing land use. These approaches are typically heavily informed by biophysical sciences and understanding of ecosystem processes, which also adopt system approaches.

Increasing understanding of key elements such as drivers of change and governance, as well as knowledge on sustainable development of communities, is integral to advance the theoretical and practical advances of climate change adaptation, including EbA (Chong, 2014; Doswald and Osti, 2011; Reid, 2015; Roberts et al., 2012; Travers et al., 2012). Here, input from the social sciences, including sociology, anthropology, and political ecology, has been prominent.

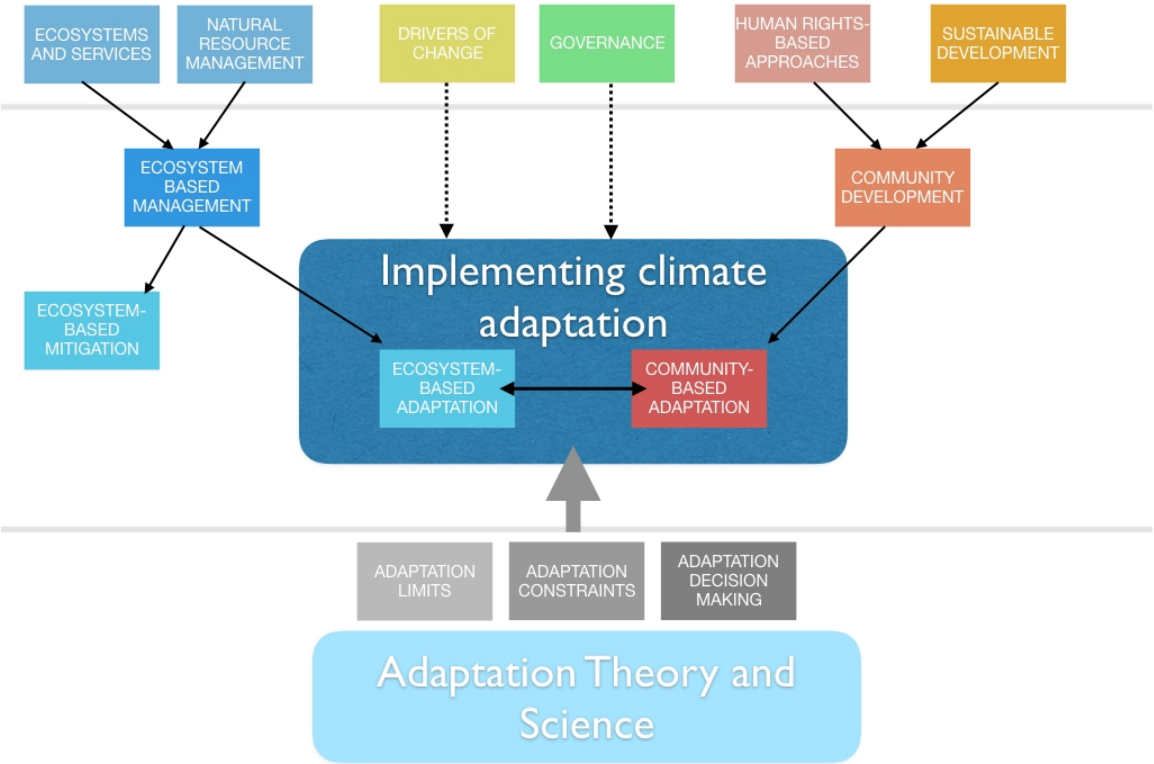

Figure 2. Disciplinary roots for Ecosystem-based Adaptation. The figure focuses on EbA and CBA as the implementation tools for EbA, and as such does not intend to indicate these are the only approaches to implement climate change adaptation. (Source: authors).

Related concepts

There are many related concepts, which are all ecosystem-related but not necessarily framed strictly as “EbA” (Table 1). For example, ‘Ecosystem-based Management’ (EBM) is a management approach that tries to balance goals, such sustainable resource use while ensuring equal access to resources and achieving conservation goals (Heenan et al., 2016). EBM is “an integrated approach to management that considers the entire ecosystem, including humans” (Sierra-Correa and Cantera Kintz, 2015, p. 386). Steizenmuller et al. (2013, p. 150) note that EBM consists of “adaptive and flexible governance and management systems that require suitable and effective information-providing mechanisms". EBM is one of the most common natural resource management approaches that is explicitly ecosystem focused.

Katsanevakis et al. (2011, p. 807) discuss Ecosystem based marine spatial management (EB-MSM), which includes "the full array of interactions within an ecosystem, including human uses, rather than considering single issues, species, or ecosystem services in isolation". This approach is used in marine spatial planning and ocean management, and is another ecosystem focused approach. There is also Ecosystem-based Mitigation (EBM), which is "the use of ecosystems for their carbon storage and sequestration service to aid climate change mitigation" (Doswald and Osti, 2011, p. 1). This EBM approach is often talked about in the context of Payments for Ecosystem Services (PES), and Reduction of Emissions from deforestation and forest degradation (REDD+) in the context of United Nations Framework Convention on Climate Change (UNFCCC) (World Bank, 2009).

Table 1. Different management approaches, which focus on ecosystems but do not mention EbA.

Specific Category	Sub-categories/Explanation	Example of Sources
Resource Governance and Use		
Adaptive Management	Adaptive Co-Management (ACM) Adaptive Delta Management	Doswald et al., 2014; Doswald and Osti, 2011; Lukasiewicz et al., 2016; McKinnon and Hole, 2015; van Wesenbeeck et al., 2014;
Community-based NRM (CBNRM)	An approach promoted since 1970s and 1980s for NRM to be more inclusive	Reid, 2015
Customary governance and management (CGM)	Customary sea tenure (CST)	Aswani, 2011
Ecological engineering	A strategy to adjust natural systems via human intervention to increase coastal safety	Van Wesenbeeck et al., 2014
Ecosystem approach/Ecosystem-based approach	An ecosystem focused approach, which aims to deliver environmental, social and economic benefits	Ahmed et al., 2013; Chong, 2014; De Bremond and Engle, 2014; Katsanevakis et al., 2011; Oloukoi et al., 2013; Randhir, 2016;
Ecosystem management	Improving ecosystem-based management can result in positive adaptation outcomes	Mori et al., 2013; Uy and Shaw, 2012; Wamsler et al., 2016; Wertz-Kanounnikoff et al., 2014; World Bank, 2009
Ecosystem-based Disaster Management	Healthy ecosystems provide disaster risk reduction benefits	Sitas et al., 2016
Ecosystem-based Management (EBM)	Various definitions: EBM as an attempt to achieve sustainable	Aswani, 2011; Castrejon and Charles, 2013; Curtin and

	use, equity in allocation of resources, and conservation goals; the approach considers both humans and the environment.	Prellezo, 2010; Dhital et al., 2015; Giebels and de Jonge, 2014; Heenan et al., 2016; Lukasiewicz et al., 2016; Rosen and Olsson, 2013; Sierra-Correa & Cantera Kintz, 2015; Stelzenmüller et al., 2013; Trush et al., 2016; Travers et al., 2012; Uy and Shaw, 2012; Van der Nat et al., 2016; Yanez-Arancibia et al., 2013
Ecosystem-based Marine Spatial Management (EB-MSM)	Considers ecosystems in marine areas, including humans	Katsanevakis et al., 2011
Ecosystem-based Mitigation (EBM)	Activities, which enable carbon storage in ecosystems	Doswald and Osti, 2011; World Bank, 2009
Flood Risk Management (FRM) catchment scale	Approach to reduce flood risk mainly through land use change	Roullaird et al., 2015
Greening Flood Protection (GFP)	Trying to use natural ecosystems as part of flood protection strategies	Janssen et al., 2015
Integrated Coastal Area Management (ICAM)	A risk management approach in coastal areas, which also targets climate change adaptation	Schmitt et al., 2013
Integrated Coastal Zone Management (ICZM)	Coastal planning process (pre Ecosystem-based Management)	Sierra-Correa & Cantera Kintz, 2015
Integrated Island Management (IIM)	Island-scale ecosystem management approach for the Pacific	Jupiter et al., 2014
Nature-based defences	Aim to maintain healthy ecosystems while providing benefits to humans	Ahammad et al., 2013; Narayan et al., 2015; Spalding et al., 2014; van der Nat et al., 2016
Payments for Ecosystem Services (PES)	An innovative mechanism to bring economic benefits for conserving ecosystems	Scarano and Ceotto, 2015; Schmitt et al., 2013; Vignola et al., 2009; World Bank, 2009
Protected Areas	Using protected areas for providing benefits for people and the environment	Scarano and Ceotto, 2015
Spatially Managed Areas (SPAs)	Approaches that use a more strict spatial management framework	Stelzenmuller et al., 2013

An approach tailored specifically for the Pacific Islands is that of Integrated Island Management (IIEM) approach. IIEM according to Jupiter et al. (2014, p. 193) is an "island-wide planning and implementation of ecosystem management in the Pacific" that aims to be more holistic and effective than other approaches in the past. Stelzenmuller et al. (2013, p. 149) suggest the use of Spatially Managed Areas (SPAs), which are "discrete spatial entities with different spatial extensions where a spatial management framework such as MSP is in place, under development, or considered."

Other approaches include 'Greening Flood Protection' (GFP), which focuses on ecosystem options as part of flood management regimes but the authors do not use the term EbA (Janssen et al., 2015). Narayan et al. (2016, p. 2) in turn discuss the concept of 'nature-based defenses', which are "existing coastal habitats within which wave reduction has been measured". Ondiviela et al. (2014) also review the role of seagrasses in coastal protection but do not discuss the concept of EbA.

One of the main arguments for using EbA is contrasting it against traditional hard engineered infrastructure. Indeed, there is a strong dichotomy between EbA and hard infrastructure. Mycoo (2014) discusses the case of Barbados, and classifies EbA measures as planting mangroves and coral reef transplantation distinct from planned retreat, beach nourishment, and hard infrastructure options. In tourism industry, EbA is often used to complement hard infrastructure solutions, such as planting vegetation on the foreshore to increase coastal protection, while increasing the aesthetics of the landscape (Figure 3).

Figure 3. Hard infrastructure (rockwalls) in one of the tourist resorts in Savai'i Island (Samoa) next to sandbags and planted coastal vegetation.

Across the EbA literature, there is increasing support to perceive EbA as a new and different concept from what has existed before. Doswald et al. (2014) and Wamsler et al. (2014, 2016) note that EbA is a 'new concept', whereas others describe EbA as 'relatively new issue in the scientific arena' (Vignola et al., 2009, p. 696). Yet, other authors, such as Mori et al. (2013) note that ecosystem-based management (EBM) has been discussed since the 1990s and that EBM is effectively the conceptual platform from which EbA has emerged. As such, EbA is not necessarily a novel approach.

But what exactly makes EbA new? This relates to the definitions of EbA itself and the way it is being conceptualised and advocated for in the literature. The most common thread running through the EbA definitions is its ability to increase societal resilience to anthropogenic climate change by using, restoring and maintaining healthy ecosystems (Chong, 2014; Doswald et al., 2014; Munroe et al.,2012; Ojea, 2014; Roberts et al., 2012). It is this response to anthropogenic climate change versus other stressors that seems to legitimate EbA as a new approach.

2.2. Co-benefits emerging from EbA

The capability to generate multiple simultaneous benefits sits at the core of EbA. A presentation by the Convention of Biological Diversity (2016), for example, shows that both ecosystem based disaster risk reduction (DRR) and adaptation are expected to bring a broad range of benefits (Figure There are many generic benefits (vulnerability reduction, increased resilience) but there are also specific benefits relating to EbA (Table 3). Alternative livelihoods are for example connected not only to increased income but also increases in food security and poverty reduction (Munang et al., 2013a; Roberts et al., 2012).

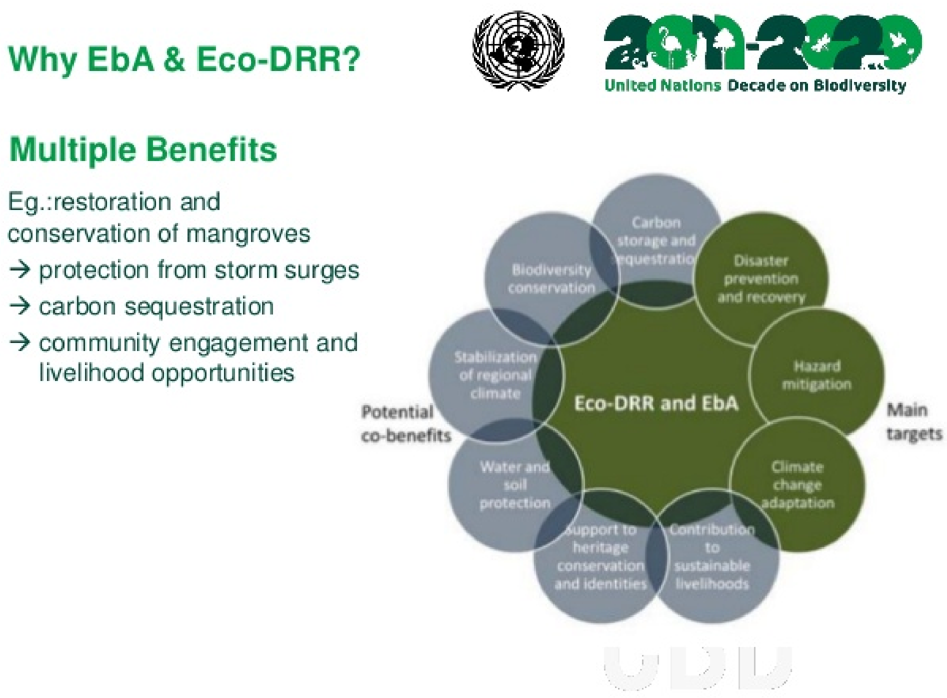

Figure 4. Slide from CBD (2016) presentation on Ecosystem-based Adaptation to visualise multiple co-benefits.

In the case of South Africa, Roberts et al. (2012, p. 184) notes that an EbA project generated 23 full-time jobs, and an additional 10 part-time and 639 temporary jobs with further 583 people involved in project activities. Similar observations have been made in Mexico where projects planting palm leaves and coffee generate alternative incomes to communities and engage women in particular in the production processes (Schroth et al., 2009).

Ahammad et al. (2013, 836) similarly report a coastal afforestation project in Bangladesh to have provided “income opportunities through cash for work to 12, 371 coastal people in afforestation interventions for nursery bed preparation, seedling raising, plantation and maintenance”. Munang et al. (2013b) also note in the case of Africa the many income-generating activities that EbA projects can deliver while also simultaneously increasing food security and reducing costs of planting.

Table 2. EbA related benefits discussed in the literature.

Specific benefit	Explanation	Source
Livelihoods and food		
Alternative livelihoods and food security	Provides additional livelihoods for communities, helps to eradicate poverty and increase food security	Ahammad et al., 2013; Munang et al., 2013a; Nel et al., 2014; Schroth et al. 2009, Roberts et al., 2012; Wertz-Kanounnikoff et al., 2011
Increase in nutrition	Alternating crop types increases protein availability	Munang et al., 2013
Carbon storage		
Carbon sequestration	Monetised ecosystem services such as carbon sequestration	Daigneault et al., 2016; Lukasiewicz et al., 2016; Roberts et al., 2012
Increase in protective and carbon rich forest coverage		Ahammad et al., 2013
Coastal protection by ecosystems	Reduced wave energy and wave height, reduced erosion, reduced water flow velocity; infrastructure protection	Ahammad et al., 2013; Spalding et al., 2014
Coastal protection		
Improves coastal planning to cope with sea level rise	Provides multiple benefits and makes coastal systems more resilient	Sierra-Correa and Cantera Kintz, 2015
Increase in capacity of coastal ecosystems to adapt to current and future changes	Increases the functional capacity of ecosystems to deal with a range of threats, including climate change	Ahammad et al., 2013
Biodiversity conservation		
Conservation of biodiversity	Critical co-benefit of EbA projects	Roberts et al., 2012
Increased species diversity (leading to climate resilience)	Functionally diverse habitats are more climate resilient	Ahammad et al., 2013
Social benefits		
Decreased social vulnerability	Reduces vulnerability to climate hazards	Pasquilini and Cowling, 2015
Health and restorative benefits	Reduced stress, active spaces for walking and hiking	Demuzere et al., 2014
Increase in cultural services and value (spiritual, educational, tourism)	Combination of increased business opportunities and well-being	Nel et al., 2014; Scarano and Ceotto, 2015;
Increase in social and individual coping capacities	Spaces for social bonding, which increase both individual and community capacity to cope	Demuzere et al., 2014
Governance		

Opportunity for collaborative governance	EbA projects can cut across sectors and engage wide range of stakeholders	Ahammad et al., 2013; Schmitt et al., 2013
Increases the political agency of adaptation	Results in development outcomes and makes adaptation relevant	Roberts et al., 2012
Increase in community access to local government services	Communities in EbA projects have better access to climate information and other external services provided by the government	Ahammad et al., 2013
Economic benefits		
Cost-effective	Due to the nature of multiple EbA benefits, projects are cost-effective in particular when compared to hard infrastructure projects	Ahammad et al., 2013; Alverson, 2012; Boer and Clarke, 2012; Chong, 2014; Daigneault et al., 2016; Jones et al., 2012; Narayan et al., 2016; Pramova et al., 2012; Roberts et al., 2012; Uy et al., 2012; Wertz-Kanounnikoff et al., 2011; World Bank, 2009
Creates both mitigation and adaptation benefits	Links to carbon sequestration potential; also links to development goals and outcomes	Ahammad et al., 2013; Jones et al., 2012; Roberts et al., 2012
Non-timber forest products	EbA projects increase the availability of non-timber forest products	Daigneault et al., 2016
Reduced planting costs and saved time, increased income	EbA measures improve soil productivity and therefore reduce planting costs, result in saved time for farmers who can invest time in alternative income streams	Munang et al., 2013a
EbA as a win-win measure, providing short-, mid- and long-term benefits	Generates multiple benefits	Ahammad et al., Burch et al., 2014; 2013; Travers et al., 2012
Other environmental benefits		
EbA effective in controlling temperature	Studies report significant reductions in temperature from EbA measures	Brink et al., 2016; Pramova et al., 2012
Improved air quality	Urban vegetation absorbs pollutants and increases air quality	Demuzere et al., 2014
Increase in environmental education opportunities	Chance to educate people in EbA projects of the linkages between ecosystems and well-being; with hands on learning	Demuzere et al., 2014; Roberts et al., 2012

Increase in soil productivity and nitrogen fixation	Improved soil quality and reduced need to use fertilizers	Munang et al., 2013
Increase in land stabilization capacity	Strengthening mangrove ecosystems stabilises land	Ahammad et al., 2013

EbA is also perceived as comparatively cost-effective. Daigneault et al. (2016, p. 34), for example, note that EbA projects are “cost-effective ways to collectively reduce disaster risk and improve natural resource management” in particular when compared with hard infrastructure options. In their estimate of EbA cost-effectiveness in Fiji, Daignealt et al. (2016) find that riparian buffer planting and upland afforestation are the most cost-effective strategies to reduce flooding.

In their review of EbA options, Jones et al. (2012) similarly find that losing ecosystems, such as coral reefs and mangroves, and then substituting them with hard infrastructure would be economically disastrous. In contrast, Roberts et al. (201, p. 190) reflect on their experience in Durban and point out that EbA projects can generate lots of costs just like hard infrastructure projects. At the same time, however, these EbA projects are still beneficial as the “outcomes are likely to be more cost-effective, more adaptable and have multiple co-benefits across a range of scenarios and time line”.

2.3. Trade-offs

The recognition of trade-offs is important in EbA projects and design for a range of reasons. Trade-offs accruing from EbA “will be of lower magnitude than those afflicting many hard interventions” (Jones et al., 2014, p. 508). In considering trade-offs, both social and ecological outcomes need to be acknowledged so that both communities and ecosystems benefit from EbA interventions (Bennett et al., 2016).

Similarly, issues such as equity are important when it comes to trade-offs (Chong, 2014). Ahammad et al. (2013, p. 839) for example note that involving a broad range of stakeholders can reduce unequal trade-offs. Andrade et al. (2011, p. 7) also note “Trade-offs can also occur between short and long-term benefits, as well as among alternative land-uses”. This is because EbA requires prioritization of land-use for example between “managing forests for water flow regulation rather than harvesting of timber and nontimber forest products” (Andrade et al., 2011, p. 7). This requires clear decisions as to which land use and ecosystem services to prioritize within a community or a stakeholder group. For example, upstream communities might choose to utilize their forests, which impacts on the downstream communities’ ability to get adequate water supply (Pramova et al., 2012). Yet, De Bremond and Engle (2014) note trade-offs should be also considered through a broader picture that looks at the interplay between adaptation, mitigation and development issues.

Some practical examples of potential trade-offs are offered by Demuzere et al. (2014) in a study on green urban infrastructure, including (p. 113):

- Maintenance of green infrastructure, including construction (increase in greenhouse gases) and potential need for fertilisers (reduced stormwater quality);
- Tree shade (cooling, Figure 5) and large trees (increase in demand for winter heating due to increased shadows and reduced wind flow); and
- Extended green areas (increases in driving distances within a city and increase in

pests and animals in green areas).

Figure 5. Shading at a tourist resort to provide thermal comfort to visitors and enhance amenity value.

Pramova et al. (2012) discuss the trade-offs between trees and crops in agroforestry and note that although trees can protect crops from extreme events and climate disturbances, they can also shade crops and inhibit their growth. Oloukoi et al. (2014) provide another practical example of gender-related trade-offs in their case study of Nigeria where men's coping strategies with climate stress practically trade away women's opportunities for EbA. The authors note that during increased climate stress, men turn to short-term quick economic activities, such as charcoal production and burning of the forest, which decrease women's opportunity to use the same ecosystem for agro-forestry. While this is a gender-specific observation, it also relates to time scales in achieving benefits from ecosystems. In other words, trade-offs often occur between ecosystem service types, gender and livelihood activities, and between current and future uses and generations.

Instead, while the existence of trade-offs needs to be recognised, Jones et al. (2012, p. 506) argue that there is ample space to achieve win-win solutions, which address both climate adaptation and conservation goals:

> "Although some trade-offs surely exist (for example, where a conservation priority conflicts with the management needs of an EbA intervention), proactively identifying and prioritizing win–win opportunities should be a clear goal of both the EbA and biodiversity conservation fields moving forward to maximize benefits for both people and nature."

This idea of co-benefits and win-win solutions feature prominently in EbA related reporting.

Yet, there is still ample room to actually develop frameworks how such “win-win” outcomes can be measured especially given that most ecosystem-based approaches need much longer timeframes to show benefits than short infrastructure-based projects.

2.4. Constraints

There are several constraints, which hinder currently the implementation and consideration of EbA as part of climate change adaptation action portfolio. These constraints relate mainly to Economic and Financial Constraints, Governance and Institutional Constraints, Knowledge Constraints, Knowledge Gaps, and Social and Cultural Constraints (Figure 6).

Although these constraints partly explain why EbA has not been implemented yet widely, one has to also consider underlying stressors, which impact on current vulnerability. For example, Andrade et al. (2011, p. 4) include factors such as “meteorological hazards, poverty and unequal access to resources, food insecurity, trends in economic globalization, conflict, and incidence of disease”. All of these combined create particular location-specific vulnerabilities in the context where EbA is implemented.

Bourne et al. (2016, p. 2) add to this list “the distribution and level of access to resources, such as wealth, municipal services, infrastructure, education and natural resource”. These again have a large impact on community vulnerability even before the impacts of climate change are considered. In the Cambodian context, Chong (2014, p. 402) notes that factors such as “spiralling and intertwined drivers of poverty, illegal resource extraction, poor law enforcement, corruption, lack of political will, and the historical dismantling of a society and its customs”, all play a role in decreasing resilience. Thus, the constraints to EbA implementation interact with and emerge from many of these factors in each specific context.

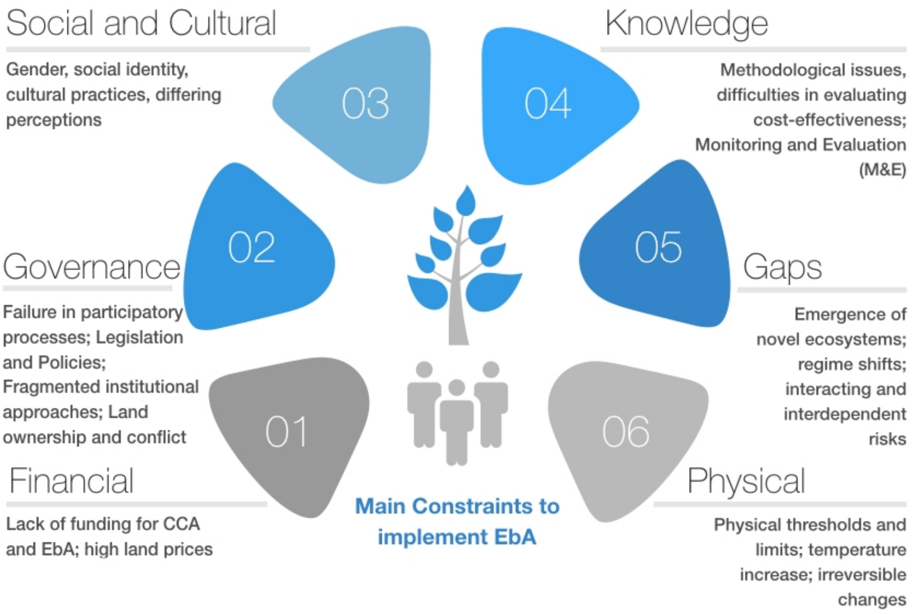

Figure 6. The main constraint categories identified in the study (Source: authors).

2.5. Enablers

There are a range of conditions enabling the effectiveness and proper use of EbA; both relating to governance and knowledge.

In terms of governance (Table 3), crucial factors relate to participation, equity and good governance. Andrade et al. (2011, p. 8) for example insist that a truly effective EbA "must be participatory, transparent, accountable, and culturally appropriate, while actively embracing equity and gender issues". Engaging a broad range of stakeholders can reduce conflicts, increase acceptance of the project, and provide multiple feedback channels that can help with the monitoring and evaluation of the project (Doswald and Osti, 2011; Spalding et al., 2014). Such engagement is critical because it also helps in "avoiding trade-offs among diverse types of coastal land uses and ensuring institutional capacity and effectiveness in climate resilient resource management" (Ahammad et al., 2013, p. 839).

Policies and legislation also play an important role in supporting EbA. Schroth et al. (2009) note that in Mexico, the government has developed a series of supportive mechanisms and legislations, which enable harnessing the economic benefits of ecosystem services, such as related to carbon or watersheds. Mainstreaming and integrating EbA and ecosystem services into policies and adaptation plans can also increase policy coherence (Andrade et al., 2011; Geneletti and Zardo, 2016; Spalding et al., 2014; Wamsler and Pauleit, 2016).

The Durban experience also notes legal compliance and the concept of Green Economy as adding to the importance of EbA and finding support for the concept among other policy issues. Adding to this, Roberts et al. (2012, p. 191) observe that there are several critical pre-conditions that need to be met in order for an EbA approach to be sustainable:

> "the development of structured and resourced programmes that have direct and immediate development co-benefits for local communities and that ensure integration across institutional and political boundaries".

Implementing EbA at local scale is crucial as that scale can better capture such issues as equity (Andrade et al., 2011), and allows "a direct link to local contexts and place-specific challenges" (Bourne et al., 2016, p. 2). Local approaches are also deemed to be more culturally attuned and have a greater chance to represent local interests (Girot et al., 2012).

Table 3. Governance related enablers.

Specific Enabler	Explanation	Examples of Sources
Governance systems and institutional hierarchy		
Community engagement and participation/participatory processes, including indigenous groups	Community empowerment and participation are key factors in enabling effective EbA	Chong, 2014; Doswald and Osti, 2011; Reid, 2015; Roberts et al., 2012; Travers et al., 2012
Multi-sectoral engagement and multi-stakeholder participation	Engaging with key staff members across sectors is vital for EbA measures, and ensuring all actors are included in EbA planning and assessments	Ahammad et al., 2013; Doswald and Osti, 2011; Spalding et al., 2014; Wongbusarakum et al., 2015

Policies and Legislation	Putting in place policies and legislation that support EbA approaches and increase for equal land access	Djoudi et al., 2013; Doswald et al., 2014; Lukasiewicz et al., 2016; Schroth et al., 2009
Integration of traditional governance and formal top-down approaches	Strengthening community-based management to enhance the implementation of EbA, and combining top-down and bottom-up approaches	Girot et al., 2012; Grantham et al., 2011
Clear actions and responsible bodies	EbA plans and policies identify who is responsible to implement particular measures, and what these measures are	Demuzere et al., 2014; Geneletti and Zardo, 2016
Most effective as decentralized management	EbA approaches are best managed at the local scale where they can be tailored to address local issues	Andrade et al., 2011; Bourne et al., 2016; Girot et al., 2012
Gender sensitive	Given differential vulnerabilities among genders, EbA approaches need to deliver benefits to both genders	Andrade et al., 2011; Girot et al., 2012; Oloukoi et al., 2014
Institutional stability and flexible funding arrangements	Better cooperation can be achieved with long-standing institutional collaboration and flexibility in how particular funds can be used	Lukasiewicz et al., 2016; Roberts et al., 2012
Mainstreaming ecosystem services and EbA to all policies to ensure policy coherence	Ecosystem services need to be mainstreamed across sectors and to all planning processes and policies	Andrade et al., 2011; Geneletti and Zardo, 2016; Spalding et al., 2014; Wamsler and Pauleit, 2016
Tangible socio-economic co-benefits	Providing direct incentives and benefits to communities will enable EbA to be maintained at long-term	Lukasiewicz et al., 2016; Reid, 2015
Access to land and land ownership	Secure tenure and land ownership can enable EbA to remain viable in the long-term	Ahammad et al., 20143; Djoudi et al., 2013; Roberts et al., 2012

In terms of knowledge enablers (Table 4), McKinnon and Hole (2015, p. 56) argue that “robust understanding of the local biophysical conditions and socioecological context” is critical if EbA interventions are going to be effective. An effective EbA approach has to consider “all relevant drivers and responses to change, including, climate-driven change, disaster risk response, climate variability, and broader long-term socio-economic change” (Travers et al., 2012, p. 10). Such factors as future demographic change, and changes arising from economic trends (e.g. increase in tourism), should be included in vulnerability assessments for EbA (Spalding et al., 2014).

Table 4. Knowledge related enablers.

Specific Enabler	Explanation	Examples of Sources
Knowledge related		
Understanding the context	Understanding the background and context where EbA intervention is to be implemented, including power structures	Andrade et al., 2011; McKinnon and Hole, 2015; Reid, 2015
Access to relevant sources of knowledge	Combined and accessible information on Ecosystem services, loss costs and social vulnerability	Pasquilini and Cowling, 2015; Spalding et al., 2014
Integrating different kinds of knowledges into adaptation planning	Need to consider and integrate scientific knowledge with traditional and local knowledges	Andrade et al., 2011; Grantham et al., 2011; Mercer et al., 2014; Pramova et al., 2012a; Wongbusarakum et al., 2015
Consider all drivers of and responses to change	Include a wide variety of factors in analysis of vulnerability and underlying context, including future climatic variables, socio-ecological vulnerability, and future demographic changes	Bourne et al., 2016; Travers et al., 2012; Spalding et al., 2014
Focus on current and future benefits	EbA has to aim to reduce current threats and future threats to ecosystems and their services	Pramova et al., 2012a
Mapping causal pathways toward adaptation goals	Increasing understanding of what factors lead to which goals within the context of adaptive management	McKinnon and Hole, 2015
Translate the science into understandable formats	Translating science into locally relevant formats, and consider using visualisation tools to make future risks more 'real'	Bourne et al., 2016; Spalding et al., 2014
More field tests on EbA	More field tests are needed to test the effectiveness of EbA interventions	Spalding et al., 2014
Vulnerability assessments as key for EbA	Vulnerability assessments are crucial for any EbA design or intervention although these are often complex	Djoudi et al., 2013; Ojea, 2014
Monitoring and Adaptive Management	Critical factors in enabling EbA to be successfully implemented and managed through learning processes	Andrade et al., 2011; Doswald and Osti, 2011; McKinnon and Hole, 2015; Pramova et al., 2012b; Roberts et al., 2012; Sierra-Correa and Cantera Kintz, 2015; Travers et al., 2012
Learn lessons from older disciplines	Given that EbA is a relatively new approach/discipline, it needs to tap into the	Reid, 2015

already learned lessons from natural resource management

One should consider all stakeholders and all livelihoods practiced in an area where EbA project is planned to take place. This also means that EbA approaches need to be “knowledge inclusive” and not represent only one form of knowledge. This means in particular the recognition and inclusion of traditional and indigenous knowledge, and the integration and sharing of knowledge in an integrated and ethical manner (Andrade et al., 2011) (Figure 7). Traditional knowledge plays a particularly important part in understanding current and past practices, and how these can be utilised for climate change adaptation together with science. In the Pacific, many communities have diverse strategies to cope with food security, which can be harnessed and used to support EbA as well (Grantham et al., 2011).

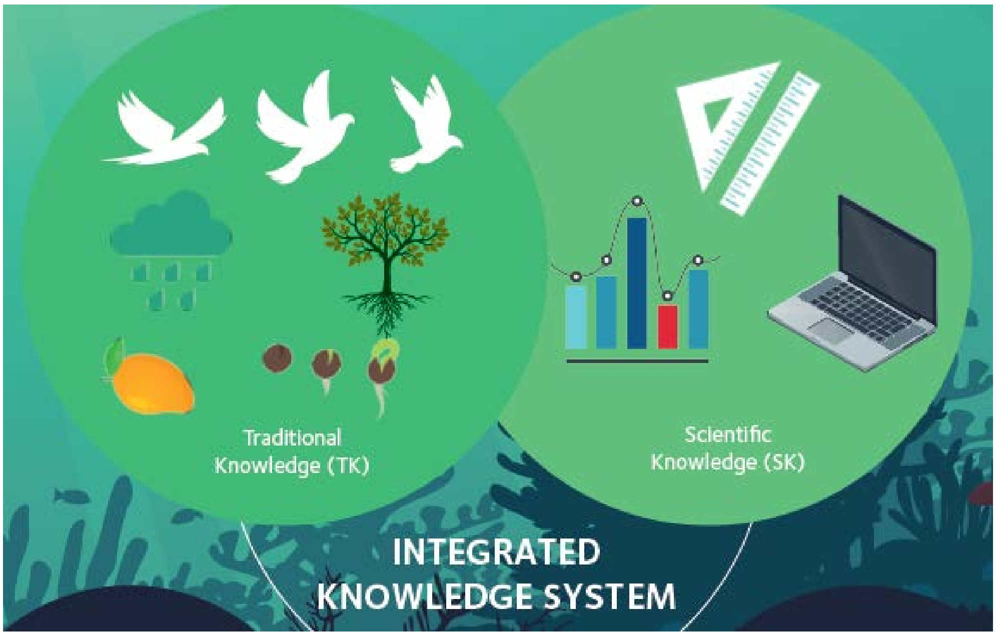

Figure 7. Integrated knowledge systems that bring together traditional and scientific knowledge.

Monitoring and Adaptive Management are seen as critical enabling conditions for successful EbA. Monitoring should include socio-economic components, changes in ecosystem service flows, and the extent co-benefits have been created (Roberts et al., 2012).

While providing comprehensive assessments as the basis for EbA is important, this information needs to be also put in a visual form for stakeholders in order to enable a better understanding of what kind of future scenarios and risks might emerge (Spalding et al., 2014). For example, adaptation pathways should be mapped so that stakeholders can articulate and comprehend their goals and causal factors, and how these can be managed through adaptive management approaches (McKinnon and Hole, 2015).

There is also a need to learn from the on-going EbA projects as to what is working and what is not working in order to better understand those factors bringing out ‘effective’ EbA (Spalding et al., 2014). In addition, given that EbA is considered as a relatively new field of research and practice, it needs to utilise the lessons learned from such fields as community-based natural resource management that has been in operation for the past 40 years (Reid, 2015).

3. Concluding Discussion

This report reviewed the concept of EbA, and its many benefits, trade-offs, constraints and enablers for its use as a tool for climate change adaptation.

While much of the EbA discourse is highly positive and promotes EbA as an adaptation vehicle with significant co-benefits, such as poverty reduction, increased food security, and increased resilience of ecological systems, the examples of trade-offs remind us that rarely are there pure 'win-win' or 'no-regret' adaptation options. The implementation of each option will necessitate a choice between particular land uses and values.

This makes adaptation planning and decision-making highly value-based processes where people weigh up values and goals, and where one person's adaptation can easily become another's maladaptation (Adger et al., 2005; Klein et al., 2014). Understanding this dynamic is crucial in particular as ecosystem-based adaptation is directly tied to changes in land uses, which in turn might lock in particular adaptation pathways. Trade-offs are essentially tied to issues of equity between individuals, groups and governance scales. At the moment there is, however, a lack of research focused on the normative and ethical aspects of EbA (Brink et al., 2016).

Yet, although lack of locally tailored information can significantly reduce the uptake of different adaptation options, better information alone will not necessarily fix the problem. Nalau et al. (2017) found in their study of tourism operators in Fiji that the most significant factors impacting the uptake and use of information related to the person's professional status, experience with climate and weather, and level of information seeking skills. Most operators who are mainly dependent on ecosystems for their operations, such as coral reefs, are currently focused on short-term issues and ignoring longer-term risks that for example climate change potentially poses to their businesses.

The enablers mainly to issues to do with governance and its processes and management practices, and those relating to different dimensions of knowledge production. Participatory processes were deemed important in enabling broader participation of multiple stakeholder groups, including indigenous people, and engaging across sectors to reduce institutional fragmentation. It is therefore not surprising that concepts such as integration and mainstreaming were also prominent as enablers as these would strengthen policy coherence and result in more streamlined approaches to EbA.

The knowledge related enablers also stressed the importance of considering different kinds of knowledges in order to build upon a more holistic and system-wide knowledge base. This also includes the emerging emphasis that is increasingly given to indigenous and local knowledges (Nalau et al., 2017; Parsons et al., 2016, 2017). While producing robust knowledge is considered important, that knowledge needs to be presented in a user-friendly manner (Bourne et al., 2016). This might involve tailored communication with stakeholders and the use of visualisation tools (Spalding et al., 2014).

The review has demonstrated the variety of concepts and assumptions in use regarding EbA. There is ample future work both in EbA research, policy and project design in investigating which currently implemented EbA interventions work and are delivering the desired outcomes. Within the tourism industry, such approaches like EbA could provide multiple benefits especially to those destinations that are highly dependent on natural ecosystems for their activities and destination branding.

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