Entrepreneurship in Ecosystem-based Adaptation to Climate Change

Debora de Block

Propositions

1. Entrepreneurs' above-average risk taking propensity is an indispensable actor characteristic for climate change adaptation when adaptation benefits are uncertain
   (this thesis)

2. Delays in multi-actor adaptation projects are not caused by the working pace of either public or private entrepreneurs, but by the differences in working pace between the two groups
   (this thesis)

3. Climate change adaptation scholars should consider more often including methods from the social sciences when assessing adaptation success

4. Scientists from different disciplinary backgrounds connect when using the same research methods

5. Sharing the high points in the life of fellow PhD students creates opportunities to overcome the barriers encountered during one's own PhD trajectory

6. Willingness to take risks and ability to adapt are necessary conditions for successful personal intercultural relationships

Propositions belonging to the thesis, entitled
"Entrepreneurship in Ecosystem-based Adaptation to Climate Change".

Debora de Block
Wageningen, 7 May 2018

Entrepreneurship in Ecosystem-based Adaptation to Climate Change

Debora de Block

Thesis committee

Promotor
Prof. Dr P.H. Feindt
Professor of Strategic Communication
Wageningen University & Research
Professor for Agriculture and Food Policy
Humboldt University, Berlin

Co-promotor
Dr E.J.J. van Slobbe
Lecturer, Water Systems and Global Change Group
Wageningen University & Research

Other members
Prof. Dr H.A.C. Runhaar, Wageningen University & Research
Dr A.R.P.J. Dewulf, Wageningen University & Research
Prof. Dr D. Huitema, VU University and Open University, Amsterdam
Prof. Dr C. Pahl-Wostl, University of Osnabrück, Germany

This research was conducted under the auspices of the Graduate School for Socio-Economic and Natural Sciences of the Environment (SENSE)

Entrepreneurship in Ecosystem-based Adaptation to Climate Change

Debora de Block

Thesis

submitted in fulfilment of the requirements for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus
Prof. Dr A.P.J. Mol,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Monday 7 May 2018
at 4 p.m. in the Aula.

Debora de Block
Entrepreneurship in Ecosystem-based Adaptation to Climate Change,
210 pages

PhD thesis, Wageningen University, Wageningen, the Netherlands (2018)
With references, with summary in English

ISBN 978-94-6343-756-1
DOI https://doi.org/10.18174/442949

Table of Contents

CHAPTER 1

General introduction

1.1 Background and problem statement

Climate change and biodiversity loss are among the main global challenges of our time Both processes imply the potential degradation of ecosystems and the loss of ecosystem functions and services (Steffen et al., 2015). The responses to reduce the dangers from climate change are typically classified into mitigation and adaptation measures (IPCC, 2007). While climate change mitigation comprises interventions to reduce the sources or to enhance the sinks of greenhouse gases (Victor et al., 2014), climate change adaptation is generally defined as 'adjustments in natural or human systems in response to actual or expected climate stimuli or their effects, which moderate harm or exploit opportunities' (IPCC, 2007: p. 869). Adaptation to climate change incorporates a range of potential measures. They can be broadly categorized into 'soft' and 'hard' approaches. 'Soft' approaches generally focus on information, policy, capacity building and institutional functions, whereas 'hard' approaches centre on physical and engineering solutions (Jones et al., 2012). Within the broader field of climate change adaptation practices, ecosystem-based approaches to climate change adaptation are measures which use ecosystem services to attain or support adaptation to climate change. There is growing interest in the potential of ecosystem-based measures, either combined with or substituting other engineered and technological solutions, to ensure the safety of populations and the security of assets, including ecosystems and their services (Noble et al., 2014).

This thesis focuses on ecosystem-based approaches to climate change adaptation (EbA) because of their relative novelty. As an emerging field of practice, EbA is more likely to be shaped by actors who aim to promote innovations, i.e., by entrepreneurs. EbA have been defined in several ways (Milman and Jagannathan, 2017). The most commonly used definition is: 'the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change' (CBD, 2009: p. 41). It 'includes the sustainable management, conservation and restoration of ecosystems as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities' (CBD, 2011: p. 3). Examples of EbA are flood regulation through sustainable water management (Postel and Thompson, 2005) or securing food provision through the conservation of diverse agricultural landscapes (Vignola et al., 2015). Initially promoted by international conservation organizations, i.e., the International Union for Conservation of Nature (IUCN), The Nature Conservancy (TNC) and the World Wide Fund for Nature (WWF)

(Ash and Price, 2008; Ikkala and Martinez, 2008; TNC, 2008), the concept has found its way into the international climate change arena (SBSTA, 2011; SBSTA, 2013), and is increasingly considered and implemented alongside other adaptation options that are more based on traditional engineering measures or social change (Noble et al., 2014).

Conceptually, EbA is rooted in the ecosystem services concept. Ecosystems are understood as a dynamic complex of plant, animal and micro-organism communities and their non-living environment, which interact as a functional unit (CBD, 1992). Ecosystem services are the ecological characteristics, functions or processes that directly or indirectly contribute to human wellbeing, i.e. to the benefits that people derive from functioning ecosystems (Costanza et al., 1997; MA, 2005). Within this broader context, EbA also builds on concepts such as disaster risk reduction where ecosystems are deployed in risk reducing measures (UNISDR, 2007), and resilience, which emphasises that the services of well-functioning ecosystems strengthen the capacity of social-ecological systems to remain within a stability domain, continually changing and adapting yet remaining within critical thresholds (Folke et al., 2010).

Since the 2010s, several policy initiatives were taken in Europe to stimulate implementation of EbA, for example, through the EU strategy on adaptation to climate change which has given specific attention to the inclusion of civil society, private businesses and conservation practitioners (EC, 2013). Furthermore, the EU formulated a research and innovation policy agenda for the more recent concept of 'nature-based solutions' (NBS) involving societal, policy and business stakeholders. The NBS approach builds on the concepts of ecosystem services and EbA. NBS refers to actions which are inspired by, supported by or copied from nature, i.e., derived from the observation of natural materials or processes. Since NBS proponents had declared climate change adaptation one of the principal areas of application, implementation of NBS both at the policy and project level is also relevant for the uptake of EbA in policy and practice (EC, 2015).

The emphasis on the inclusion of state, market and societal actors reflects the multi-actor challenge in the governance of climate adaptation. Adaptation governance involves collective efforts by multiple societal actors to address the problems and to reap the benefits associated with climate change (Huitema et al., 2016). The multi-actor challenge refers in this context to the mode of governance linked to adaptation efforts. Generally, various modes of governance have been distinguished according to the degree of centralisation of decision making, ranging

from hierarchical coordination by state actors to spontaneous coordination through market mechanisms. In climate adaptation policy, the spectrum of modes of governance stretches from the hierarchical imposition of adaptation policies to the use of market mechanisms and the encouragement of self-organizing civil society networks, or any combination thereof (Dewulf et al., 2015; Thompson, 1991). An important question is how the necessary innovations to meet the novel challenges of climate change adaptation are created and implemented. Responding to this challenge, a specific group of actors has been increasingly considered in discussions on climate change and environmental challenges since the early 2000s: entrepreneurs (e.g.Cohen and Winn, 2007; Dean and McMullen, 2007; Mees et al., 2012; Swart et al., 2014b).

In this thesis, entrepreneurs in EbA are understood as actors that innovate and take risks to develop opportunities, thereby enabling the creation of new ecosystem services, markets for these services and actor constellations that maintain these services. Four arguments suggesting entrepreneurs could play a role in EbA have been developed in the literature. First, through creation of technologies and innovative business models, entrepreneurs can contribute to preservation of ecosystems, biodiversity conservation and climate change adaptation as Cohen and Winn (2007) and Dean and McMullen (2007) hypothesize. Second, entrepreneurs are expected to address the need for new business and cooperation models that enable long-term financing of EbA, including public-private partnerships (EC, 2015). Third, the involvement of entrepreneurs can give a powerful impetus to adaptation projects and ensure a better embedding of nature, recreation, agriculture and other interests in projects, leading to innovative solutions, as an assessment of 100 spatial planning and water management projects in the Netherlands related to climate adaptation showed (Swart et al., 2014b). Finally, the willingness of entrepreneurs to invest in activities with an uncertain outcome may stimulate implementation of EbA, where there is still considerable uncertainty over both the adverse and the beneficial effects of the approach on adaptation as well as over the effects of climate change on ecosystems' ability to continue to provide their adaptation services into the future (Adger et al., 2005; Jones et al., 2012). Mees et al. (2012), for example, hypothesize that higher levels of uncertainty increase the need for innovative entrepreneurs who are willing to risk their time and money to generate flexible adaptation strategies. Involvement of entrepreneurs and the private sector more broadly in issues such as biodiversity conservation and climate change adaptation is frequently criticized as an expression of neoliberal thinking, emphasizing private initiative

and monetary valuation and commodification of ecosystem services (McAfee, 2012; McCauley, 2006). In section 6.3.3, I take up this critique in the context of this thesis and look at the motives of entrepreneurs that have become involved in EbA. Empirically, I found a more complex mixture of egoistic profit and other motives.

To date, the majority of scholarly work on EbA has focused on elucidating the potential benefits of ecosystems for adaptation to climate change (Jones et al., 2012; Munang et al., 2013b) or examining the knowledge base for the use of ecosystems for adaptation (Brink et al., 2016; Doswald et al., 2014). Empirical studies were conducted on EbA at the local level in the context of both developing (Bourne et al., 2016; Mercer et al., 2012; Roberts et al., 2012; Uy et al., 2012) and developed countries (Geneletti and Zardo, 2016; Wamsler, 2015; Wamsler et al., 2014). Other studies have addressed the emergence of EbA in international legal frameworks on climate change and biodiversity (Chong, 2014) and in international climate policy (Ojea, 2015).

The study of entrepreneurs in EbA can draw on discussions in the literature on climate change adaptation about the responsibilities of private (and public) actors for adaptation (Klein et al., 2017; Mees et al., 2012; Runhaar et al., 2016) and the provision of adaptation goods by private actors (Tompkins and Eakin, 2012). Further, the literature on social-ecological systems and resilience provides insights in the variegated strategies of entrepreneurs, including trust building, the mobilisation of social networks, knowledge generation and the creation of public awareness for environmental problems (Evans et al., 2015; Olsson et al., 2004; Olsson et al., 2006). This thesis builds upon these insights when analysing the roles and strategies of entrepreneurs in various EbA projects in the UK and the Netherlands. The analysis, however, is not limited to private business entrepreneurs. Rather, the – sometimes shifting – roles of public and private actors in several EbA projects are analysed. The focus is on the creation of opportunities in EbA which enable entrepreneurial success through innovation, and on the entrepreneurial strategies to create opportunities.

Thereby the thesis aspires to address a knowledge gap with regard to entrepreneurship in EbA. It aims to further elaborate the conceptual understanding of the role of entrepreneurs in EbA, the entrepreneurial opportunities that are developed in EbA and the interlinkages between entrepreneurs and opportunities The thesis pursues this with a strong empirical focus, conducting within-case and cross-case analyses, and engages in methodological discussions

that support the qualitative comparative research required to move from isolated case studies to systematic analysis of causal factors.

1.2 Key concepts

This section provides a general overview of the key concepts of entrepreneurs, ecosystem services, entrepreneurial opportunities, opportunity creation and opportunity exploitation. These concepts will be further elaborated and discussed in the relevant chapters.

1.2.1 Entrepreneurs

Economists have discussed entrepreneurship since at least the 18th century. Richard Cantillon is widely credited for introducing the term 'entrepreneur' into the economic discourse in 1755 when he described the activities of merchants (Mintrom, 2000). Around 1800, the French economist Jean-Baptise Say defined an entrepreneur through its allocative function, i.e. as someone who 'shifts economic resources out of an area of lower and into an area of higher productivity and greater yield' (Drucker, 1985: p. 19). The most influential modern contributors to the economic theory of entrepreneurs are Knight (1921), Schumpeter (1934) and Kirzner (1973). Knight described the entrepreneurial activity as decision making in the face of *uncertainty*. In his view, profit represented the reward for risk taking (Bhidé, 2000). Schumpeter (1934) opposed this view by arguing that risk bearing is performed by any number of people in and around a business, e.g. the owner of the means of production, and was therefore not an identifying characteristic of entrepreneurs (Bhidé, 2000; Mintrom, 2000). Instead, Schumpeter referred to the entrepreneur as an *innovator* who could develop and market new products, improve the quality of an existing good, open up a new market (either on the supply or the demand side) or create a new type of organization to increase profit (Mintrom, 2000). These new combinations, if successful, lead to the 'creative destruction' of incumbent businesses who lose competitiveness, and are therefore the main driver of economic change and growth (Schumpeter, 1934). Kirzner (1973), a leading proponent of the Austrian school of economics, argued that the defining characteristic of the entrepreneur was neither risk taking nor innovation, but *alertness* to profit opportunities. In discovering and exploiting such opportunities, entrepreneurs are competing with other entrepreneurs (Kirzner, 1997).

Combined with the concept of EbA, these perspectives result in the following definition of entrepreneurs in EbA used in this thesis:

Entrepreneurs in EbA are innovating and risk-bearing individuals who develop opportunities, thereby enabling the creation of new ecosystem services, markets for these services and actor constellations that maintain these services.

Economic theory suggests that entrepreneurs only function in the economy if the environment is uncertain and thus, is accompanied with risks. The argument here is that if all individuals had perfect information, then all opportunities would be exploited instantaneously and there would be no further entrepreneurial role (Gifford, 2005). This characteristic of entrepreneurs is very applicable in a climate change context, where there is considerable uncertainty over the impact of adaptation. Moreover, whereas the risk reducing features of hard infrastructural approaches can often be based on past experience, the adverse and beneficial effects of soft engineering approaches are very uncertain (Adger et al., 2005). Therefore the Knightian focus on risk bearing has been included in the definition of entrepreneurs used in this thesis.

Increased awareness of environmental and social problems has stimulated a critique of the more classical notions of 'economic entrepreneurship' which emphasise the motive to maximize monetary reward in the shortest possible time(Parrish, 2010; Tilley and Young, 2009). However, the entrepreneurial activities included in the definition above – risk bearing, innovating and developing opportunities – are not necessarily linked to profit motivations. Consequently, the concept of entrepreneurship has been introduced to other areas. These include social entrepreneurship, which aims at improving socio-economic conditions of the wider society (Zahra et al., 2009), and eco-entrepreneurship or environmental entrepreneurship, which seeks to change market structures and to reduce environmental impacts (Schaltegger and Wagner, 2011). Sustainable entrepreneurship aims to simultaneously enhance social, economic and environmental values. Here, human and natural resources are not only a means to generate wealth, but an end in their own right (Hall et al., 2010; Parrish, 2010; Schaltegger et al., 2016; Tilley and Young, 2009). Various business and management scholars have described the differences between these forms of entrepreneurship, which are presented as a typology in Table 1.1.

Table 1.1. Typology of entrepreneurial goals and motivations (based on Schaltegger and Wagner (2011), Parrish (2010) and Tilley and Young (2009))

	Economic entrepreneurship	Social entrepreneurship	Environmental entrepreneurship	Sustainable entrepreneurship
Core motivation	Personal economic gain/ monetary profit	Contribute to solving societal problems and create value for society	Contribute to solving environmental problems and create economic value	Contribute to solving societal and environmental problems through the realization of a successful business
Main goal	Generate maximum monetary returns quickly	Achieve social goals	Gaining monetary rewards by solving environmental problems	Simultaneous creation of social, economic and environmental values

The typology shows that the motivations and goals of actors that can be considered as entrepreneurs may vary widely. Importantly, according to the above typology, entrepreneurs can be private sector, public sector or civil society actors. This broad understanding of entrepreneurship will also shape the analysis of the case studies in this thesis. A categorization of actors according to the definition above found that the majority of the entrepreneurs in the case studies belonged to the private sector, while I also found entrepreneurs from civil society and the public sector (see Table 1.2). However, we would expect that by definition civil society and public sector entrepreneurs are more driven by social and environmental motives and less by profit motivations – for public sector entrepreneurs this would even conflict with their roles and responsibilities. Civil society entrepreneurs in the case studies in this thesis are mainly nature conservation NGO's, although educational institutes as well as individual citizens were also involved. It has been observed that NGO's are generally challenged to identify new opportunities for self-financing and to develop innovative business models (Zahra et al., 2009). This broader trend is also reflected in the cases analysed in this thesis, which is the main reason

[1] The formulation leans on Brouwer's (2011) definition of policy entrepreneurs as 'risk-taking bureaucrats that seek to change policy and are involved throughout the policy change process' (p. 4). However, this thesis does not analyse policy change but the enabling and implementation of EbA projects, and the concept of an entrepreneur has been adapted accordingly.

why some civil society actors behave as entrepreneurs. Finally, state or governmental actors at any administrative level can sometimes be considered as entrepreneurs. In this thesis, I refer to public entrepreneurs as risk-taking politicians and civil servants from any governmental level who are willing and able to invest their resources (time, reputation and/or knowledge) to enable planning and implementation of economically, socially or environmentally desirable projects, here EbA projects.[1]

Table 1.2. Categorization of entrepreneurs in the EbA cases analysed in this thesis

Cases	Public entrepreneurs	Business entrepreneurs	Civil society entrepreneurs
Abbotts Hall			X
Blue Green Dream		X	X
Blue Green Global		X	
Building with Nature		X	
Bureau Stroming		X	
Butterfly Beef		X	X
CAFCA		X	
Climate Resilience ltd.		X	
Green Climate Belt			X
Inlandshore Wieringermeer	X	X	X
Landbouw op Peil	X	X	
Nienhuis Architects		X	
Pastures New	X	X	X
Roof doctors		X	
The Green City		X	X
Trent and Tame Futurescapes		X	X
Wallasea Island	X	X	X
Water holding		X	X
Working with Nature		X	X

1.2.2 Ecosystem services

The above definition of entrepreneurs in EbA implies that their actions (aim to) enable the creation of new ecosystem services, markets for these services and/or actor constellations that maintain or harness these services. Ecosystem services are at the core of the concept of ecosystem-based adaptation. Since the publication of two seminal studies about ecosystem services 20 years ago (i.e., Costanza et al., 1997; Daily, 1997) various classification systems were developed for scientific analysis, economic valuation and policymaking. Four categories

of ecosystem services are now widely distinguished (Costanza et al., 2017): provisioning, regulating, cultural and supporting services. However, harnessing these services often requires combination of ecological processes with built, human and social capital. First, provisioning services, combined with built, human and social capital, produce, for example, food, timber and fibre. Second, regulating services, combined with built, human and social capital, produce flood control, storm protection, water regulation, human disease regulation, water purification, air quality maintenance, pollination, pest control, and climate control. Third, cultural services, combined with built, human and social capital, offer recreation, aesthetic, scientific, cultural identity, sense of place, or other 'cultural' benefits. Finally, supporting services describe the basic ecosystem processes such as soil formation, primary productivity, nutrient cycling and provisioning of habitat. They contribute indirectly to human wellbeing by maintaining the processes and functions necessary for provisioning, regulating, and cultural services (Costanza et al., 2017).

Ecosystem services differ with regard to their public or private good characteristics, i.e. whether their consumption is excludable and rival. Most provisioning services are 'private goods', or can at least be privatised, i.e. individuals or private enterprises control the means of production and supply chains. On the contrary, most regulating services are 'public goods', i.e., goods that are non-excludable and from which multiple users can simultaneously benefit. Most cultural services consist of a mix of private and public goods (Costanza et al., 2017; Paudyal et al., 2016). Some elements of adaptation to climate change are public goods, for example, the conservation of important habitats and common cultural heritage. Other types of adaptation involve private goods, for example an investment in flood protection that benefits only a small number of specific households, or if a private water supply company invests to adapt to changing patterns of precipitation as the result of climate change, the costs and benefits of this response are largely private (Adger et al., 2005). Table 1.3 provides an overview of the ecosystem services addressed in the case studies in this thesis.

Table 1.3. Ecosystem services in each EbA case analysed in this thesis. One typical EbA case is selected for each consultancy (in italic). Note that Climate Resilience ltd. is not included in the table since it is not involved in physical EbA projects but rather in desk studies. Definitions of the ecosystem services are based on table 2 in Costanza et al. (2017).

Cases	Provisioning services	Regulating services	Supporting services	Cultural services
Abbotts Hall	Food production	Disturbance regulation (storm protection and flood control)	Biodiversity	Recreation
Blue Green Dream		Water regulation (drought prevention) Disturbance regulation (flood control) Air quality regulation Climate regulation	Biodiversity	
Building with Nature		Disturbance regulation (storm protection and flood control)		Recreation
Butterfly Beef	Food production		Refugia (wildlife habitat)	
Green Climate Belt	Raw materials (biomass)	Air quality regulation	Biodiversity	Recreation Cultural (educational values)
Inlandshore Wieringermeer	Food production Water supply	Water regulation		
Landbouw op Peil	Food production Water supply	Water regulation Soil formation		
Pastures New			Refugia (migration habitat)	Recreation
Roof doctors	Food production Water supply	Air quality regulation Climate regulation	Biodiversity	Recreation Cultural (aesthetic values)
The Green City		Air quality regulation Climate regulation	Biodiversity	Cultural (aesthetic values)
Trent and Tame Futurescapes		Disturbance regulation (flood control)	Refugia (migration habitat)	Recreation Cultural (educational values)

Table 1.3. continued

Wallasea		Disturbance regulation (storm protection and flood control)	Biodiversity	Recreation
Water holding	Food production Water supply	Water regulation (drought prevention)		
Blue Green Global *City of London*		Water regulation (drought prevention) Disturbance regulation (flood control) Air quality regulation Climate regulation	Biodiversity	
Bureau Stroming *Climate Buffer 'Oude Maasarm'*		Disturbance regulation (flood control) Water regulation (drought prevention)		
CAFCA *Newcastle Science Central*	Water supply	Disturbance regulation (flood control)		
Nienhuis Architects *Room for the River 'Varik-Heesselt'*		Disturbance regulation (flood control)		
Working with Nature *Lymington Harbour Habitat Replenishment*		Disturbance regulation (storm protection and flood control) Erosion control and sediment retention		

1.2.3 Entrepreneurial opportunities

Since the 2000s, the development of opportunities has received increased attention from entrepreneurship, business and management scholars who consider explaining the development of opportunities as a key part of entrepreneurship research (Alvarez and Barney, 2007; Ardichvili et al., 2003; Klein, 2008; McMullen et al., 2007; Sarasvathy et al., 2005; Shane, 2003; Shane and Eckhardt, 2005; Short et al., 2010) (Ardichvili et al., 2003; Short et al., 2010). To obtain an overview of how opportunities are generally understood in adaptation literature, I systematically reviewed 19 peer-reviewed papers and 27 documents from the grey literature on

EbA published between 2009 and 2014. The search terms ‘opportunity’, ‘opportunities’, ‘chance’, ‘drivers’ and ‘stimulus’ were used. The description of EbA-related opportunities in this literature can roughly be grouped along two dimensions: First, the purpose (‘opportunities for what?’), for example disaster risk reduction, health, sustainable development, biodiversity and ecosystem services, climate change problems, indigenous people and local communities, or economic growth; and second, the context (‘opportunities where?’), for example watersheds, forests, agriculture or recreational areas). However, no source in the EbA literature linked opportunities to entrepreneurship. When we now turn to the management and entrepreneurship literature to define entrepreneurial opportunities, we must therefore be aware that this concept differs from the opportunities for climate change adaptation discussed in the EbA literature. It is therefore an open question whether the opportunities that entrepreneurs develop contribute to climate change adaptation in each specific case. In section 6.2.1, the link between successful entrepreneurship and successful adaptation is discussed in more detail.

The conceptualisation of entrepreneurial opportunities is further complicated by the fact that there is not one agreed definition of this term. Short et al. (2010: p. 55), for example, focus on the profit motive when they define an entrepreneurial opportunity as ‘an idea or a dream that is discovered or created by an entrepreneurial entity and that is revealed through analysis over time to be potentially lucrative’. Shane and Venkataraman (2000: p. 220) emphasise the element of innovation in combination with the profit motive when they describe entrepreneurial opportunities as ‘those situations in which new goods, services, raw materials and organizing methods can be introduced and sold at greater than their cost of production’. Sarasvathy et al. (2005: p. 142) stress the innovative element when defining an entrepreneurial opportunity as ‘a set of ideas, beliefs and actions that enable the creation of future goods and services in the absence of current markets for them’. Many papers on entrepreneurial opportunities do not even provide a definition of opportunities and it is left to the reader to infer what scholars may have meant by opportunity (Renko et al., 2012). The understanding of entrepreneurial opportunities in EbA in this thesis builds on the definitions above and is further elaborated in Chapters 2, 3 and 4. An EbA-related entrepreneurial opportunity is defined in this thesis as:

a set of ideas, beliefs and actions that enable the creation of (new) ecosystem services, markets for these services and actor constellations that maintain ecosystem services.

Some entrepreneurship scholars present the development of entrepreneurial opportunities as a process comprised of subsequent phases. Shane and Venkataraman (2000) for example, distinguish a discovery, evaluation and exploitation stage. However, because EbA requires active project development, this thesis embraces a more active concept of entrepreneurial opportunities than implied by the notion of discovery and distinguishes two stages: opportunity creation and opportunity exploitation (see section 1.2.4 and 1.2.5). The opportunity evaluation phase is not included because it is closely related to opportunity discovery. The two phases are treated as a heuristic device to unravel the opportunity development process, assuming that each phase can include different processes and actor constellations (Shane, 2003). In reality, however, opportunity development is a fuzzy process where elements of creation and exploitation iterate and overlap (Dimov, 2007). This is further discussed in section 6.6.

1.2.4 Opportunity creation

There are two different views on the nature of entrepreneurial opportunities in the entrepreneurship literature, understanding opportunities as either discovered or created. The discovery view assumes that either the means or ends are given; the missing factor has to be discovered (if it exists, e.g. if there is a means to a given end, or an end for given means) (Sarasvathy et al., 2005). In the opportunity creation view, supply and demand evolve from a highly dynamic interaction process between entrepreneurs (Sarasvathy et al., 2005), through which opportunities are not discovered, but created (Alvarez and Barney, 2007). Chapter 2, which focuses on the opportunity creation stage, further elaborates how the opportunity creation reflects the dynamic development of opportunities in EbA through the interacting strategies of entrepreneurs.

1.2.5 Opportunity exploitation

Following Schumpeter's (1934) distinction between invention and innovation, invention constitutes the creation of an opportunity and innovation its exploitation. Some scholars have argued that opportunity exploitation begins when the entrepreneur mobilises resources to set up a new business (Alvarez and Busenitz, 2001; Nieto and González-Álvarez, 2014). However, opportunity exploitation can also take place within existing firms or through market mechanisms (Fuentes Fuentes et al., 2010; Shane and Eckhardt, 2005). Opportunity exploitation then comprises any gathering and recombining of resources to pursue an opportunity, as opposed to the more mental activity of opportunity discovery (Shane, 2003). In this thesis, I therefore conceptualize entrepreneurial opportunity exploitation in EbA as:

Gathering and (re)combining resources to create new ecosystem services, markets for these services and actor constellations that maintain ecosystems and their services, either through new or established firms and organizations.

Chapters 3 and 4 address opportunity exploitation. Chapter 3 focuses on characteristics of actors when looking to the motivations of entrepreneurs in EbA, but expands on this view by including contextual conditions for successful entrepreneurial opportunity exploitation, i.e., the moment when ideas and beliefs that entrepreneurs developed previously, materialize and are put into practice (McMullen and Shepherd, 2006). Chapter 4 builds on the insights gained in Chapters 2 and 3 by focussing on a specific strategy deployed (i.e., framing) that is used by public and private entrepreneurs to shape the conditions for successful opportunity exploitation. Chapter 3 aims to measure the conditions for successful opportunity exploitation at one point in time. To enable a more dynamic view, which better fits the dynamic process of opportunity exploitation (Short et al., 2010), Chapter 4 adopts a dynamic perspective on the conditions by conducting an in-depth and longitudinal case study. The focus is thereby on one specific entrepreneurial strategy as identified in Chapter 2, i.e., framing, and a framing approach is used to analyse the ongoing negotiations in an EbA project and how they shape the conditions for entrepreneurial success.

1.3 Research objective and questions

The overall research objective of this thesis is:

To increase the understanding of how entrepreneurs develop opportunities in ecosystem-based adaptation practice

The following corresponding research questions have guided the thesis.

Question 1: *How do public and private entrepreneurs create opportunities in ecosystem-based adaptation?* (Chapter 2)

Various studies on entrepreneurship in the context of social-ecological systems provide a comprehensive overview of the different strategies that entrepreneurs deploy to transform governance systems for ecosystem management or to realize environmental policy change (e.g. Brouwer, 2013; Evans et al., 2015; Meijerink and Huitema, 2010; Olsson et al., 2004; Olsson et al., 2006). Based on an analysis of four EbA projects, the first part of this study builds upon these insights by focusing on the strategies of both public and private entrepreneurs who interactively create opportunities in EbA. This is the first step in elaborating the conceptual model of the opportunity development process in EbA. Furthermore, with this study I have an ambition to contribute to the science *for* adaptation, referring to practice-oriented research in support of adaptation-related decision-making (Swart et al., 2014a). In particular, it seeks to contribute to the multi-actor challenge in the governance of climate change adaptation, allowing a better understanding of the roles of public and private entrepreneurs. Such knowledge might then contribute to EbA-oriented policies.

Question 2: *What are the conditions for successful exploitation of entrepreneurial opportunities in ecosystem-based adaptation?* (Chapter 3)

To date, most adaptation research has examined a small number of in-depth cases to explore the causes of success or failure and to draw lessons for other contexts (Ford et al., 2010; Rudel,

2008). However, there is a need for a more systematic comparison to contribute to the 'science *of* adaptation', i.e., fundamental inquiry and concept development around adaptation (Swart et al., 2014a). My ambition for this study is to identify the conditions for successful entrepreneurial opportunity exploitation by systematically comparing 18 EbA cases using Qualitative Comparative Analysis. This study further elaborates the conceptual model on entrepreneurial opportunities by inductively deriving causal components of the opportunity exploitation phase.

Question 3: *How do public and private actors negotiate the conditions for entrepreneurship during an ecosystem-based adaptation project?* (Chapter 4)

Chapter 3 analyses the conditions necessary for successful opportunity exploitation at one point in time. While this provides insights which conditions are more or less important at a specific moment of the opportunity exploitation process, in reality, conditions change continuously. Therefore, I adopt a longitudinal perspective under the third research question which broadens the conceptual model of opportunity development. The dynamic development of the conditions for successful entrepreneurship is reconstructed by analysing how entrepreneurs involved in an EbA project frame these conditions over a period of two years. Hence, this study provides an in-depth, longitudinal analysis of the frames held by public and private entrepreneurs in an EbA project in the Netherlands. The ambition of this study is to provide lessons for adaptation policy and practice dealing with similar challenges.

The fourth research question addressed in this thesis emerged during the research process and has a methodological character. While conducting the Qualitative Comparative Analysis under research question 2, I found little guidance and empirical material on transformation of qualitative into quantitative data for QCA, which constituted an important part of the analysis. A literature review combined with consultation of various QCA-experts confirmed that to date, this has indeed received little attention in methodological discussions about QCA (for more information about the review and expert consultation see Appendix G). Despite some early attempts by scholars to explore QCA in a climate change adaptation context (e.g. Pahl-Wostl and Knieper, 2014), it is also a relatively new method in adaptation science. However, QCA can potentially support adaptation scholars in answering questions such as 'what are the

conditions that are necessary or sufficient in explaining why adaptation is or is not successful' (Swart et al., 2014a: p. 6)? Since qualitative data can help to answer such questions, I decided to dedicate one chapter of this thesis to this issue. The following research question guided this step:

Question 4: *How to transform qualitative into quantitative data for Qualitative Comparative Analysis in specific, and mixed-methods research more generally?* (Chapter 5)
Behind this question are the objectives to explore how researchers currently use qualitative data in QCA in terms of data calibration, presentation and testing the sensitivity of their findings, and to contribute to the standards of good practice in QCA research. These objectives indicate the methodological ambition of this chapter, namely to provide QCA scholars and the wider mixed-methods research community with an overview and directions on how to go about with quantifying qualitative data in QCA. The directions provided potentially increase the transparency of QCA research using qualitative data and hence, replicability of these studies.

1.4 Research approach

While Chapters 2-5 each elaborate on the specific methods used, this section highlights the overall methodological design from three angles: the different types of case study research deployed in this thesis, the case selection procedure and the mixed methods approach.

1.4.1 Case study research

Case studies form the core of this thesis. I understand case studies not as a method in and of itself, but rather as a design frame that can incorporate multiple qualitative and quantitative methods. A case study is an in-depth exploration of the complexity and uniqueness of a particular project, policy, institution, program or system in a real-life context (Simons, 2009). In general, case studies are the preferred research strategy when 'how' or 'why' questions are being posed, the investigator has little control over the events and the focus is on a contemporary phenomenon within a real-life context (Yin, 2003). The 'how' questions asked in Chapters 2 and 4 and the 'why' question in Chapter 3, combined with the strong empirical focus on EbA practices, led to the decision to use case study research as the main research

design frame. This research uses both single case and comparative case methods with respectively within-case and cross-case levels of analysis. Chapters 2 and 3 adopt a comparative case study approach, i.e., 'the non-statistical comparative analysis of a small number of cases' (George and Bennett, 2005: p. 151). Chapter 2 compares two EbA cases in the Netherlands and two in the UK to analyse the opportunity creation process. The two countries have been selected based on their similarities in terms of adaptation features, regulatory environment, entrepreneurship culture and practical reasons (see section 1.4.2 for more details on the similarities and differences between the two countries). The conceptual perspective here is on public and private entrepreneurs. Therefore, the four cases were selected based on the presence of multiple types of entrepreneurs and the possibility to reconstruct the opportunity creation process due to a larger amount of data collected per case compared to the other cases analysed in this thesis. Chapter 3 aims at identifying the conditions for successful exploitation of entrepreneurial opportunities in EbA. Therefore, Qualitative Comparative Analysis (QCA) has been applied. QCA's main assumptions of (1) equifinality, i.e., a scenario in which alternative conditions can produce the same outcome and (2) conjunctural causation, where single conditions do not display an effect on their own, but only together with other conditions (Schneider and Wagemann, 2012), enables the identification of conditions under multiple causality. This approach is well suited for the examination of a moderate number of cases (i.e., a number of cases too few for the application of commonly used multivariate statistical techniques but too many for detailed, case oriented analysis). QCA allows for empirical intimacy with cases while at the same time formulating generalizations (Ragin et al., 2003). The approach requires the inclusion of cases with positive and negative outcomes (Berg-Schlosser and De Meur, 2009). The QCA of 18 EbA cases where entrepreneurial opportunities have been successfully exploited to varying degrees allowed the inclusion of contextual conditions as an addition to the focus on actors in Chapter 2, and to derive more general lessons about enabling factors for entrepreneurship in EbA. Chapter 4 aims at better understanding how the conditions for successful entrepreneurship in EbA are shaped over time through the interactions of public and private entrepreneurs. It is therefore based on a single case study which allowed to engage in the longitudinal examination of the complexities and relationships between multiple variables within the case, thus studying the case at two or more points in time (Yin, 2003). Such a case study requires intimate and often not publicly accessible knowledge.

The Wieringermeer case was selected because of my involvement as a reflexive observer in the project for a period of two years, resulting in a large amount of data collected and thus a thorough understanding of the case. This enabled me to study the dynamic development of conditions for entrepreneurship in an EbA project. Analysing how the actors shaped the conditions led to the addition of a third (namely interactive) conceptual angle to this thesis.

1.4.2 Case selection

Qualitative research uses non-probability samples for selecting the population for study. Units are deliberately selected to reflect particular features of, or groups within, the sampled population. This makes them well suited to small-scale in-depth studies (Ritchie et al., 2003). This is the main reason to deploy a non-probability sampling strategy in this study. Moreover, non-probability sampling is better suited to explore a diversity of cases. In the context of QCA, this allows the examination of commonalities across the same outcome in cases more effectively (Tóth et al., 2017). The specific type of non-probability sampling used in this thesis is purposive sampling. Here, the sample units are chosen because they have particular features in common (e.g. presence of a business model and presence of entrepreneurial opportunities) which enable detailed exploration of the central theme. It also allows for examination of the unique experiences of individuals while guaranteeing coverage of all groups and diversity within the sample of cases (Ritchie et al., 2003). A detailed description of the purposive sampling design and an overview of the selected cases in this thesis can be found in Appendix A.

In this research, cases were selected from the Netherlands and the UK for the following reasons. First, similarities of the countries in terms of adaptation challenges, given their vulnerability to sea level rise, river and coastal flooding and northward movement of species (EEA, 2013); second, both countries' reputation for high levels of adaptive capacity, for being forerunners in adaptation policy and for implementation of adaptation measures (OECD, 2008). Third, as members of the European Union both countries are subject to the same international regulatory environment, including the EU strategy on adaptation to climate change (EC, 2013). Fourth, they share a similar entrepreneurship culture and a political economy that promotes enterprise, providing a setting where companies can grow, not being fettered by state interference and where new small enterprises get support (Dimov, 2007; Kirby, 2003). Finally, because of

practical reasons in terms of data accessibility, the opportunity to visit the EbA projects in person and the absence of language barriers were important practical considerations. Next to these similarities, differences exist between the two countries in how they govern adaptation. For example, while the UK developed new procedural instruments (e.g. policy evaluations) for adaptation to climate change, in the Netherlands adaptation is mostly fitted within existing procedural decision structures (Biesbroek, 2014). Differences exist also more specifically in the way flood risk management is governed. Whereas in the Netherlands the government is fully responsible, in the UK the responsibilities are shared between the state, insurance companies and individuals and communities inhabiting flood plains (Wiering et al., 2015). Section 6.4 reflects upon the implications of these differences on the research findings.

1.4.3 Mixed methods approach

The unique strength of case studies is their ability to deal with a full variety of evidence, e.g. documents, artefacts, interviews and observations (Yin, 2003). Within the case studies, I apply both qualitative and quantitative methods for data collection and analysis, and thus adopt a mixed-methods research approach. Mixed methods research can be defined as 'research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry' (Tashakkori and Creswell, 2017: p. 4). Primarily, in this research, qualitative data is obtained in the form of semi-structured interviews, project documents and observations made during project meetings and field visits. The quantitative approach relies on the calibration process, or quantitization, as part of the QCA, i.e., 'the numerical translation, transformation or conversion of qualitative data' (Sandelowski et al., 2009: p. 208).

1.5 Thesis outline

The main objective and research questions of this thesis are addressed in four scientific chapters. Each chapter addresses a research question. Figure 1.1 gives a schematic overview of the chapters included in this thesis. Following a general introduction in Chapter 1, Chapter 2 elaborates the conceptual model of entrepreneurship in EbA by presenting the sequential and dynamic deployment of strategies by entrepreneurs to create opportunities in EbA. Chapter 3 further develops the conceptual model by exploring the next phase of the opportunity

development process: exploitation. Here, the actor level of analysis from Chapter 2 is complemented with contextual factors. Chapter 3 explores the conditions that are conducive to successful entrepreneurship based on a systematic analysis of 18 EbA cases in the Netherlands and the UK. While enabling policies and availability of funding were expected to be important conditions, the findings show that, surprisingly, altruism was of less importance. Chapter 4 builds on the results from Chapters 2 and 3. The interactional view adopted there shows how entrepreneurs frame the conditions for entrepreneurship throughout time in an EbA case in the Netherlands. The most challenging issue here appears to be the alignment of different spatial and temporal scale frames of public and private entrepreneurs. Based on the experience in Chapter 3 that there is limited information and guidance available for researchers who want to use qualitative data in QCA, Chapter 5 defines good practices related to data calibration, presentation and sensitivity testing which are interesting for scholars involved in mixed-methods research. Finally, Chapter 6 synthesizes the results of all previous chapters, provides additional reflections on the contribution of entrepreneurship to ecosystem-based adaptation, reflects on the study's main concepts and methodology and suggests directions for future research.

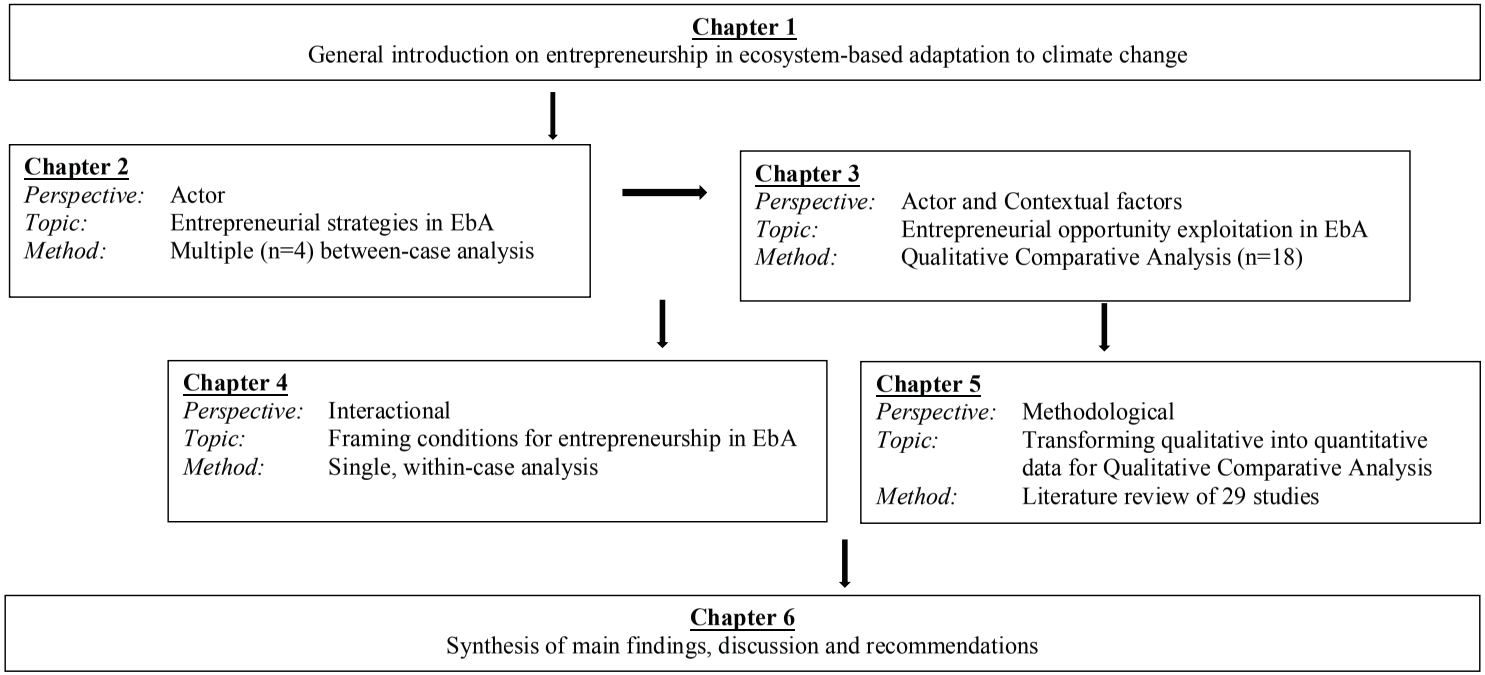

Fig 1.1. Overview of the various chapters, conceptual perspectives taken and methods deployed

CHAPTER 2

Creating entrepreneurial opportunities in climate change adaptation: lessons from four ecosystem-based adaptation projects

Abstract

Determining the roles of public and private actors in the planning and implementation of adaptation practices is one of the challenges in the governance of climate change adaptation. Entrepreneurs, with their ability to create novel solutions and innovative business models, are increasingly considered important to address climate change and biodiversity-related issues. Despite the acknowledgement of the important role for entrepreneurs, there is little knowledge about the ways in which entrepreneurs act in climate change adaptation. This paper analyses the strategies deployed by entrepreneurs from government, business and civil society to collaboratively create opportunities that enable maintaining and creation of ecosystem services for adaptation. Our comparison of four ecosystem-based adaptation projects in the UK and the Netherlands shows that the opportunity creation process is dynamic, with both individual and collective strategies used throughout the planning and implementation process and where strategies are both sequentially and simultaneously deployed. We find that EbA projects involve unusual coalitions of entrepreneurs where the same set of strategies can result in mutual opportunities. Further, our cases illustrate the shifting roles and responsibilities of public and private actors in climate change adaptation practice.

The manuscript corresponding to this chapter will be submitted as:

De Block, D., van Slobbe, E. and Biesbroek, G.R. Creating entrepreneurial opportunities in climate change adaptation: lessons from four ecosystem-based adaptation projects. *Journal of Environmental Policy and Planning.*

2.1 Introduction

The term ecosystem-based adaptation (EbA) is generally used for measures where ecosystem services are used to support efforts to adapt to climate change. An example is redesigning flood plains to provide water storage and flood regulation (CBD, 2009). There is growing body of scientific research on EbA, including its multiple benefits (Munang et al., 2013b), its effectiveness (Doswald et al., 2014), and the differences between the costs and benefits of EbA and of hard-engineering options (Jones et al., 2012). Empirical studies have been conducted on EbA at the local level (e.g., Roberts et al., 2012; Wamsler, 2015) and projects and programmes have been initiated to test some of the EbA principles in practice (e.g., Doswald and Osti, 2011; Naumann et al., 2011).

In recent years, several policy initiatives have been initiated in Europe to stimulate implementation of EbA, for example through the EU strategy on adaptation to climate change where specific attention is given to the inclusion of civil society, private business and conservation practitioners (EC, 2013). Furthermore, the EU formulated a research and innovation policy agenda for nature-based solutions, a concept which is closely related to EbA (EC, 2015). Here too the involvement of society, policy and business is emphasized, reflecting the shift 'from government to governance', the emergence of private steering mechanisms and governance in and by partnerships (Rosenau and Czempiel, 1992).

The emerging climate change scholarship increasingly refers to the importance of entrepreneurs for several reasons. First, there are still many uncertainties about the effects of climate change on ecosystems' ability to continue to provide their services into the future and over the adverse and beneficial effects of EbA itself (Adger et al., 2005; Jones et al., 2012). Risk-taking, innovative entrepreneurs who generate flexible adaptation strategies are therefore needed (Mees et al., 2012). Second, not-for-profit and non-governmental organizations, which are often involved in EbA, are increasingly under pressure to identify new opportunities for self-financing through the development of innovative business models and entrepreneurial strategies (Zahra et al., 2009). Third, entrepreneurs can contribute to preservation of ecosystems, biodiversity conservation and climate change adaptation and mitigation through the creation of technologies and business models (Cohen and Winn, 2007; Dean and McMullen, 2007). Finally, empirical research shows that entrepreneurs give a powerful impetus to adaptation

projects through innovative solutions and generating extra energy and momentum (Mees et al., 2012; Swart et al., 2014b).

The current literature from which lessons can be learned about entrepreneurship in EbA mainly focuses on a specific type of entrepreneurs: policy entrepreneurs, i.e., actors that desire and promote significant policy change (Mintrom and Norman, 2009). Brouwer (2013), for example, looked at the strategies of policy entrepreneurs in water management, while Meijerink and Huitema (2010) analysed the role of policy entrepreneurs in realizing water policy transitions. Relatively little research is conducted to entrepreneurs coming from the business domain. One explanation why these are under-explored, is that EbA mostly involves ecosystem services that can be denoted as public goods, i.e., goods that are non-excludable and multiple users can simultaneously use, for example storm protection, flood regulation and pollination (Costanza et al., 2017). Public goods are supposed to be less interesting for business entrepreneurs to invest in. One of the few studies that address private actor involvement in adaptation is the research by Tompkins and Eakin (2012) who explore the characteristics of 'privately provided adaptation public goods' and argue that this form of adaptation provision is increasingly recognised in climate change adaptation. Also, most studies on entrepreneurship in environmental sciences provide lists of strategies deployed without taking into account their development and interactions through time (e.g. Evans et al., 2015), particularly in the context of climate change adaptation (Swart et al., 2014b).

The question this paper aims to answer is: How do public and private entrepreneurs create opportunities in ecosystem-based adaptation? We operationalize the 'how' by looking at the strategies that entrepreneurs deploy. In doing so, this paper contributes to the governance of adaptation literature by (1) analysing EbA initiatives at the project level as opposed to the policy level; (2) exploring how opportunities for entrepreneurs develop, i.e., are created, through the strategies of entrepreneurs; (3) analysing four EbA projects where entrepreneurs from government, business and civil society are involved and (4) identifying patterns in terms of sequence and combinations of strategies deployed across the four projects.

This paper is structured as follows. First, we present our conceptual framework where we introduce our understanding of public and private entrepreneurs and creation of opportunities through entrepreneurial strategies. Then we present the methods. The results section presents our comparison of four ecosystem-based adaptation projects in the Netherlands and the UK,

consisting of a case description and identification of the strategies deployed in each case by the various entrepreneurs. The discussion section derives more general lessons based on the comparative analysis.

2.2 Strategies to create entrepreneurial opportunities in ecosystem-based adaptation

2.2.1 Entrepreneurship

Shane and Venkataraman (2000) argue that the concept of entrepreneurship connects the presence of lucrative opportunities to the presence of enterprising individuals. In this research we distinguish between private and public entrepreneurs to denote the actors present in the selected EbA projects. We build upon a perspective in the governance of adaptation literature that focuses on the multi-actor challenge of adaptation, meaning the conjoint roles and responsibilities of public and private parties in the development and implementation of adaptation (Dewulf et al., 2015). Here, public actors are governmental actors on any administrative level. Private or non-state actors can be grouped into two categories: market parties, who are looking for possibilities to make profit, and the parties that belong to civil society, such as NGO's and citizens (Meijerink and Dicke, 2008). Throughout this paper we refer to public entrepreneurs, business entrepreneurs and civil society entrepreneurs, respectively.

To conceptualize business entrepreneurs, we follow Schumpeter's (1934) defining characteristic of entrepreneurs, which is their penchant for innovation. Entrepreneurs develop and market new products, improve the quality of an existing good, open up a new market (either on the supply or the demand side) or create a new type of organization to increase profit. Through these actions the entrepreneur engages in 'creative destruction': in creating opportunities entrepreneurs destroy older ways of doing things (Mintrom, 2000). Kingdon (1984) was one of the first scholars who applied the term entrepreneurs to the public sector, defining policy entrepreneurs as 'advocates for proposals or for the prominence of ideas' (p. 129). Brouwer (2011) defines them as 'risk-taking bureaucrats that seek to change policy and are involved throughout the policy change process' (p. 4). Our understanding of public entrepreneurs is that they are risk-taking people from different governmental levels who are

willing to invest their resources (time, reputation and/ or knowledge) throughout the whole EbA project time. Although civil society entrepreneurs (e.g., NGO representatives, lobbyists and academics) are understood as private entrepreneurs in this paper, they can also take the role of policy entrepreneurs when involved in the policy process (Huitema and Meijerink, 2010).

2.2.2 Conceptualizing opportunities for public and private entrepreneurs

Entrepreneurship scholars do not have a common definition of entrepreneurial opportunities. Often it is left to the reader to infer what scholars may have meant by 'opportunity' (Renko et al., 2012). Short et al. (2010: p. 55) define an entrepreneurial opportunity as 'an idea or dream that is discovered or created by an entrepreneurial entity and that is revealed through analysis over time to be potentially lucrative'. Shane and Venkataraman (2000: p. 220) describe entrepreneurial opportunities as 'those situations in which new goods, services, raw materials and organizing methods can be introduced and sold at greater than their cost of production'. According to Sarasvathy et al. (2005: p. 142), an entrepreneurial opportunity consist of 'a set of ideas, beliefs and actions that enable the creation of future goods and services in the absence of current markets for them'. In this paper, we define entrepreneurial opportunities as ideas, dreams, beliefs and actions that are discovered or created by entrepreneurial entities and that enable the creation of (new) ecosystem services, markets for these services and actor constellations that maintain ecosystem services.

In the entrepreneurship literature there are two views on the development of opportunities: discovery and creation. Whereas opportunity discovery assumes that either the supply or demand exists and the non-existent factor still has to be found, in the opportunity creation view both supply and demand evolve from a highly dynamic interaction process between entrepreneurs (Sarasvathy et al., 2005). Rather than searching for supply or demand as in discovery, opportunity creation necessitates entrepreneurs to create supply and demand through interaction (Alvarez and Barney, 2007). Whereas several entrepreneurship scholars adhere to either the discovery or creation view as different world views, others reconcile both perspectives by arguing that, depending on the context, an opportunity can both be discovered or created (Alvarez and Barney, 2007; Miller, 2007). In this paper, we follow the creation view as we assume that this better reflects how opportunities in EbA are dynamically developed through interacting strategies of entrepreneurs.

2.2.3 Strategies for opportunity creation in EbA

Although the opportunity creation view originated more recently in entrepreneurship literature and therefore is conceptually less developed as the discovery view, the existing literature provides some insights in the strategies deployed by entrepreneurs in opportunity creation. We use these insights as sensitizing concepts which, instead of providing prescriptions of what to see, merely suggest directions where to look (Blumer, 1954). We thus adopt an exploratory and inductive approach by deriving the strategies from our empirical cases. In opportunity creation, the supply and demand, or the solution and the problem, are both unknown and have to be developed. Ardichvilli et al. (2003) refer to the entrepreneurs active in this process as 'artists' or 'dreamers'. They may not yet have a clear idea of what the final ecosystem service, market or actor constellation will look like. Creation is an exploratory and experimental process in which knowledge is generated, experimentation is promoted (Olsson et al., 2006) and innovation and learning are encouraged (Evans et al., 2015). Entrepreneurs are challenged, for example, to build networks, advocate, identify possible partnerships, broker these, and try to secure resources (Huitema and Meijerink, 2010; Westley et al., 2013). Trust building among stakeholders is an important strategy (Olsson et al., 2006), as is dynamic interaction and negotiation (Sarasvathy et al., 2005). Rigorous planning too early in the process is undesirable, and relatively static and detailed strategies are less appropriate. Instead, planning processes and strategies need to be flexible and open to change (Alvarez and Barney, 2007).

2.3 Methods

We analysed four EbA projects to find out how public and private entrepreneurs created opportunities. The cases were selected following a purposive sampling strategy (Ritchie et al., 2003). Criteria related to the type, phase, geographical scale and funding of projects, and the potential presence of business models and entrepreneurial opportunities were used to select similar cases (Appendix A). We selected cases from the Netherlands and the UK because of these countries' similarities in terms of adaptation challenges and measures (EEA, 2013; OECD, 2008), their similar entrepreneurship culture and a political economy that promotes enterprise (Dimov, 2007; Kirby, 2003) and practical reasons in terms of data accessibility, the opportunity to visit the EbA projects in person and absence of language barriers. Two cases from the UK were selected from a database listing 153 ecosystem-based mitigation and

adaptation cases in Europe (Naumann et al. 2011). The cases from the Netherlands were selected from a programme focussing on innovations in the water sector.

Fifteen entrepreneurs were interviewed between April 2014 and June 2016. Additionally, project reports, news items and meeting reports were collected (Table 2.1).

Table 2.1. Data sources used for the four EbA cases

Case	Number of entrepreneurs interviewed	Additional information sources
Wallasea Wild Coast Island	3	Project documents (4)
Inlandshore Wieringermeer	5	Project meetings (12), field visits (4), informal meetings (8), project documents (2)
Pastures New	2	Field visit (1), informal meeting (1), project documents (2), website (1)
Water holding Walcheren	5	Project meeting (1), field visit (1), website (1)

The interviews were independently coded by two researchers using the open coding option in Atlas-ti. First, the opportunities in the different cases were identified and discussed, after which the actions of entrepreneurs leading to these opportunities were identified. We coded the actions using existing denotations for strategies from literature while also naming additional strategies. The coding results of both researchers were compared and differences in interpretation discussed. The outcomes were then discussed by a group of four researchers, including the two researchers who coded the interviews, and the result of this discussion was used for the final analysis.

2.4 Results

This section provides an overview of four EbA cases where the strategies of various entrepreneurs create opportunities. Each case is first described chronologically, followed by an overview table including the entrepreneurs involved, strategies deployed and opportunities created.

2.4.1 Wallasea Island Wild Coast Project

The Wallasea Island Wild Coast Project (hereafter: Wallasea project) is a 783 ha coastal wetland restoration initiative taking place on Wallasea Island in the county of Essex in the southeast of the UK. It involves a 'managed realignment' of the island's coastal defences, i.e. the construction of new sea walls setback from the old coastal defences and subsequent breaching of the old sea walls to allow controlled tidal flooding of the land between the two sea defences, thereby creating new shoreline habitat while also improving hinterland coastal flood protection (RSPB et al., 2012).

The area of species-rich mudflats and saltmarsh in the UK has decreased vastly in recent centuries due to rising sea levels and human encroachment. Therefore, one of the goals of the Royal Society for the Protection of Birds (RSPB) was to restore and recreate coastal habitat and they were actively searching for suitable locations to realize this goal. The first episode of the Wallasea project started in 1999, when representatives of the RSPB participated in a local flood committee meeting which included a visit to the Wallasea Island, then farmland. To protect the low lying Wallasea Island and its hinterland from flooding, large investments in flood protection measures were needed, which were unlikely to be made by the sole land owner of the island. Due to its strategic location and the possession of the island by only one farmer, the RSPB realized the potential of the island to recreate coastal habitat. In the following years the RSPB maintained contact with the landowner and after a negotiation process bought Wallasea Island in 2007, the start of the second episode. The RSPB started communicating about its ideas for the island, which was originally the establishment of a regulated tidal exchange scheme controlled by sluices. The ideas were picked up by people from Crossrail, a governmental organization establishing an underground railway in London: '*It was actually very good timing because although they started to develop Wallasea in terms of what they wanted to do with it, they needed someone like Crossrail to make it work'* [Crossrail representative, June 13, 2014]. Crossrail was searching for suitable locations as it committed itself to the beneficial re-use of excavated material resulting from their tunnelling activities. A Crossrail representative decided to visit Wallasea and contacted the RSPB to explore opportunities for cooperation. When he was convinced that Wallasea was a promising site to deposit large amounts (i.e. 3-4 million tonnes) of material, in 2007-2008 he started to lobby internally to convince other people within Crossrail about the ideas: *'Wallasea was a great opportunity for us. It was an opportunity that*

we could (...) make it fit our programme (...). That very much fitted with our whole sustainability agenda'. [Crossrail representative, June 13, 2014]. In 2009 Crossrail and the RSPB reached an agreement about this innovative cooperation. The third episode started in 2011 with the implementation of the Wallasea Island Wild Coast Project. The involvement of Crossrail meant that the original idea of a regulated tidal exchange was abandoned. Instead, managed realignment was now possible because of the large amounts of excavated material available, which was seen as a more sustainable flood defence. The RSPB framed the Wallasea project as part of her national Futurescapes' programme; an attempt to expand the area of wildlife-friendly landscapes in the UK through establishing partnerships. They involved regulators in the project to deal with various regulatory issues and raised awareness about the project through organizing public events on site together with Crossrail. Gaining experience and generating knowledge about the innovative approach was also an important goal of the RSPB and Crossrail, as well as for a consultancy firm that was closely involved from the start of the project (ABP MER): *'Commercially you might get more work because you did the last one, and if you did it well you might get more work'.* [ABP MER representative, May 30, 2014]. In 2015, the final material from Crossrail was delivered to Wallasea Island. The whole project will not be finished until 2025, meaning that the RSPB has to continue looking for partnerships to complete the managed realignment scheme.

We identified three distinct episodes in the Wallasea project where opportunities were created as a result of the various strategies deployed by public and private entrepreneurs (Table 2.2).

Table 2.2 Different episodes in the Wallasea project where strategies of entrepreneurs created opportunities

	Episode I (1999-2007)	**Episode II (2007-2009)**	**Episode III (2011-2015)**
Public and/ or private entrepreneurs involved	RSPB (civil society) Land owner (business)	RSPB Crossrail (local government)	RSPB Crossrail ABP MER (business)
Strategies	**Search for suitable locations** to restore coastal habitats (RSPB) **Establishing and maintaining relationship** with the land owner (RSPB) **Awaiting** the right moment to sell the land (land owner) **Negotiating** about buying Wallasea (RSPB and land owner)	**Communicating** about needs to acquire (RSPB) and dispose (Crossrail) material **Search for suitable locations** to dispose material (Crossrail) **Establishing and maintaining relationship** with potential 'customer' of tunnelled material (Crossrail) Internal **lobbying** (Crossrail) **Coalition forming** (RSPB and Crossrail)	**Framing** the project as part of a national programme (RSPB) **Establishing and maintaining relationship** with regulators (RSPB) Organizing public events to **raise awareness** (Crossrail and RSPB) **Experience and knowledge creation** (Crossrail, RSPB and ABP MER)
Opportunity	The sale of Wallasea Island by the owner enables the RSPB to develop coastal habitat	Coalition between RSPB and Crossrail enables Crossrail to depose of its tunnelling waste and the RSPB its managed realignment scheme	Implementing the Wallasea project enables the RSPB to expand the area of wildlife-friendly landscape, Crossrail to realise its sustainability ambitions and ABP MER to acquire new projects

2.4.2 Inlandshore Wieringermeer

The inland shore Wieringermeer is a project located along lake IJssel in the province of North-Holland, the Netherlands. In 2007, the then newly installed 'Delta Committee' formulated recommendations to manage the water levels in lake IJssel more flexibly to anticipate the effects of climate change. This would have significant consequences for lake shore designs

(Deltacommissie, 2014). The first episode started in 2007 when a representative of the Ministry of Infrastructure and the Environment, who was inspired by examples of similar, but more pristine lakes in Eastern Europe, and a researcher proposed the creation of novel ecosystems named 'inland shores', i.e. areas behind the flood defences where water can be temporarily stored in combination with other functions. They framed the creation of inland shores as the local implementation of an essential national policy for climate change adaptation. Their ideas were successfully tested in a first project (2012-2014) also involving other authorities (i.e. the province and water board). In the second episode, the initiators searched for a suitable location to establish a second inland shore. By sharing success stories about the first inland shore and framing the inland shores combined with aquaculture as contributing to local economic development, a local landowner was willing to lease a 20 ha farm. Together with the province, municipality and water board and two entrepreneurs involved in developing innovative aquaculture (i.e. mitten crabs and salt tolerant crops) a second project in the Wieringermeer started.

Everyone can say about this project: we don't have to do it. The water board does not have to do it, the ministry does not have to do it, the province does not have to do it, entrepreneurs don't have to, and knowledge institutes neither. So if we would not have taken the initiative, no one would probably have said at this moment: let's start doing this together. [Civil servant, June 26, 2014].

During project implementation, creative sessions attended by a multitude of actors were held to raise awareness of the challenge of combining water storage with economic uses, while at the same time providing an opportunity for networking and establishing and maintaining relationships. Policymakers were regularly informed about the progress. In the course of 2015, experiments with floating agriculture and recreational fishing were included in the project and subsidies were successfully acquired in 2016.
The Inlandshore Wieringermeer project can be divided into three episodes (Table 2.3).

Table 2.3. Different episodes in the Inlandshore Wieringermeer project where strategies of entrepreneurs created opportunities

	Episode I (2007-2008)	**Episode II (2008-2014)**	**Episode III (2014-2016)**
Public and/ or private entrepreneurs involved	Ministry of Infrastructure and the Environment (national government) Researcher (civil society) Province (regional government) Water board (local government)	Ministry of Infrastructure and the Environment Researcher Province Water board Municipality (local government) Landowner (business) Aquaculture entrepreneurs (business)	Ministry of Infrastructure and the Environment Researcher Province Water board Municipality Aquaculture entrepreneurs
Strategies	**Preliminary idea development** about inland shores (Representative and researcher) **Framing** the inland shores as climate change adaptation measure and local implementation of a national policy (representative and researcher) **Experimenting** with inland shores (representative, researcher, regional and local government)	**Sharing success stories** (representative and researcher) **Search for a suitable location** to create inland shores (representative, entrepreneurs) **Framing** the inland shores as contributing to local economic development (representative)	**Establishing and maintaining relationships** (all) Organizing sessions to **raise awareness (all)** **Experimenting** (entrepreneurs)
Opportunity	The advice of the Delta Committee enabled the representative and researcher to introduce and develop their ideas about inland shores	Leasing a farm enables the ministry and water board to experiment with innovative water management, the province and municipality to stimulate local economic development and the entrepreneurs to experiment with new combinations of aquaculture	Granting of funding allowed continuation of the project and thus the possibility for all actors to continue to work towards their aims

2.4.3 Water holding Walcheren

The water holding Walcheren is an initiative of eight farmers in cooperation with knowledge institutes and consultancies spanning almost 300 ha in the province of Zeeland, in the southwest of the Netherlands. The project emerged from two other initiatives. The first initiative (2011-2014) was a pilot project concerning storage and infiltration of freshwater in creek deposits with controlled drainage systems at a horticulture and arable farm (Veraart et al., 2017). In 2012, a foundation called 'Waterbuffer' was established to maintain the knowledge derived from the pilot and to keep the issue of underground water storage (i.e., buffering water, hence the name) on the political and administrative agenda. The second initiative was developed by consultancy firm Aequator. They were challenged by the Ministry of Infrastructure and the Environment to develop innovative ideas and products to deal with freshwater shortages for agriculture and domestic uses in dry summer months. Together with several parties from different backgrounds, Aequator developed the idea of a 'water husbandry'; combatting freshwater shortages in summer by underground water storage in winter. To start experimenting with this idea, Aequator was searching for a suitable location in terms of geomorphology and hydrology and where farmers were willing to cooperate. Aequator came to know about the pilot in Zeeland and contacted foundation Waterbuffer, after which the two initiatives joined forces. The second episode started when they started testing techniques for underground freshwater storage and subsequently optimizing and scaling them up for application over a larger area by involving new stakeholder groups. Whereas the Waterbuffer was more involved in lobbying at the political level, Aequator was working to create a group of farmers and equip them with knowledge and tools for the experiment:

We started as initiator and needed to convince the farmers about the problem. Climate is something different than three to four years ago. Back then, it was being perceived as: whatever, it does not happen here. Well, the last three to four years we have had (...) long periods of drought or a very wet spring (...), which helped'. [Representative Aequator, April 22, 2014].

Together, Aequator and the farmers approached the water board to lobby for loosening the restrictions in the current regulations around water quality for infiltration. The Waterbuffer also

used its network in the water sector to accomplish this. This was a success and the project could continue, which marked the start of the third episode. At the start of the project, the farmers were more the problem owners in need of a solution:

The group of farmers had said before: there is a lot of water coming from the dunes and we can store it in spring but it would be even better if we could store it in the soil in winter. So they themselves came with the idea. [Representative Waterbuffer, April 30, 2014].

However, after a few years the farmers took ownership over the solution and came up with their own ideas to improve the situation. The role of Aequator resultantly shifted from being initiators towards being a source of information that the farmers could turn to when needed. The farmers started to experiment themselves by varying the water levels on their land and trying out different irrigation and drainage techniques. They approached the water authority and other local and regional authorities to discuss their ideas. They also contacted nature conservation organizations and recreational entrepreneurs in the vicinity of their land for potential cooperation. The strategies and opportunities identified are listed in Table 2.4.

Table 2.4. Different episodes in the Water holding project where strategies of entrepreneurs created opportunities

	Episode I (2011- 2013)	**Episode II (2013-2014)**	**Episode III (2014-2015)**
Public and/ or private entrepreneurs involved	Foundation Waterbuffer (civil society) Aequator (business)	Foundation waterbuffer Aequator Farmers (business)	Farmers
Strategies	**Experimenting** with storage and infiltration of freshwater in creek deposits (Waterbuffer) **Development of ideas** about underground water storage (Aequator) **Search for a suitable location** to test ideas about underground water storage (Aequator) **Coalition forming** (Waterbuffer and Aequator)	**Experimenting** with techniques for underground freshwater storage, including exploring possibilities for optimization and upscaling (Aequator and farmers) **Lobbying** at water board to loosen water quality restrictions (all)	**Experimenting** at field level (farmers) **Lobbying** to discuss their ideas with local authorities (farmers) **Establishing and maintaining relationship** with neighbours (farmers)
Opportunity	Coalition between the Waterbuffer and Aequator increases the chance that the experiment will be continued and that the Waterbuffer can use the lessons learned to influence the political agenda. For Aequator, the coalition provides a relevant local network to test their ideas in practice.	By adapting the regulations the water board enabled Aequator and the farmers to continue with the experiment	The first positive results of the experiment lead to plans of Aequator to export the 'product water holding' to other regions, offers the farmers the possibility to expand their production as well as other income-generating activities and the Waterbuffer to influence the political agenda

2.4.4 Pastures New

Pastures New was a 5-year landscape initiative started by the Dorset Wildlife Trust in 2007. It aimed at protecting and extending priority biodiversity habitats to create wildlife-rich, resilient and ecologically functional landscapes. At the start of the first episode, in 2004-2005, different

conservation organizations (i.e., the Dorset Wildlife trust, Natural England, the Dorset Environmental Records Centre, the Dorset Flora group and the mammal network) came together to identify the biodiversity-rich areas in Dorset and the areas where wildlife habitats were declining. They also brainstormed about measures how to connect these habitats: *'There was a lot of blue sky thinking, a lot of open mind, about what can we do to bridge the gap?* [Representative Dorset Wildlife Trust, May 27, 2014]. The organizations were so enthusiastic about their ideas, that they started contacting potential partners, such as farmers and local butchers. With their ideas and a preliminary network in place, the Dorset Wildlife Trust (DWT) contacted several potential funders to actually implement their plans. When the Tubney Charitable Trust announced that they were looking for suitable projects, the aforementioned organizations worked together to make their ideas fit the requirements of the Trust. Their ideas were evaluated positively and the Pastures New project could start in 2007, the start of the second episode. The project consisted of two main components. The first one was related to conservation grazing, i.e., grazing with traditional breeds with low stocking density on the chalk lands, and subsequently market the meat as an accredited brand. However, this idea did not succeed due to irregular meat supply, high prices and insufficient interest from the farmers. The second element of the project was grassland creation and restoration. The challenge here was to make these activities economically sustainable. Within the project team there was room for lateral thinking and unconventional ideas:

You could literally sit together as a group of people and say: this might work, let's go and have a focus group and see what people say and give it a go (...). We had some targets to reach (...) but mostly we could go and reach those targets in whatever way we thought. [Representative Dorset Wildlife Trust, May 27, 2014].

This spawned the novel idea of letting groups of farmers apply for agro-environment schemes as to receive compensation for their extensive farming activities. Farmers were visited regularly and an inventory of their needs was made, grassland management demonstrations were held, farm walks and road shows were organized for local inhabitants to raise awareness and gain support for the activities of the DWT and the farmers, and the project was framed as enabling migration of species under climate change to ensure broad political support. Together with

Natural England the DWT facilitated the entry of several farms into a collective landscape-scale Higher Level Stewardship (HLS) agreement. Individually, none of the farms would have qualified for HLS funding. Further, the DWT organized visits for DEFRA representatives to the project site to inform them about the progress and success of the approach. Table 2.5 provides an overview of the different strategies and opportunities identified.

Table 2.5. Different episodes in the Pastures New project where strategies of entrepreneurs created opportunities

	Episode I (2004-2007)	**Episode II (2007-2011)**
Public and/ or private entrepreneurs involved	Dorset Wildlife trust (civil society) Natural England (national government) Dorset Environmental Records Centre (civil society) Dorset Flora group (civil society) Mammal network (civil society) Farmers (business) Butchers (business)	Dorset Wildlife trust Natural England Farmers
Strategies	**Development of ideas** on how to halt and reverse the decline of wildlife habitats in Dorset (all civil society groups and Natural England) **Establishing and maintaining relationships** with farmers and butchers (DWT) **Approaching potential funders** (all civil society groups and Natural England) **Refining ideas** to make them fit the requirements of funders (all civil society groups and Natural England)	**Maintaining relationships** with the farmers (DWT) Organizing public events to r**aise awareness** (DWT and farmers) **Framing** the project as contributing to climate change adaptation (DWT) **Lobbying** by showing project results in the field to policy makers (DWT)
Opportunity	The funding provided by the Tubney Charitable trust enabled the organizations to start developing measures to connect important wildlife habitats in Dorset	Establishing a collective landscape-scale HLS enabled farmers to receive compensation for managing their land more environmental- friendly and the Dorset Wildlife Trust to receive income by acting as a consultant on collective agri-environment schemes

2.5 Discussion and lessons learned

Most strategies deployed in creating entrepreneurial opportunities in EbA are similar to the strategies described in the literature on social-ecological systems, which are attributed to policy entrepreneurs (Huitema and Meijerink, 2010), institutional entrepreneurs (Westley et al., 2013) and environmental leaders (Evans et al., 2015). For instance, the strategies of establishing and maintaining relationships, coalition forming and lobbying found in our cases are similar to those used to establish water transitions (Huitema and Meijerink, 2010). Also, experimenting is not only important in transformations towards adaptive governance of social-ecological systems (Olsson et al., 2006), but also a key component of opportunity creation. Experimentation is also a prominent part of entrepreneurship in business and management literature, where experiments are perceived necessary to cope with the large uncertainties that follow from the creation of new products and services and to evaluate reactions of customers, the government and competitors (Hekkert et al., 2007). The following strategies that were identified in this study are particularly illustrative for the opportunity creation process in EbA. First, since EbA involves the conservation, management and restoration of ecosystems (CBD, 2009), it always includes a physical component. Hence, *searching for a suitable location* is a crucial strategy for implementing EbA. Second, because EbA involves physical projects and often aims to provide multiple ecosystem services, a variety of stakeholders is involved. Therefore, *raising awareness* by informing people about the plans, the motivations behind projects and sharing successes is an important strategy to create support for EbA. Third, *framing* is used to place the local EbA projects in a larger context, for example as part of a national programme or policy.

Our results yield four important lessons for the governance of adaptation. First, all four projects can generally be divided into two phases based on a clustering of the strategies deployed across the cases. The first phase starts with the recognition of climate change impacts, for example, coastal flooding and droughts, combined with other pressures on the human and natural system, for example habitat fragmentation. Then, entrepreneurs start to *develop ideas* on how to address these challenges (i.e., problem in search for a solution). This is often done in cooperation with like-minded people. Sometimes, the impacts of climate change are already observed or experienced by the entrepreneurs. Othertimes, the ideation, including the gathering of expertise and resources, takes place before the manifestation of a problem (i.e., solution in search for a problem, hence the denotation ‘preliminary’) (Mintrom and Norman, 2009). Simultaneously,

problem, hence the denotation 'preliminary') (Mintrom and Norman, 2009). Simultaneously, *new relationships are established* with people that can help the entrepreneurs to further develop their ideas. Then, the *search for a suitable location* starts where the entrepreneurs can implement and test their ideas in practice. Also, efforts are being made to *form coalitions* of people or organizations that complement each other. Further, means of financing the ideas are being sought which often includes *lobbying* and *framing* the project to make it fit particular funding requirements. The strategies are sometimes used by individual entrepreneurs and other times in cooperation with others. The first phase usually ends with finding a location and a partnership to start the EbA project. This process is depicted in Figure 2.1.

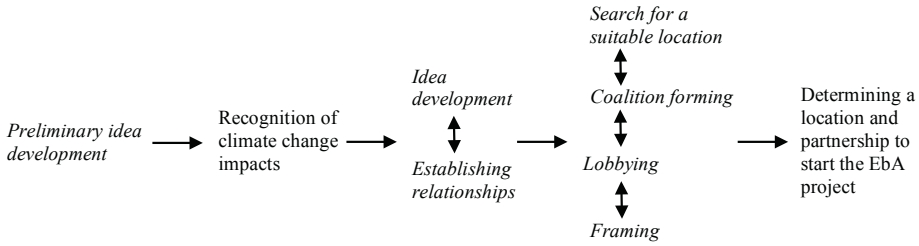

Fig. 2.1. Strategies deployed in the first phase of EbA projects where entrepreneurial opportunities are created. The strategies are depicted in italics. The horizontal arrows indicate sequentiality, whereas the double arrows indicate that the strategies are combined and influence each other. Note that preliminary idea development not precedes climate change recognition in all cases.

Figure 2.1 shows that there is a sequence in strategies deployed while multiple strategies are also deployed at the same time. The sequentiality is more difficult to determine in the second phase, where multiple entrepreneurs develop and combine strategies. This observation is supported by Dimov (2007), who argues that rather than directional, sequential and ordered, the entrepreneurial innovation process is an iterative process of shaping, elaborating and refining ideas. Strategies such as *establishing and maintaining relationships* with project partners, authorities and local residents, *lobbying* at different administrative levels and *framing* are simultaneously deployed. *Awareness raising* is important to gain support for the project activities around the project location. The results of *experiments* are used for awareness raising

activities as well as for lobbying purposes. Figure 2.2 shows the dynamic second phase of the opportunity creation process.

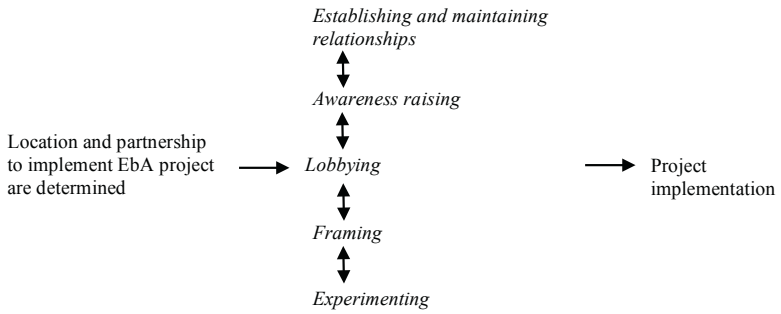

Figure 2.2. Dynamic interactions between different strategies in the second phase of the opportunity creation process in EbA

The second lesson relates to the type of strategies deployed, specifically individual versus collective strategies. Our results show that throughout the opportunity creation process, both individual and collective strategies are deployed. Often, initially strategies such as searching for a suitable location or lobbying are deployed by individual entrepreneurs or organizations, but as soon as coalitions are formed and relationships are established, mutual strategies are developed. The Water holding case for example shows that after collectively developing and implementing strategies, individual strategies prevail again as a result of shifting the ownership of a project towards one actor group (in this case the farmers).

Third, our results show that EbA projects require - often unusual - coalitions between entrepreneurs from different backgrounds (e.g., Transport for London with a nature conservation NGO) resulting in mutual opportunities. For example, the need of the RSPB for material to realize a coastal realignment was met by Crossrail, who could in its turn fulfil its sustainability goals. The mutual opportunities increase as the projects progresses. The involvement of entrepreneurs from government, business and civil society seems crucial for creating these mutual opportunities. Entrepreneurs from the public sphere have close links to authorities and can create conditions for experimentation and innovation by widening possible

restricting policies or regulations, which is a common constraint in EbA (Lukasiewicz et al., 2016). Business entrepreneurs can contribute to the longer-term economic sustainability of EbA projects through the creation of innovative business models. This is important given the difficulties to obtain long-term funding for EbA (Brink et al., 2016). Finally, civil society entrepreneurs, often environmental NGO's, are important for their knowledge on ecosystem services, their contacts in the field and to gain (local) support for the plans.

Until the rise of neoliberalism in the 1980's, public issues were seen as the sole responsibility of the public domain, and private issues as the responsibility of private actors. Thereafter it became increasingly accepted that the private sector shared, or took over, responsibilities from public actors (Mees, 2017). 'Soft policy instruments', which encourage participatory approaches by allowing private actors to influence the goals of adaptation and the distribution of responsibilities, reflect this (Klein et al., 2017). Our results illustrate the shifting roles and responsibilities of entrepreneurs in adaptation practice. Business entrepreneurs contributed to EbA beyond mere financial input, necessitating a more accurate depiction of the role of the private sector beyond that of project funders which is currently hold in EbA studies (Naumann et al., 2011; Vignola et al., 2009). The business entrepreneurs in our cases innovatively combined ecosystem services such as water regulation and food production (i.e., aquaculture with floating agriculture). Also, new actor constellations were set up in the form of a network of farmers involved in underground water storage. However, the business entrepreneurs were not the only ones creating opportunities. A civil servant developed the idea of combining novel water management practices with products to increase the economic sustainability of inland shores. Further, a nature conservation NGO started to provide consultancy services to farmers after their successful attempt to facilitate the collective application for agro-environmental subsidies. These examples indicate the shifting roles as well as the mutual interdependence of entrepreneurs in EbA projects.

CHAPTER 3

Entrepreneurial opportunity exploitation in climate change adaptation: A fuzzy set Qualitative Comparative Analysis of 18 ecosystem-based adaptation cases in the UK and the Netherlands

Abstract

Entrepreneurship receives increasing attention in climate change adaptation. While entrepreneurial behaviour is the attempt to exploit opportunities for own benefit, it can also aim to contribute to environmental, social and/ or economic values for the wider society. However, there is limited knowledge about the factors that shape the success or failure of entrepreneurial opportunity exploitation related to climate change adaptation. Drawing on interviews, field observations and literature, this paper presents an in-depth comparative study of 18 ecosystem-based adaptation initiatives in the Netherlands and the UK, in order to examine the conditions that support entrepreneurial opportunity exploitation. Our empirical analysis of the cases, using fuzzy set Qualitative Comparative Analysis, identifies two specific combinations of conditions that explain successful opportunity exploitation in ecosystem-based adaptation: facilitating policies and regulations combined with either high availability of capital or with strong financial motives. Individually, however, these conditions are insufficient for successful opportunity exploitation. Altruism is neither a necessary nor a sufficient condition for success, nor part of a combination of necessary and sufficient conditions. The findings suggest that strategies to enhance ecosystem-based adaptation should concentrate on access to financial capital and facilitating policies and regulations.

The manuscript corresponding to this chapter is currently under revision (required after review) as:
De Block, D., van Slobbe, E. and Feindt, P.H. Entrepreneurial opportunity exploitation in climate change adaptation: A fuzzy set Qualitative Comparative Analysis of 18 ecosystem-based adaptation cases in the UK and the Netherlands. *Environment and Planning C: Politics and Space.*

3.1 Introduction

In search for responses to global environmental challenges such as climate change adaptation and biodiversity loss, the private sector has received increasing scholarly attention (Berkhout et al., 2006; Mees et al., 2012; Milman and Warner, 2016; Schneider, 2014; TEEB, 2012; Tompkins and Eakin, 2012; Weinhofer and Busch, 2013) as a source of expertise, technology, financing and entrepreneurial spirit (Coleman et al., 2011). A specific area of climate change adaptation where contributions of private actors are currently explored is Ecosystem-based Adaptation (EbA), i.e. the use of ecosystems in supporting people to adapt to climate change. EbA initiatives aim to address the risks of climate change while simultaneously offering additional benefits for society (CBD 2009). Originally, the main actors in EbA were governments and (international) environmental organisations (Andrade Pérez et al., 2010; Colls et al., 2009; Dudley et al., 2010; TNC, 2009; UNEP et al., 2013; WB, 2009). However, state retrenchment and ongoing processes of decentralisation and privatisation in western democracies have triggered greater interest in the provision of adaptation public goods and services by private actors (Tompkins and Eakin, 2012). Indeed, private sector parties are increasingly interested in the business opportunities associated with climate change adaptation and solutions to ecosystem degradation and biodiversity loss (Hart, 2007; WBCSD, 2008). An example is the forest biodiversity program of a large paper producer who aimed for market differentiation (WBCSD, 2012).

This paper focuses on a specific type of private actor contribution to EbA, namely entrepreneurship. Schumpeter (1934) famously stylised entrepreneurship as 'creative destruction', as innovation that disrupts existing markets by establishing new products or services, by exploiting new sources of supply, or by introducing novel combinations of means of production, methods of production or forms of organization. The new products or combinations replace the established ones and thereby stimulate economic change and growth. In recent years, the innovation debate has broadened to include social, environmental and climate change adaptation goals with claims that entrepreneurial approaches could help to preserve ecosystems, maintain biodiversity and contribute to climate change adaptation and mitigation (Cohen and Winn, 2007; Dean and McMullen, 2007). Despite concerns about false corporate claims about environmental benefits (greenwashing) (Delmas and Burbano, 2011; Laufer, 2003), studies proliferate on entrepreneurs that create social value for people and

communities (Zahra et al., 2009), reduce environmental impacts (Schaltegger and Wagner, 2011) or simultaneously enhance social, environmental and economic values (Hall et al., 2010; Parrish, 2010; Schaltegger et al., 2016; Tilley and Young, 2009).

Despite multiplying case studies about sustainability-themed entrepreneurship, we lack knowledge about the conditions for successful entrepreneurship in sustainability issues in general, and in climate change adaptation and EbA more specifically. Therefore, this paper attempts to identify combinations of conditions for successful entrepreneurship in EbA. We focus on the opportunity exploitation phase of entrepreneurial innovations when ideas that entrepreneurs had developed previously materialize and are put into practice (McMullen and Shepherd, 2006). Our guiding research question is: What are the conditions for successful exploitation of entrepreneurial opportunities in ecosystem-based adaptation? Our explorative study comprises 18 cases of entrepreneurial opportunity exploitation in EbA in the UK and the Netherlands, using fuzzy set Qualitative Comparative Analysis (fsQCA), which allows examination of multiple conditions in conjunction (Ragin, 2000). Since EbA is usually undertaken in the context of complex social-ecological systems (Bourne et al., 2016), the sensitivity of QCA analysis to detect multiple causality is particularly useful.

In the next section, we introduce our conceptual framework by reviewing insights from entrepreneurship and adaptation literature on entrepreneurial opportunity exploitation and its related conditions. This is followed by an overview over the research design. The results section presents the combinations of conditions (paths) that lead to successful opportunity exploitation in EbA in our case set. We subsequently discuss the findings and the potential of QCA for advancing adaptation science and policy, and present our conclusions.

3.2 Conceptual framework: Entrepreneurial opportunity exploitation and its conditions

3.2.1 Entrepreneurial opportunity exploitation

EbA aims to contribute to 1) climate change adaptation, 2) socio-economic development, 3) environmental protection and biodiversity conservation and 4) sustainable economic development (Munang et al., 2013b). The public good component of these aims makes private sector entrepreneurial approaches precarious, since benefits cannot be fully internalized.

Entrepreneurial EbA will therefore combine private and public gain. Examples are the production of seedlings by local community members ('treepreneurs') for a reforestation project in Durban, South-Africa (Roberts et al., 2012) and the introduction of water boxes to increase the survival rate of newly planted trees to prevent erosion and combat desertification in Spain (Pijnappels and Dietl, 2013). These are cases of 'sustainable entrepreneurship' (Parrish, 2010; Schaefer et al., 2015; Schaltegger and Wagner, 2011), which focuses 'on the preservation of nature, life support and community in the pursuit of perceived opportunities to bring into existence future products and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy and society' (Shepherd and Patzelt, 2011: p. 142).

Entrepreneurship has been conceptualised as comprising first the discovery or creation of an entrepreneurial opportunity followed by its exploitation (McMullen and Shepherd, 2006; Shane, 2003). Entrepreneurial opportunities are situations in which new goods, services and markets can be introduced to create profit (Kirzner, 1997; Shane and Venkataraman, 2000). Subsequent to the discovery or creation of an opportunity, entrepreneurship involves the decision whether or not to exploit it (McMullen and Shepherd, 2006). Following Schumpeter's (1934) distinction between invention and innovation, invention constitutes the discovery or creation of an opportunity and innovation its exploitation. Some scholars argue that opportunity exploitation begins when the entrepreneur mobilises resources to set up a new business (Alvarez and Busenitz, 2001; Nieto and González-Álvarez, 2014). However, opportunity exploitation can also take place within existing firms or through market mechanisms (Fuentes Fuentes et al., 2010; Shane and Eckhardt, 2005). Opportunity exploitation then comprises any gathering and recombining of resources to pursue an opportunity, as opposed to the more mental activity of opportunity discovery (Shane, 2003). We therefore understand entrepreneurial opportunity exploitation in EbA as gathering and (re)combining resources to introduce new goods and services related to EbA, either through new or established firms and organizations. Our focus on opportunity exploitation is therefore motivated by an interest in the conditions under which EbA entrepreneurs are able to mobilise sufficient resources to realise both economic benefits solely for the entrepreneur and non-economic benefits for both the entrepreneur and the broader community.

3.2.2 Conditions explaining successful opportunity exploitation

Overview

Entrepreneurial opportunities can be exploited to different extents, ranging from successful to unsuccessful exploitation. The extent to which opportunities are successfully exploited is in this paper based on whether or not (1) a sustainable business model is implemented, (2) activities are undertaken related to the introduction of the EbA-related products or services and (3) EbA-related products or services are operated at full-scale. Opportunities are successfully exploited when all three elements are present. Appendix B provides more information about the degrees of opportunity exploitation distinguished in this paper. Explanations for the success and failure of entrepreneurial opportunity exploitation in EbA contexts can be found in both entrepreneurship and adaptation literature. Although certainly not exhaustive, our analysis of 15 peer-reviewed entrepreneurship papers and 44 peer-reviewed and other documents on EbA suggests that a set of four conditions are likely to be strong predictors of opportunity exploitation: altruism, financial motives, capital availability and policies and regulations. These conditions combine actor attributes (characteristics of entrepreneurs involved in opportunity exploitation) and characteristics of the opportunity (contextual components of opportunity exploitation) (cf. Shane, 2003) (Figure 3.1). Regarding actor attributes, the motivation of entrepreneurs to exploit opportunities, and more specifically altruistic and financial motives are emphasised in the EbA literature (Naumann et al., 2011; Tompkins and Eakin, 2012). Contextual components of opportunity exploitation relate to the economic, political and cultural institutions that shape the situation (Shane, 2003). The EbA literature emphasises the economic and policy factors that influence exploitation, in particular

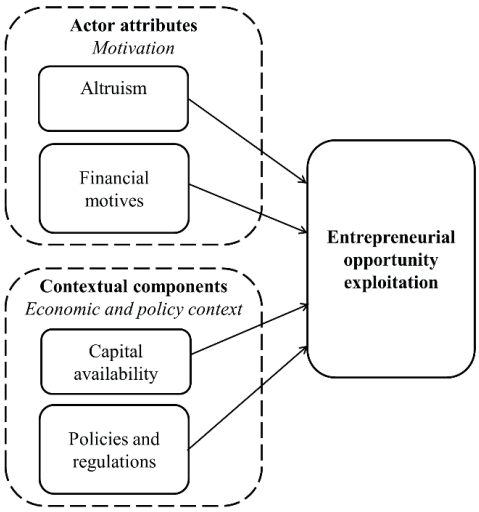

Fig. 3.1. Schematic representation of the four selected conditions influencing entrepreneurial opportunity exploitation

availability of capital (Colls et al., 2009) and enabling international, national and local policies (Doswald and Osti, 2011; Naumann et al., 2011).

Table 3.1 presents the four conditions and associated indicators. We discuss each condition separately below before we combine and test them as necessary and sufficient conditions in the empirical analysis.

Table 3.1. Description of indicators covering the four selected conditions

Condition	Indicators	Description	References
Actor attributes: Motivation			
Altruism (AL)	Empathy – connectivity to place	A strong bond with the location where EbA takes place	Patzelt and Shepherd (2011); Tompkins and Eakin (2012)
	Empathy – solidarity with others	A motivation to advance other people's situation through improving their livelihoods or providing societal benefits	Naumann et al. (2011); Patzelt and Shepherd (2011); Tompkins and Eakin (2012)
	Climate change awareness and risk perception	Awareness of climate change and perception of climate change risks	Naumann et al. (2011)
	Enhancement of biodiversity and ecosystem services	A motivation to strengthen biodiversity and/or ecosystem services in a specific place	Patzelt and Shepherd (2011)
Financial motives (FM)	Profit maximization	A motivation to increase personal or corporate economic gains	Dean and McMullen (2007)
	Development of business models	A motivation to assure a continued delivery of the EbA-related products or services	Engel et al. (2008); Wertz-Kanounnikoff et al. (2011)
Contextual components: Economic and policy context			
Capital availability (CA)	Availability of external capital	Access to external capital, i.e. capital without pay-back obligation	Halme and Korpela (2014); Teece (2010)
	Availability of internal capital	Access to personal or company financial resources	Shane and Eckhardt (2005)
	Availability of revenues	Ability to obtain revenues from EbA- related products or services	Osterwalder et al. (2010)
Policies and regulations (PR)	Influence of international, national and local policies	Extent to which international, national and local policies influence the introduction of EbA-related products and services	Cowan et al. (2010); Dimov (2007)
	Influence of regulations	Extent to which regulations influence the introduction of EbA-related products and services	Dimov (2007); Naumann et al. (2011)

Actor attributes: motivation

'Motivation' is operationalised in Tompkins and Eakin's (2012) study of private providers of adaptation public goods where managers of private capital create adaptation benefits for a broader community; hence benefits either do not directly accrue back to the private provider or are diffuse in space and time. Examples are soil and water conservation measures taken by farmers and actions of citizens to enhance the infiltration capacity of urban areas. In all cases, adaptation goods are deliberately provided by actors who have, amongst others, two types of motivations: 1) altruistic and/or 2) financial.

Altruism is 'the individual motivation to improve the welfare of another person' (Penner et al., 2005: p. 368). Altruistic values are positively related to pro-environmental behaviour (De Groot and Steg, 2009; Karp, 1996; Klöckner, 2013; Stern, 2000) and motivate action on climate change (Johnson, 2012). Howell and Allen (2017) showed that altruistic concerns about climate change impacts on future generations and vulnerable people are most important for climate change mitigation actions. Altruistic motivations can move private organizations or actors to fund EbA initiatives (Naumann et al., 2011). Based on the perceived contribution of EbA to socio-economic development, climate change adaptation and biodiversity conservation (Munang et al., 2013b), we distinguish three indicators for altruistic behaviour. First, empathy enables individuals to think, feel, and experience emotions similar to those experienced by others. They are motivated to find opportunities to improve other people's situation because this improves their own emotional state (Patzelt and Shepherd, 2011). Empathy can be driven by connectivity to place or solidarity with others (Tompkins and Eakin, 2012). A strong connection with the location of an EbA initiative can motivate entrepreneurial activity since places provide a sense of identity (Patzelt and Shepherd, 2011). Feelings of solidarity can drive EbA entrepreneurship when it improves the livelihoods of others or provides multiple societal benefits (Naumann et al., 2011). The second indicator is awareness of climate change and related risk perceptions which enhance the willingness of individuals to take or support leadership on the issue. Perception of climate risk at a local level is a strong impetus for action. In EbA, this is frequently flood risk perception (Naumann et al., 2011). The third indicator is a motivation to strengthen biodiversity and ecosystem services, which distinguishes EbA from other adaptation strategies (CBD, 2009). People do experience empathy not just for humans,

but also for animals, which can motivate them to improve the environmental conditions in which animals live (Patzelt and Shepherd, 2011).

Financial motives can also drive EbA entrepreneurship. They include 1) profit maximization and 2) development of business models. Profit maximization refers to the opportunity to increase the entrepreneurs' personal or corporate economic gains (Dean and McMullen, 2007). Compensatory and incentive payments address this motive (Tompkins and Eakin, 2012). Motivations to introduce business models relate to the desire to assure a continued delivery of EbA-related products or services. Payment schemes for ecosystem services, a mechanism to translate external, non-market values of the environment into financial incentives for actors to provide such services, address this motive (Engel et al., 2008; Wertz-Kanounnikoff et al., 2011).

Contextual components: economic and policy context

Among the external factors for successful opportunity exploitation in EbA, the availability of capital and government policies and regulations have been emphasised (Shane et al., 2003).

Availability of capital is a critical factor because it positively influences opportunity exploitation (Nieto and González-Álvarez, 2014), while lack of funding and lack of knowledge about potential financing instruments are common constraints in EbA implementation (Colls et al., 2009; Naumann et al., 2011). Capital availability can originate from different sources: 1) External capital refers to capital without pay-back obligation, acquired through funding from organizations and institutions other than the entrepreneur's own firm, e.g. subsidies (Halme and Korpela, 2014). As there is not always a business model that can support value capture in EbA, government funding and/ or philanthropy is often needed (Teece, 2010). 2) Internal capital is the entrepreneur's own financial resources. Entrepreneurs with greater own capital are more likely to exploit opportunities (Shane and Eckhardt, 2005). 3) Revenues obtained from the products and services: entrepreneurial success also depends on the availability of a market, or customer segments, to sell the product or service (Osterwalder et al., 2010).

Policies and regulations can either promote or constrain entrepreneurship (Dimov, 2007). Constraints arise from rules and regulations prohibiting or conditioning certain entrepreneurial actions. Successful opportunity exploitation partially depends on the entrepreneurial skills to make persuasive claims against actual or pending regulation or administrative decisions that

would limit opportunity exploitation. Entrepreneurship also includes bargaining and coalition formation to influence the relevant governance structures (Companys and McMullen, 2007). The regulatory framework can also support entrepreneurship in EbA. Examples are regulations that require the restoration of damaged sites (Naumann et al., 2011) or the initiation of National Adaptation Strategies. The implementation and further development of climate change laws and strategies in some countries, e.g. the UK, could promote EbA (Cowan et al., 2010). The development and use of EbA are potentially facilitated by the EU green infrastructure initiative (Naumann et al., 2011) and the EU Water Framework Directive (Doswald and Osti, 2011).

Assumption

Our empirical field work and data analysis aimed to explore systematically whether and how the factors described above form necessary and sufficient combinations of conditions for successful opportunity exploitation. While QCA analysis serves as an evaluation of theoretical assumptions rather than statistical hypothesis testing (Schneider and Wagemann, 2012), it is useful to formulate an assumption that guides the data analysis. Based on the literature and our selection of the four conditions, in formal QCA notation the assumption is:

AL (CA*PR) + FM (CA*PR) → OE

where the symbol '+' indicates disjunction (logical 'OR'), meaning that either conditions or conjunction is sufficient, indicated with '→'. '*' represents conjunction (logical 'AND'), meaning that a combination of conditions is sufficient for the outcome. In plain language, we expect that two conjunctions are sufficient for successful entrepreneurial opportunity exploitation: 1) altruism (AL) combined with capital availability (CA) and facilitating policies and regulations (PR), or 2) financial motives (FM) combined with capital availability (CA) and facilitating policies and regulations (PR).

3.3 Materials and methods

Identifying conditions for successful entrepreneurial opportunity exploitation in EbA required systematic case comparison. We conducted both within-case and cross-case analyses. Within-case analysis aimed at understanding how the four conditions manifest themselves in each case

(Yin, 2003). The cross-case analysis systematically compared the cases by a set-theoretic Qualitative Comparative Analysis (QCA) to identify patterns across cases (Rihoux and Ragin, 2009).

3.3.1 Case selection and data collection

Due to the exploratory character of our study, purposive sampling was used to select cases (Ritchie et al., 2003). The prime consideration was variety in outcome to ensure that cases with successful, unsuccessful as well as partially successful or unsuccessful outcomes were included (Berg-Schlosser and De Meur, 2009), see Table B4 in Appendix B. Three other criteria for case selection were used: 1) located in the Netherlands or the UK, 2) existence or development of a business model that 3) aims to introduce new products or services related to EbA. These three factors demarcate the 'area of homogeneity' of this study, which ensures that the selected cases are similar enough for meaningful comparison (Berg-Schlosser and De Meur, 2009). Appendix A provides more information about the case selection procedure.

Based on the selection criteria, we chose two cases from a database containing ecosystem-based adaptation projects (Naumann et al., 2011) and four cases from the Climate-KIC project portfolio. Twelve cases were found by consulting two scholars and ten practitioners working on EbA. Overall we included 18 EbA cases, nine each from the UK and the Netherlands. The total number was based on benchmark tables used in QCA research to determine the ratio between number of conditions and number of cases (Marx, 2010), as well as pragmatic reasons in terms of data accessibility, language skills and the possibility for face-to-face interviews and field visits (Berg-Schlosser and De Meur, 2009). Overall, we interviewed 28 entrepreneurs, some of whom were involved in more than one case. The number of interviewees per case varied from one (some firms consist of only one person) to five. Interviews lasted between 45 and 90 minutes and were fully tape-recorded and transcribed. Further information on the cases was collected from observations during informal meetings and field visits, relevant documents such as project reports, websites and media coverage. Finally, five interviewees were contacted again by email and phone after the first data analysis phase to clarify some indistinct interview data and fill in missing information. Table B3 in Appendix B gives an overview of the number of persons interviewed and additional information sources per case.

3.3.2 Using QCA as an analytical approach

Qualitative Comparative Analysis (QCA) was developed in the 1980s to compare causal patterns in intermediate-N situations. It aims at identifying the minimally necessary and sufficient (combinations of) conditions for specific outcomes. For this purpose, QCA uses Boolean algebra to treat cases as configurations of causal conditions and outcomes and applies a set-theoretic perspective, i.e. it analyses whether a given condition or combination thereof stands in a subset or superset relationship to the outcome. Different from statistical approaches such as regression analysis, QCA is not employed to identify how individual conditions correlate with outcome, but how multiple conditions combine to necessary or sufficient sets of conditions. This implies analysis whether there is only one necessary or sufficient combination or several different combinations of conditions (causal recipes) for generating the same outcome (Ragin, 2008). QCA is based on three key assumptions: 1) the existence of equifinality, i.e. a scenario in which alternative conditions can produce the same outcome; 2) conjunctural causation, where single conditions do not display an effect on their own, but only together with other conditions, and 3) asymmetry, meaning that the explanation for the non-occurrence of an outcome cannot automatically be derived from the explanation of the occurrence of the outcome (Schneider and Wagemann, 2012). Particularly the first two assumptions resonate with the suggestions in both environmental science and entrepreneurship literature to take into account the complex interactions accompanying adaptation efforts and to look for causal factors in conjunction when studying entrepreneurial opportunities (Ostrom and Cox, 2010; Patzelt and Shepherd, 2011). For a more detailed explanation of QCA, see Ragin (2008), Rihoux and Ragin (2009) and Schneider and Wagemann (2012).

3.3.3 Calibration of the qualitative dataset to fuzzy values

QCA's two main variants are crisp-set QCA (csQCA) and fuzzy-set QCA (fsQCA). Whereas csQCA allows only two mutually exclusive states, either membership (1) or non-membership in a set (0), fsQCA extends crisp sets by permitting intermediate membership scores in the interval between 0 and 1 (Ragin, 2000). Thus, a case can be a partial member of a set (Schneider and Wagemann, 2012). Based on the level of detail of our data, we chose to apply an fsQCA approach. Application of fsQCA requires a conversion of the qualitative data to quantitative fuzzy-set membership values. We developed a specific comparative research design following

the stepwise approach proposed by Basurto and Speer (2012) for structuring the calibration of qualitative data as fuzzy sets. First, a list of conditions with associated indicators was constructed through an iterative process where the case and contextual knowledge informed the operationalization of the theoretical concepts. Second, we developed an interview guide and conducted the interviews. The transcribed interviews and other qualitative data were independently coded by two researchers using a seven scale classification to express the extent to which each indicator was present in the case. Similarly, four different values (i.e. 1, 0.67, 0.33 and 0) were assigned to each case to express the degree of opportunity exploitation (outcome). Systematic cross-case comparison as well as discussions between the two researchers determined the final fuzzy-set values for indicators and outcome, whereas the final value for each condition was determined by applying the arithmetic mean of the indicators. A detailed description of the calibration procedure including a case example and the resulting fuzzy-set membership values for the conditions and outcome for all cases are provided in Appendix B.

3.4 Results

3.4.1 Entrepreneurial opportunities in an EbA context

An inventory of the goods or services developed in each case (Appendix C) showed that a range of actors appeared as EbA entrepreneurs. In several cases, individuals started a small firm, e.g. providing consultancy services on climate change adaptation (Climate Resilience ltd.) or designing landscape plans for more resilient riverine areas (Nienhuis Landscape Architects). However, all small business entrepreneurs were part of consortia which collaborated to create ideas, develop visions, bid for tenders and, if successful, implement the plans. Businesses, knowledge institutes and governmental bodies cooperated, for example, in Blue Green Dream, Building with Nature and Inlandshore Wieringermeer. Both new or established firms and organizations were involved in opportunity exploitation. In existing organizations entrepreneurial individuals started to exploit opportunities (e.g. Landbouw op Peil). The origin of the firms and organizations varied. For some, strengthening biodiversity and ecosystem services through EbA was the primary goal, e.g. Wildlife Trusts and nature conservation NGO's. Others saw business opportunities in developing EbA and focused on profit-making

(e.g. CAFCA). The goods and services provided also varied. Products were derived from agriculture, aquaculture and horticulture and tools and models supporting blue-green infrastructure were developed. Services were mostly provided as consultancies.

3.4.2 Sufficient paths for opportunity exploitation

The next step was the analysis of the fuzzy-set data obtained through the calibration of the qualitative data using fsQCA software (Ragin and Davey, 2014). Following Schneider and Wagemann (2012), we first assessed the presence of any necessary condition(s) for opportunity exploitation, meaning that if the outcome was present, the condition was also present. We used a consistency threshold of 0.9 (cf. Ragin, 2006), indicating the degree to which the empirical information aligned with the statement of necessity. Our analysis indicates that no single condition – altruism (AL), financial motives (FM), capital availability (CA) and policies and regulations (PR) – or its negation was necessary for successful opportunity exploitation (outcome OE) – the highest consistency value was 0.77 for condition CA. Based on the same threshold, no single necessary condition was found for unsuccessful opportunity exploitation (negation of the outcome ~ OE). We then calculated the consistency for necessary pairs of conditions. Based on our assumption and following the systematic necessity assessment as proposed by Bol and Luppi (2013), we calculated the necessity score for the combinations CA+FM, CA+AL, PR+FM and PR+AL, where the symbol '+' indicates that one of the two conditions is necessary for the outcome. None of the conjunctions met the consistency threshold of 0.9 for necessity.

We then looked for sufficient conditions, meaning that whenever the (combination of) conditions was present, the outcome was present, while the outcome could also appear without the specific sufficient condition(s). A truth table was created based on the fuzzy-set data (Table 3.2). We excluded four logical remainder rows (i.e. combinations of conditions with zero cases). After iterative analysis (Appendix D), we determined the consistency threshold at 0.85 and re-coded the truth table values >0.85 as 1 and the remaining ones as 0. A first look at the truth table combined with the fuzzy-set values from table B4 in Appendix B indicates that in general, our expectations as expressed in the assumption were confirmed. In rows 1, 3 and 5 the fuzzy-set values for the conditions CA, PR and either AL or FM are 'in' the set (i.e. fuzzy-set values >0.5), while the outcome is 1, indicating successful opportunity exploitation. Rows 2 and 4

show a different pattern, since here only a combination of conditions CA and PR or FM and PR lead to a successful outcome. In rows 6-12, which all contain unsuccessful outcomes, only condition CA or PR, or none of these two conditions, is fulfilled: these rows also confirm our expectations. Rows 5-8 contain contradictory configurations: combinations of conditions that lead to an unsuccessful outcome for some cases, but to a successful outcome for others. Contradictory configurations are common in fsQCA (Rihoux and De Meur, 2009).

Table 3.2. Truth table guiding the analysis of sufficient conditions

Row	AL	FM	CA	PR	OE	Number of cases	Case names	Raw consistency
1	1	0	1	1	1	3	Pastures New, The Green City, Trent and Tames Futurescapes	0.93
2	0	0	1	1	1	1	Climate Resilience ltd.	0.92
3	1	1	1	1	1	1	Abbotts Hall	0.90
4	0	1	0	1	1	1	Nienhuis Landscape Architects	0.90
5	0	1	1	1	1	2	Building with Nature, Water holding[a]	0.90
6	0	0	1	0	0	1	Landbouw op Peil[a]	0.85
7	1	0	0	1	0	2	Bureau Stroming[a], Butterfly Beef	0.84
8	1	1	1	0	0	1	Roof Doctors[a]	0.84
9	1	0	1	0	0	1	Green Climate Belt	0.81
10	0	0	0	0	0	1	Blue Green Global	0.81
11	0	1	1	0	0	1	CAFCA	0.81
12	0	1	0	0	0	3	Blue Green Dream, Inlandshore Wieringermeer, Working with Nature	0.77

[a] contradictory truth table rows. We included all contradictory rows in the logical minimization process.

The results of our sufficiency analysis (Table 3.3, for details see Appendix E) indicate that while no single condition alone was sufficient, two paths were sufficient for successful opportunity exploitation:

CA*PR + FM*PR → OE

High capital availability (CA) combined with facilitating policies and regulations (PR) or strong financial motives (FM) coupled with facilitating policies and regulations were sufficient for a

successful outcome (OE). In other words, if one of these two combinations of conditions was present in a case, it was likely that opportunities were successfully exploited.

Table 3.3. Overview of coverage and consistency of the two sufficient paths as presented in the most parsimonious solution. The true logical contradictory case is indicated with a *

	CA*PR +	**FM*PR** → **OE**
Raw coverage	0.64	0.56
Unique coverage	0.08	0.02
Covered cases	Abbotts Hall Building with Nature Climate Resilience ltd. Pastures New The Green City Trent and Tame Futurescape Water holding*	Abbotts Hall Building with Nature Nienhuis Landscape Architects Water holding*
Consistency	0.89	0.85
Solution coverage	0.69	
Solution consistency	0.87	

The value for raw coverage indicates how much of the outcome OE is covered by each path, whereas the unique coverage shows how much of the outcome is covered only by one specific path. The higher scores of path CA*PR for both parameters is mirrored in the cases covered; while CA*PR has four cases that are unique for this path, FM*PR has only one unique case. The solution is characterized by a high solution consistency value (0.87) and can explain seven out of ten cases of successful opportunity exploitation (i.e. cases with an outcome value > 0.5 in table B4, Appendix B). However, the cases Bureau Stroming, Landbouw op Peil and Roof doctors remain unexplained; they are also logical contradictory cases in the truth table.

The results of our sufficiency analysis are graphically displayed in Figure 3.2. Perfect consistency requires that all cases are located above or on the main diagonal. However, as Ragin (2000) explains, it is more difficult to find perfect subset relations for fuzzy sets than for crisp ones. Hence, reaching perfect sufficiency cannot be the (only) goal of such analysis. Four cases fall below the diagonal: Building with Nature (4), Butterfly Beef (6), Water holding (17) and Working with Nature (18). Water Holding is a true logically contradictory case, meaning that while the sufficient path has a value >0.5 and thus, the conditions are present, opportunities are not successfully exploited since the outcome value is <0.5 (Schneider and Wagemann, 2012). Possible explanations for the contradiction are considered in the discussion section.

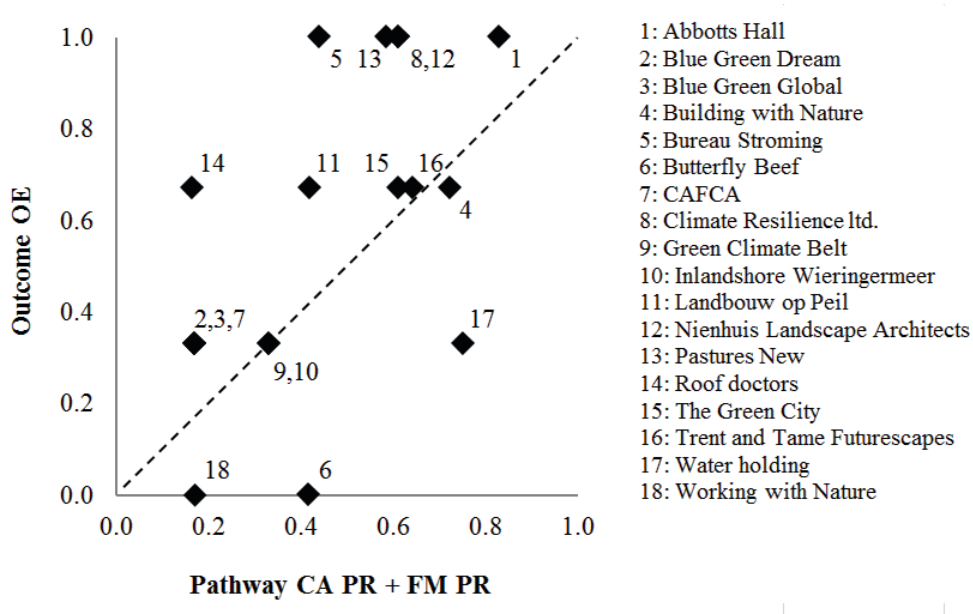

Fig 3.2. Plot of outcome OE against conditions CA*PR + FM*PR for 18 EbA cases

3.4.3 Robustness of the sufficient configurations

The robustness of QCA results is the degree to which the solution is sensitive to changes in the choices made by researchers at the various stages of systematic complexity reduction of the raw data (Skaaning, 2011). Following suggestions by Schneider and Wagemann (2012) and Skaaning (2011) we conducted two robustness tests. First, we changed the frequency of cases linked to the configurations. Due to the relatively low number of cases (n=18) we initially included all configurations representing at least one empirical case. An additional sufficiency analysis that included only configurations with at least two cases resulted in a considerably smaller truth table with only four rows. The parsimonious solution for this set shows only one condition as sufficient: capital availability (CA). As CA can be considered a superset of the first conjunction in our main solution, this outcome does not contradict our initial findings. Second, we changed the consistency threshold from 0.85 to 0.77, corresponding to the gap between row 11 (0.81) and 12 (0.77). The additional sufficiency analysis delivers CA + PR → OE as the parsimonious solution term (for more details about this alternative solution see Appendix F). Since the solution from our main analysis is a subset of this alternative solution, this outcome again does not contradict our initial findings. Finally, we checked whether the path CA*PR + FM*PR is sufficient for the complement of the outcome (~OE) to account for simultaneous subset relations (i.e. the path is sufficient for both the outcome and its negation, which would indicate a logical fallacy). We included ~OE in a truth table with consistency threshold 0.8. The highest raw consistency score was 0.57 for FM*PR. Hence, no simultaneous subset relations are present. In sum, all three robustness tests confirmed the consistency and robustness of the main solution.

3.5 Discussion

3.5.1 Reflection on conditions and cases in the sufficient paths

The causal path CA*PR + FM*PR→ OE explains seven out of ten cases of successful opportunity exploitation, whereas seven out of the eight non-successful cases contain neither of the two conjunctions. According to our fsQCA results, six cases (Abbotts Hall, Building with Nature, Climate Resilience ltd., Pastures New, the Green City and Trent and Tame Futurescapes) had a high level of capital availability and facilitating policies and regulations, which together led to successful opportunity exploitation. Capital availability includes internal and external capital and revenues. In five of the six cases, external capital from a private Trust (e.g. Pastures New) or government grants (e.g. Building with Nature) was very important. Internal capital was important in five of the six cases. E.g. for Building with Nature, investments by the coastal engineering companies drove the initiative before the Dutch government invested as well. Market revenues were important in all cases. Two cases which were not part of the causal path offer interesting insights. Nienhuis Landscape Architects and Bureau Stroming successfully exploited opportunities despite low internal and external capital availability. These cases provide exceptions to the dominant emphasis on lack of funding as major constraint to EbA implementation (Colls et al., 2009; Naumann et al., 2011). A possible explanation for this exception is that from the start, both enterprises generated enough income (i.e. revenues) from projects they initiated. Obtaining sufficient revenues for a long-term implementation of EbA can be explored further, especially since time-scale mismatches often compromise current financial mechanisms to stimulate EbA (Ojea, 2015). For example, Wamsler (2015) showed that the temporary structures created for EbA projects financed by external funds (‘external capital’) dissolved after the financing ended and resultantly, progress slowed significantly. The temporal availability of capital for EbA projects makes this condition for success fragile, and cases that we have coded as successful might easily become less successful if a funding source disappears.

Seven successful cases confirm the significant role of – mainly environmental – facilitating policies and regulations (six from the first sufficient path and Nienhuis Landscape Architects from the second sufficient path). These include the European (Water Framework Directive, Birds and Habitats Directive, EU adaptation strategy, European Landscape Convention and the

Common Agricultural Policy), national (National Adaptation Strategies, Delta program and flood protection policies) and local level (environmental designations, consents for coastal realignment and environmental impact assessment). This observation confirms the emphasis in earlier EbA studies on the supportive function of policies at various administrative levels (Brink et al., 2016; Chong, 2014; Doswald et al., 2014). A study of Wamsler et al. (2014) comparing Swedish municipalities shows that supporting legislation for EbA is currently especially lacking at the local level because of highly regulated and inflexible local planning. Informal planning and rules are currently used to cope with this issue (Wamsler, 2015). Several of our cases (e.g. Nienhuis Landscape Architects and the Roof Doctors) show that entrepreneurs can stimulate EbA at the local level by finding innovative ways to deal with existing planning practices. Wamsler et al. (2014) also found that even without supporting legislation, the presence of strong leadership can lead to EbA. Several interviewees also stressed the restricting function of some regulations limiting the room for experimentation as well as being very time-consuming. Indeed, generally one of the most frequent barriers for implementing EbA are unsupportive legal frameworks, e.g. for environmental and building permits (Brink et al., 2016). Other constraints in regulatory structures are institutional complexity due to the multiple disciplines involved and compartmentalised funding (Lukasiewicz et al., 2016; Wamsler et al., 2016).

Our analysis shows that successful opportunity exploitation could also be expected in the presence of both financial motives and facilitating policies and regulations, as in the cases of Abbotts Hall, Building with Nature and Nienhuis Landscape Architects. Whereas the first two cases also had high levels of capital availability, the latter shows that only profit motivation combined with facilitating policies and regulations was sufficient for successful opportunity exploitation.

Water Holding is a logical contradictory case in both sufficient paths, meaning that all three conditions were present, but opportunities were still not exploited. A possible explanation is the relatively early and experimental phase of the case where opportunities might be exploited at a later stage. This suggestion is confirmed by a cluster of other cases (Figure 3.2) which were still at their infancy when observed and had not (yet) scored as successful, namely CAFCA, Blue Green Global, Blue Green Dream, Green Climate Belt and Inlandshore Wieringermeer. Although our sample also contains successful early stage cases (e.g. Climate Resilience ltd.) and more mature, but unsuccessful cases (e.g. Butterfly Beef), the cluster suggests that time

influenced our results. This potential 'temporality problem' is a common challenge in QCA and empirical social science research in general (De Meur et al., 2009). Over time, the values for both the conditions and the outcome are likely to change, which is very relevant for EbA since the long-term nature of adaptation makes measuring its success challenging (Doswald et al., 2014). Accounting for the temporal dimension is beyond the scope of our study and we are therefore unable to make statements about the influence of time on our results. However, strategies to include temporality, e.g. running separate QCA's for different points in time (Schneider and Wagemann, 2012) and dynamic in-depth case studies, e.g. with process tracing (Rohlfing and Schneider, 2013) can be included in future studies.

3.5.2 The role of altruism

Our data suggest that altruistic motivation was neither alone nor combined with other conditions necessary or sufficient for successful opportunity exploitation. Table B4 in Appendix B shows that of the ten cases with a low value for altruism (<0.5), eight have a value between 0.4 and 0.5, and none of the cases received value 0, indicating that altruism is to a greater or lesser extent present in all cases. However, while eight out of 18 cases showed a high value for altruism (>0.5), this condition was 'crowded out' by the other conditions. Our data suggest that financial motives play a larger role in our cases. This can have two reasons. First, our focus on the exploitation stage of entrepreneurial innovation processes. When considering the overall process, altruism is likely to function as a motivator for people to get involved in EbA in the first place. Patzelt and Shepherd (2011), for example, argue that altruistic entrepreneurs are more likely to discover opportunities for sustainable development. Second, two of our selection criteria (i.e. existence or development of a business model and the aim to introduce new products or services related to EbA) implied the choice for cases where sustainable entrepreneurship is present and hence, it is likely that profit motivation is important.

3.5.3 Potential of QCA for advancing adaptation science and policy

To date, most adaptation research has examined a small number of cases in-depth to explore the reasons for success or failure and to draw lessons for other contexts (Ford et al., 2010; Rudel, 2008). However, moving towards a theory of EbA with more generalizable propositions, other types of research design are needed (Swart et al., 2014a), not least to identify 'the

conditions that are necessary or sufficient in explaining why adaptation is or is not successful' (p. 6). Despite some early attempts (e.g. Pahl-Wostl and Knieper, 2014), QCA is still not established in climate change adaptation research. Our study suggests that QCA could be useful to generate more general lessons from small to intermediate-N situations, supporting fundamental inquiry and concept development around adaptation (Swart et al., 2014a), and to study causal conditions in conjunction.

3.5.4 Limitations

There are three main limitations to the present study. The first one concerns the heterogeneity of innovations present in the cases. While our case selection criteria demarcated an 'area of homogeneity', allowing for meaningful comparison, the goods and services developed in our cases do differ among themselves, especially the goods (Appendix C). Selection and comparison of cases with similar innovations could potentially alter our findings. However, based on the available data, we do not observe a clear connection between the individual conditions or conjunctions and similar goods or services. Additional systematic research involving a larger number of cases could provide more insight in whether different type of innovations need different conditions in various stages of the process.

The second limitation is our intentional focus on cases from the UK and the Netherlands which might limit the generalizability of our results. While European countries with similar efforts in terms of climate change adaptation may have comparable results, additional comparative studies including other countries are necessary to test the generalizability of our findings.

A final limitation is that the four conditions we identified as important drivers for successful entrepreneurial opportunity exploitation are not exhaustive. The entrepreneurship literature indicates that other actor attributes and contextual components might also be important, for example, prior knowledge of customer demands, managerial capability and stakeholder support (Choi and Shepherd, 2004; Fuentes Fuentes et al., 2010). Social capital is specifically relevant in this respect (Davidsson and Honig, 2003; De Carolis and Saparito, 2006; Fuentes Fuentes et al., 2010). Although initially selected as a condition, we decided to exclude this latter factor from our data analysis since the level of available detail in our data was insufficient to adequately assign values. Future studies could include the deselected factors.

3.6 Conclusion

Against the background of increased attention to entrepreneurship in climate change adaptation and sustainable development more generally, this study asked what (combinations of) conditions enable successful entrepreneurial opportunity exploitation in EbA. Building on 18 EbA cases in the Netherlands and the UK we conducted the first fuzzy set Qualitative Comparative Analysis on EbA success factors. The analysis found that no single condition included in the study was necessary or sufficient, but that the presence of facilitating policies and regulations combined with either high capital availability or with strong financial motives was sufficient for successful opportunity exploitation in the included EbA cases. For these cases, altruistic motivations were neither a necessary nor a sufficient condition for success, nor part of a combination of necessary or sufficient conditions. This finding was in contrast to our expectations and may be explained by either peculiarities of the case selection or the focus on the opportunity exploitation phase. Our findings suggest that for entrepreneurial success of EbA initiatives financial motivations could be sufficient if matched by corresponding policies and regulations and capital availability, in particular derived from revenue streams. The results confirm the central role of facilitating policies and regulations for the implementation of entrepreneurial approaches in ecosystem-based adaptation, and likely climate change adaptation more broadly.

CHAPTER 4

Framing entrepreneurship in climate change adaptation: case study of an emerging governance arrangement in the Netherlands

Abstract

Planning and implementation of climate change adaptation requires new, integrated governance arrangements that often involve public and private actors. While entrepreneurship is widely considered an important part of such arrangements, little is known about its enabling conditions. Through an in-depth case study of an ecosystem-based adaptation project in the Netherlands, this paper analyses how the actors in a governance network shape six conditions for entrepreneurial success established in the entrepreneurship literature. Through a framing analysis, we found that all six conditions (prior career experience, altruistic motivations, financial motives, social networks, financial capital availability and policies and regulations) were the object of constant negotiations. Their salience varied during the project as a result of variegated framing practices. In the early stages, issue, identity and relationship frames were used to create a network of people with a range of relevant experience, connected by altruistic motivations. However, as the project progressed, distrust frames and different spatial and temporal scale frames created tensions between public and private actors. Accordingly, process frames, financial motivations and capital availability became increasingly salient, reflecting the need to consolidate rules, roles and responsibilities. The findings suggest that entrepreneurial approaches to climate change adaptation imply ongoing struggles over the conditions that enable entrepreneurial success. The paper thereby adds an important new dimension to the study of the governance of climate adaptation.

The manuscript corresponding to this chapter is currently under revision (required after review) as:
De Block, D., Feindt, P.H. and van Slobbe, E. Framing entrepreneurship in climate change adaptation: case study of an emerging governance arrangement in the Netherlands. *Ecology and Society*.

4.1 Introduction

Adaptation to climate change is a quickly emerging field of policy, practice and research. Concerns often surface around the resilience of infrastructures and land use patterns, with a focus on technical and material measures (Bulkeley and Castán Broto, 2013; Feindt and Netherwood, 2011). Recent scholarly discussions, however, increasingly focus on the potential of ecosystem services to enhance resilience to climate change (Bourne et al., 2016; Jones et al., 2012). Ecosystem-based Adaptation (EbA) uses biodiversity and ecosystem services to help people adapt to climate change and includes the conservation, restoration and even creation of ecosystems (Brink et al., 2016). Examples of EbA are flood regulation through sustainable water management and securing future food provision through conserving diverse agricultural landscapes (CBD, 2009).

The existing literature on EbA generally stresses the contribution of the approach to the supporting, provisioning, regulating and cultural services that ecosystems provide. Hence, the benefits of EbA beyond climate change adaptation are often emphasized, e.g. in terms of contributions to biodiversity, livelihoods and human health (Milman and Jagannathan, 2017). However, the processes through which EbA provides these benefits are often complex and insufficiently understood. This includes uncertainty about the effect of climate change on an ecosystem's ability to continue to provide its services into the future. Also, the time needed for the adaptation benefits to arise may not always coincide with the time when costs are felt (Jones et al., 2012). From a governance perspective, this raises the questions about suitable mechanisms to improve the likelihood of timely, effective and efficient ecosystem-based adaptation measures.

Previous research suggests that the governance of climate change adaptation requires new roles for both public and private actors so that responsibilities are shared and necessary resources mobilised (Dewulf et al., 2015; Huitema et al., 2016; Mazmanian et al., 2013). While experience with public and private actor involvement in climate change adaptation is growing (e.g. Mees et al., 2012; Swart et al., 2014b; Tompkins and Eakin, 2012), much remains to be learned about the dynamic cooperation between public and private actors when maintaining or creating new ecosystem services for adaptation. This is especially interesting given the often public good nature of ecosystem services, which makes it more difficult to attract private investors to EbA projects (Tompkins and Eakin, 2012).

In this context, the contribution of entrepreneurship to EbA becomes a topic of particular interest. While some scholars argue that entrepreneurship is a promising avenue to contribute to climate change adaptation and biodiversity conservation (e.g. Dean and McMullen, 2007; Lambooy and Levashova, 2011), the conditions which entrepreneurs need to contribute to EbA remain unclear. Even less is known about the processes through which the conditions for successful entrepreneurship in EbA (which we understand as the creation of new ecosystem services, markets for these services and actor constellations that maintain ecosystems and their services) are developed, negotiated and shaped. The overall aim of our research is therefore to better understand how a set of conditions proven to be generally conducive for entrepreneurial success are shaped over time through the interactions of public and private actors in adaptation projects. Following a case study approach (Yin, 2003), we use frame analysis (Entman, 1993) to understand the evolving interactions. Our main question in this paper is: How do public and private actors negotiate the conditions for entrepreneurship during an ecosystem-based adaptation project?

First, we introduce the conditions for successful entrepreneurship in EbA and explain the distinction between issue, identity, relationship and process framing. We then describe the data collection and analysis used in the selected case, the inland shore Wieringermeer project in the Netherlands. Subsequently, the case is presented in more detail, followed by the results of our framing analysis, which explains the dynamic negotiation of the conditions for entrepreneurial success during four distinct stages of the EbA project. The discussion section addresses the interactive co-construction of conditions for entrepreneurial success, the tensions that arise during such processes, in particular if diverging temporal and spatial scale frames and distrust frames emerge, and the different modes of operation of public and private actors which can be related to the public good nature and the perceived long-term benefits of EbA. We conclude with suggestions for researchers, policy makers and project participants involved in climate change adaptation.

4.2 Conceptual framework

4.2.1 Conditions for entrepreneurship in ecosystem-based adaptation

A promising option for developing ecosystem-based adaptation is entrepreneurship that addresses both societal and environmental challenges (Schaltegger and Wagner, 2011). Entrepreneurship can be defined focusing on entrepreneurial opportunities, i.e. 'those situations in which new goods, services, raw materials, and organizing methods can be introduced and sold at greater than their cost of production' (Shane and Venkataraman, 2000: p. 220). In the context of this research, we define EbA-entrepreneurship as the creation of new ecosystem services, markets for these services and actor constellations that maintain ecosystems and their services. An example of the creation of new ecosystem services is the Building with Nature programme in the Netherlands, which introduces innovative coastal protection measures to control flooding (van Slobbe et al., 2013). New markets for ecosystem services can be stimulated by novel financing mechanisms such as payments for ecosystems services (Wertz-Kanounnikoff et al., 2011), and new actor constellations that result from strategic alliances of parties that formerly did not cooperate (Wamsler, 2015).

Business and management research (e.g. Fuentes Fuentes et al., 2010; Shane, 2003) has identified various conditions for successful entrepreneurship more generally. We use six of these conditions as sensitizing concepts which, instead of providing prescriptions what to see, merely suggest directions where to look (Blumer, 1954). We regard these conditions not as static and given, but as dynamic and changeable and constantly negotiated and co-constructed through interaction (Dewulf et al., 2009). This leads us to the following conceptual understanding of the six conditions, of which the first three are attributes of the entrepreneur and the last three are conditions in the entrepreneur's environment. We operationalize the conditions in the results section.

1) *Prior career experience* stems from individual involvement in setting up a business, in marketing, management, product development and team formation as well as from vicarious experience gleaned from others such as family, friends and colleagues (Shane, 2003). Entrepreneurs' motivations can be divided into two types: altruistic and financial. 2) *Altruistic motivation* refers to 'the individual motivation to improve the welfare of another person' (Penner et al., 2005: p. 368) or, especially relevant for ecosystem-based adaptation, empathy

for animals and their related environmental conditions (Patzelt and Shepherd, 2011). 3) *Financial motives* refer to the possibility to increase an actor's personal or company's economic gains (Dean and McMullen, 2007). 4) *Social networks* are useful to garner resources (e.g. knowledge, information, finances) and to form alliances for joint production of goods and services (Fuentes Fuentes et al., 2010). 5) *Financial capital availability* in the context of ecosystem-based adaptation stems from subsidies and grants (Halme and Korpela, 2014), actor's own financial resources (Shane, 2003), or revenues obtained from products or services (Osterwalder et al., 2010). 6) *Policies and regulations* either facilitate or restrain the introduction of new goods, services and markets through varying degrees and types of interventions (Dimov, 2007).

4.2.2 Governance arrangements

The conditions for successful entrepreneurship are shaped by governance arrangements, i.e. patterns of interaction constituted through formal and informal rules and roles, for example the allocation of insiders and outsiders and the distribution of entitlements and obligations (Andersson and Ostrom, 2008). For entrepreneurial EbA projects, these include in particular environmental and planning regulations as the context for arrangements between entrepreneurs and public actors, which might involve financial support, planning permits or particular project requirements. Such arrangements arise out of processes of negotiation, struggle and compromise. The characteristics of specific governance arrangements may encourage or discourage actors with particular motivations. In this sense they connect societal goals and values, here in particular the provision of ecosystem services, with individual motives and worldviews, in our case altruistic and financial motivations and career experience.

In EbA projects, often neither the problems nor the relevant actor constellations nor the appropriate processes are standardized (Adger et al., 2013; Eisenack and Stecker, 2012). This implies that the contextual conditions for entrepreneurial success and the relevant motivations and experiences are likely to be constantly negotiated as well. While this is a plausible expectation, there is little research how such processes are unfolding during adaptation projects. In the next section, we explain how we deploy a framing approach to analyse the ongoing negotiations in an ecosystem-based adaptation project and how they involve the conditions for entrepreneurial success.

4.2.3 Framing

Framing denotes the process through which people construct and represent their interpretations of the world and communicate about it (Gray, 2002). To frame is to 'select some aspects of a perceived reality and make them more salient in a communicating context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described' (Entman, 1993: p. 52). Consequently, frames simultaneously direct attention towards some aspects of a situation and away from others. While framing approaches have been used to better understand climate change adaptation policies and practices (e.g. Dewulf, 2013; Massey et al., 2015; Vink et al., 2013), no study has focused on the framing of the conditions for successful entrepreneurship in adaptation.

Frames are interactional alignments or co-constructions of shared social spaces (Dewulf et al., 2009). From a framing perspective the conditions for entrepreneurship and their relative importance are the product of a co-construction process that is embedded *uno acto* in the interactions between players. Participants confirm, undermine, adjust, attack or supplement each other's frames (van Lieshout, 2014). Such framing processes are multidimensional. Participants negotiate issues, their identities, relationships and appropriate processes through framing (cf. Dewulf et al. (2009):

In issue framing, people use frames to establish the existence and characteristics of a problem (Gray, 2002). Issue frames define and limit problem definitions, including their causes and suitable solutions (Lems et al., 2013). An important element of issue framing in environmental governance is scale framing (van Lieshout et al., 2011). Following Cash et al. (2006), we define scales as the spatial (e.g. region), temporal (e.g. annual) and jurisdictional dimensions (e.g. municipal level) that are used to describe a phenomenon.

Identity and relationship frames define identities and relationships resulting from and as part of social interactions. Through interactions, individuals claim an identity which is either accepted or contested by others (Dewulf et al., 2009). Identities of social groups are often constructed through comparison with and often in opposition to the identity of other groups. During such framing processes, people typically externalize responsibility for negative events to others with contrasting identities (Gray, 2002). A specific type of relational frames are trust frames which express the level of trustworthiness in relationships (de Vries et al., 2014).

Process frames refer to actor's interpretations of the actual or desirable interaction. Process framing is dynamic since participants unavoidably construct the meaning of their ongoing interactions through cueing and reacting to each other. Hence, process frames typically shift over the course of a conversation. For example, if one party perceives an EbA project as going too slow and the other as too fast, then the two parties must negotiate, either consciously or unconsciously, the nature of their process as framed through their continuing interactions (Dewulf et al., 2009).

4.3 Methods

4.3.1 Case selection

On the basis of our research aim, we derived five criteria for case selection: 1) entrepreneurship is at the core of the case; 2) both public and private actors are involved; 3) negotiation processes occur within the project; 4) the project is at least in its implementation phase to allow study of developments over time and 5) access to actors, documents and interactions is possible. The inland shore Wieringermeer project, where public authorities together with entrepreneurs collaborate to develop climate adaptive water management in combination with new economic functions, met all the criteria and was therefore considered well-suited for an in-depth study. The low-lying Wieringermeer polder is vulnerable to floods and droughts, while the socio-economic structure of the region is highly dependent on agriculture. With fresh water availability and food production predictably affected by climate change more widely, we expect this case to provide lessons to other regions where similar new governance arrangements in climate change adaptation are negotiated.

4.3.2 Data collection

We used a mixed methods approach for collecting data and analysing the various frames and conditions throughout the project. Access to the field was secured when the main researcher was invited by a project member to join the core project team in mid-2014. She was assigned the role of a reflective observer, providing detailed minutes of the project meetings as a means to administer and monitor the process and providing regular feedback. This offered a unique

opportunity for participant observation from the start of the project. Data was collected until June 2016. While the project did not end at that point in time, limited time and financial resources made further involvement impossible. The available data allow us to analyse the negotiation of conditions over an extended period of time and the researchers stayed informed about the latest developments, providing important contextual knowledge.
The following data were included in the analysis:

- Project documents and communications, including (interim) project reports, research plans, minutes and email communication from October 2014 till June 2016.
- Participant observation reports: Throughout the project, the main researcher used a reflective diary with preliminary observations and interpretations. These covered 17 meetings of the core project team, five networking events and three meetings for informing the general public.
- Semi-structured interviews with five key project participants representing the main organizations involved (i.e. national and regional government (2), companies (2) and consultancies (1).

4.3.3 Data analysis

First, we identified issue, identity and relationships, and process frames and the articulation of conditions for successful entrepreneurship in formal meeting minutes, supported by the coding program ATLAS.ti. The following six questions guided this analysis: 1) Framing object: What is being framed? 2) Framing mode: In which way(s) is this being framed? 3) What issues, identities, relationships and process frames are articulated? 4) Who are the frame promotors? 5) (Dis)agreement: Is the frame accepted or contested, and how? 6) Which conditions for entrepreneurial success are recognized in the frame? The analysis identified four dominant events which suggested a periodization of the project in four distinct stages. We then assessed the dominant frames and conditions during each stage. In a second step, we triangulated these findings with our participant observations and email communication. In a third step, we used the semi-structured interviews to extract interview quotes to make the identified frames explicit, cross-check for any additional frames and reflect on the negotiated conditions for entrepreneurial success in each stage.

4.4 Case background

The inland shore Wieringermeer is located along lake IJssel in the province of North-Holland, the Netherlands (Figure 4.1). Lake IJssel is one of the largest freshwater lakes in Europe. Different water levels, which are fixed both in summer and winter, are maintained for flood control and to cater to riparian land and water users like agriculture, urban areas and recreation. The Wieringermeer polder, in which the inland shore is located, was reclaimed from the lake at the end of the 1920's and serves mainly as agricultural area.

In 2007, the Dutch Cabinet appointed the 'Delta Committee' with the task to formulate recommendations for Dutch water management under climate change (Veerman, 2008). Regarding lake IJssel, the Committee recommended to manage the water levels more flexibly to anticipate the effects of climate change and to create a larger freshwater storage in summer. This would have significant consequences for lake shore designs (Deltacommissie, 2014). Consequently, local water managers started to develop strategies to adapt riparian land and water uses, including the design of lake shores. Representatives of the Ministry of Infrastructure and the Environment and a knowledge institute proposed the creation of novel ecosystems named 'inland shores', i.e. areas behind the flood defences where water can be temporarily stored. Such temporary lake water retention would reduce pressure on lake dikes in other locations when water levels are extremely high. These storage areas could combine water management functions with for instance nature conservation or space for innovative aquaculture. In 2012, the Koopmanspolder was designated as a 16 ha experimental 'inland shore' to assess the effects of changing water levels on ecology and fisheries. The results were positively evaluated and consequently possibilities were explored to create a second, larger scale inland shore in the Wieringermeer.

Fig. 4.1. Map of the Netherlands with encircled the Wieringermeer

The next section describes the development process of the project that followed. Entrepreneurship was expected to play an important role in the process, partly to contribute to the creation of novel combinations of ecosystem services (i.e. the physical design of a large-

scale inland shore) and partly to create new actor constellations involving public and private actors.

4.5 Results

This section presents an analysis of the ongoing co-construction of conditions for entrepreneurship during the case. The analysis is based on the identification of issue, identity, relationship and process frames. During the period of observation, June 2014 till June 2016, the analysis found four stages characterised by the occurrence of significantly different frames. The stages are separated by events which were seen as momentous by participants. Below we describe the stages and related framing activities, with particular attention to the conditions for entrepreneurial success which dominated in discussions during each stage.

4.5.1 Stage I: Issue framing to determine the boundaries of the project

The success of the Koopmanspolder pilot project (see section 'case background') inspired one of its initiators, a civil servant in the Ministry of Infrastructure and the Environment, together with two entrepreneurs to instigate a larger inland shore project in the Wieringermeer polder. A local landowner offered to lease an entire farm of 20 ha to start a project in June 2014. A project team was assembled, initially with people previously involved in the Koopmanspolder project but complementing this 'core' team with consultants and civil servants from the municipality and the province of Noord-Holland. During stage I, which lasted seven months, the actors negotiated the purpose and scope of the project, using the following – predominantly issue – frames.

Framing in stage I

During the first months, the rationale behind the project was expressed in terms of ecological pressure and economic opportunity:

> *The future of the water in the Netherlands: rising sea levels, saltier, dryer and wetter (...). The trends towards 2100 are less freshwater availability and food problems in the world and Europe. In the Netherlands we actually have more than enough freshwater and we are good in agri, so we have to start innovating on better use of freshwater and*

> *other types of agri (...) to compete with China, the USA and other parties* [Civil servant, interview statement based on presentation slides June 26, 2014]

In the quote, the project initiator framed the need for an inland shore project as an economic opportunity that could result from adaptation to climate change. The strong Dutch position in agriculture and water management and the need to innovate in a competitive global economy were linked to articulate a comprehensive frame: it includes an issue frame (long term adaptation need) and an identity frame (the Netherlands as competitor of other global economic powers). It served initially as a motivator to involve the required actors. The inland shore was presented as the local implementation of an essentially national policy that followed for instance from the national Delta Program. A communication expert explained: "The idea is to take the story around the Delta Program as a basis and zoom in from this large perspective." [based on minutes November 5, 2014].

Initially, the core team envisaged two project goals: 1) to create added value for the economy, ecology and/ or liveability using the freshwater from Lake IJssel and 2) to contribute to water safety (Ministerie van Infrastructuur en Milieu, 2015). However, the ecological and nature development aspects were soon questioned by the province and municipality. Their concerns were expressed by landscape architects involved:

> *Nature in this polder is as 'strange' as buildings, since the polder consists of agricultural land. Also when you focus on fish there is a high chance that the inhabitants and politicians denote it as 'nature'. Fish and water are seen as withdrawal of fertile agricultural land* [Landscape architects, based on minutes December 3, 2014]

Consequently, the core team agreed to place 'ecology' or 'nature' more in the background when communicating about the project. The second objective was 'multi-layer safety', a specific water management policy. Water managers argued that inland shores would enhance water safety because of their capacity to store water during heavy rains, a reasoning that formed the main justification to involve the Ministry of Infrastructure and the Environment. However, the actual contribution to water safety was soon questioned within the core team with the effect that the contribution of inland shores to water safety was reframed:

> *An inland shore at this specific location does not contribute greatly to water safety (...), but the concept can be tested at this location after which it can be applied in other parts of the Netherlands* [Landscape architects, based on minutes December 3, 2014]

Differences in issue frames were linked to divergent understandings of the project scale. The Koopmanspolder initiator originally presented a grand scheme of approx. 25 km coastline. This motivated the entrepreneurs whose ambition was to develop large-scale new business: "Our final goal is to create 1000-2000 ha with a number of cultivations." [Entrepreneur, interview June 14, 2016]. However, this large scale development was contested by the province and the municipality due to concerns about potential local opposition. Previous ambitious development projects in the area had failed and local inhabitants were opposed to more large-scale changes in land use. From December 2014 onwards, the project was therefore explicitly framed as a local-scale experiment, with a potential future expansion to regional scale. The entrepreneurs disagreed with this scale re-framing and relations between them and the core team became tense. However, both groups among themselves framed the relationships within their own group positively: "We know what we can expect from each other (...) and agreed that together we would bring this to a good end." [Entrepreneur, interview June 14, 2016]. And: "There are different interests (...) but we said: we are going for a higher goal (...). It is a small team of people that can trust each other blindly." [Civil servant, interview June 26, 2014].

Conditions of entrepreneurial success in stage I

The defining and re-defining of the project's objectives and scale reflect the attempts to forge a social network of project initiators and supporters and to make the first steps in the creation of a governance arrangement. All actors were attracted to the idea to innovate and offered relevant career experience. The network roughly consisted of three groups. The 'water managers' brought the experience with the Koopmanspolder pilot and were associated with the Ministry, the water board and a knowledge institute. Their view on the project was informed by the need to adapt national water systems to climate change. The 'entrepreneurs' were newcomers to Wieringermeer, but saw opportunities in ecosystem-based adaptation. They called for large-scale developments to create financially viable business opportunities. The local authorities (municipality and province) wanted socio-economic development for their

territory but opposed large-scale interventions in the area. This constellation of interests meant that in practice, the economic motives behind the project were only actively addressed by the entrepreneurs while the altruistic motivations (i.e. ecological and nature development aspects) were deliberately placed in the background.

4.5.2 Stage II: Expansion of the social network and increased attention to financial issues

The period from January 2015 till April 2015 was characterized by both growing tensions and increasing cooperation between the core team and some of the entrepreneurs. Four entrepreneurial initiatives, focusing on mitten crabs, salt tolerant crops, floating agriculture and recreational fishing, were now involved in the project. A funding proposal was submitted to the European Fund for Regional Development in April 2015. The proposal outlined the collaborative plans for each cultivation, including upscaling.

Framing in stage II

In stage II, the upscaling discussion continued and two entrepreneurs, those exporting mitten crabs and producing salt tolerant crops, decided to contract a formal representative with a network in the local government. They also initiated the legal establishment of a foundation, called AKWA (the Dutch abbreviation for 'inland shore cultivation in and on water'), in January 2015. The main task of the entrepreneurs' representative was to establish a covenant between the entrepreneurs and the other parties. The other actors understood the hiring of the representative as an articulation of distrust. The core team discussed the trust issue and decided that an agreement would clarify roles and responsibilities of all project participants. Identity and relationship frames were explicitly articulated: "There is a 'we' versus 'them' feeling, but we agree that it should become an 'us' feeling, so together with the entrepreneurs." [Consultants and civil servant, based on observations meeting February 11, 2015]. Despite these tensions, both the core team and the entrepreneurs continued to frame their relationship as mutual interdependence:

> *As an entrepreneur I will never be able to realize such an end design. I am not able to construct dikes, to create multilayer safety, that is not my business. So if we can profit*

> *from these developments, then of course that is good for us.* [Entrepreneur, interview June 13, 2016]

The entrepreneurs explicitly saw the initiation of AKWA as an attempt at relationship framing: "There were so many contact persons and so many meetings at the farm. We said: we have to do something to form a block and establish a clear structure." [Entrepreneur, interview June 13, 2016]. Members of the core team expressed their mixed feelings:

> *The establishment of AKWA took a lot of time and energy (...). This line went straight through our own structure (...). Ultimately, things became sharper, but it also made the process very difficult.* [Civil servant, interview May 14, 2016]

The core team thus understood the establishment of AKWA explicitly as an attempt at process framing. While the entrepreneurs framed this move as clarifying and speeding up the process, the core team did not fully acknowledge the necessity of a separate foundation.
Considerable time and effort were spent in stage II to acquire additional capital from the European Fund for Regional Development (EFRO). The proposal writing included a collaborative process frame, bringing the core team and the entrepreneurs closer together again. A consultant coordinated and facilitated the process:

> *If we had a question, then he answered immediately (...). He was a bit the cement between the stones, he kneaded it a little (...). You trust that person, he is helping you again and again. Such a person is very important.* [Entrepreneur, interview June 13, 2016]

Hence trust was re-emphasised in relationship framing. Also the core team members acknowledged the crucial role of the consultant in the process. Writing the proposal also reframed the process: "The modus within the project changed, it became more focussed." [Civil servant, based on minutes March 18, 2015].

Conditions of entrepreneurial success in stage II

Financial motives were expressed through the request of the entrepreneurs to establish a covenant, including statements about intellectual property, governmental commitment and future upscaling. The social network condition was re-negotiated through the addition of the AKWA foundation. The associated reframing of the process also affected the relationships and hence the network condition. The efforts to obtain an EFRO subsidy explicitly addressed the capital availability condition.

4.5.3 Stage III: Prevailing process frames based on career experience and financial motives

The plans as defined in the EFRO proposal formed the basis for experiments with mitten crabs production and floating agriculture in the spring and summer of 2015.

Framing in stage III

The floating agriculture experiments using lake IJssel freshwater failed, obviously because the water lacked nutrients. However, the experiment with the mitten crabs turned out successful: "From the 1st of May until we measured the crabs, we actually did quite well. (...). I was very proud of the good results, even though everyone said that it was impossible." [Entrepreneur, interview June 13, 2016]. The entrepreneur presented a strong identity and relationship frame of himself as someone who pushed through when others were in doubt. Nevertheless, members of the core team were also pleased with the results: "The economic argument for the inland shores got an enormous boost because the crabs moulted." [Province representative, based on interview May 20, 2016].

A commonly held process frame was that the successful experiment contributed to maintaining the project's momentum. The entrepreneur immediately revived the discussion about upscaling. However, the governmental parties remained reluctant to speed up the process:

> *The tension between upscaling or not is a very important threshold where you notice that the government, and also the province, is not really used yet to work together in a*

> *project with entrepreneurs. We are saying: first come with results, and then we'll discuss it further.* [Province representative, based on interview May 20, 2016]

Submitting the EFRO proposal together improved the relationship between entrepreneurs and the core team. However, the improved relationship did not endure as the AKWA foundation and the role of the entrepreneurs' representative continued to create tensions: "With AKWA, an additional consultation platform emerges that can lead to noise in the communication. I do not think it is good for the relations within the project" [Representative knowledge institute, based on minutes May 27, 2015]. And a representative of the water board voiced concern: "Was AKWA started from a strategic point of view? Or is there a lack of trust towards commitment of the governmental parties?" [based on minutes May 27, 2015]. The establishment of AKWA was interpreted as an attempt to frame relationships in terms of distrust between the entrepreneurs and the local authorities. The entrepreneurs, however, framed AKWA as a vehicle to keep the covenant on the agenda.

During this stage, the core team regularly convened after each meeting for a short reflection on the latest developments. The relationship with the entrepreneurs and the process were a recurring concern:

> *Certain things have indeed gone too slow, especially the governance structure and arrangement of finances, and therefore we are busy putting out fires. Sometimes things indeed go too quick, but from our side things also go too slow.* [Consultant, based on minutes September 2, 2015]

Conditions of entrepreneurial success in stage III

The entrepreneurs' continuing call for upscaling and governmental commitment was candidly based on reference to their earlier business experience (career experience) and their wish to develop a profitable business (financial motives), which required economies of scale. The controversy about the scale of operation caused continuous tensions, making the social network condition a continuous object of negotiation. Altruistic motivations, enabling policies and regulations, and capital availability (other than waiting for the results of the EFRO subsidy) were not explicitly addressed during this stage.

4.5.4 Stage IV: Different scale and process frames following European regulation

Stage IV started when the EFRO subsidy was granted in February 2016. The success reignited the commitment and enthusiasm from the various parties involved. However, soon afterwards the project participants learned that the European Union had included the mitten crab on its draft list of alien invasive species, which would disallow their propagation. This threat to the viability of the mitten crab experiment led to fundamental uncertainty about the continuation of the project and to practically complete cessation of all activities on the farm.

Framing in stage IV

The inclusion of the mitten crab on the list of invasive alien species implied that catching them was still allowed, but farming prohibited. Both the entrepreneurs, their representative and the public authorities were caught by surprise and started to lobby the Ministry of Economic Affairs and the European Union. The momentum gained after the successful mitten crab experiment and the subsidy grant seemed to vanish due to uncertainty about the publication date of the list and the subsequent implications: "You see that advantage now converting into a disadvantage, it's floating away because the acceleration is gone. I wouldn't be surprised if we would lose a whole year now." [Province representative, interview May 20, 2016].

Not all project participants framed the process as limp. The entrepreneurs believed that there were either still possibilities to grow the mitten crabs in a controlled environment or that they should continue the planned activities and address the consequences later:

> *Everyone has a mind-set that says: we want to have the permits first! (...) At the moment when the crabs are there and you start farming, that process will come. Then you go to the European Court and you win (...). You just have to execute. And the regulation adapts itself.* [Entrepreneur, interview June 14, 2016]

Another possibility was that the EFRO budget for growing the mitten crabs would be withdrawn. Although the participants held different process frames, these were hardly discussed. Instead, lobbying for removal of the crabs from the definitive list was given priority by all parties.

Parallel to the lobbying activities, upscaling discussions between the entrepreneurs and governmental parties continued. Since this issue had been on the agenda from the beginning of the project, reaching a decision became critical for the entrepreneurs. The province questioned the necessity for an upscaling decision because of the uncertainty about the mitten crab production: "You see that a number of parties (...) think: yes, talking about upscaling is very nice, but is it still realistic? You see (...) retreating movements." [Province representative, interview May 20, 2016]. The hesitation of the province was also informed by the realization that upscaling the farming activities would imply major challenges to landscape design:

> *If you do this, then you cannot just put 400 ha of ponds next to each other, but you have to start talking about integration and reaching a number of other goals. Then you also have to look: how does it fit the landscape, does it have a water storage function? And can you connect it with recreation?* [Province representative, interview May 20, 2016]

The differences in spatial scale frames and process frames were not bridged. Although both parties understood each other's position, the dispute reflected underlying differences in modes of operation which were also expressed in diverging process frames: While AKWA called their coveted agreement with the governmental parties a covenant, the province used the term 'timetable':

> *A timetable means that we write down which steps need to be taken to come to upscaling and what is needed for this (...). At this very moment none of the parties would sign a covenant which says: if the experiments works, we will scale up. That is still a step too far. The entrepreneurs keep calling it a covenant, we call it a timetable (...). A covenant sounds like you are having an obligation and that is not realistic at this moment.* [Province representative, interview May 20, 2016]

When reflecting on the process, project participants were fully aware that the process frames diverged with regard to speed and modes of operation, both between and within the different parties involved:

> *You see that different parties – governmental parties, entrepreneurs and knowledge institutes – have different speeds and different ambitions. That can sometimes very much accelerate or delay the process (...). And: the same bosses that told me: 'great, an innovation project!' can be the people that say: 'it should all be accountant proof'. Those are two different magnitudes.* [Civil servant, interview May 14, 2016]

From the beginning of 2016 the governance structure of the project changed. Partially in response to requirements of the EFRO subsidy, roles and responsibilities of the different project partners became more defined and legally binding:

> *You really see that we reach a new phase. The project becomes mature. Roles are distributed differently, you get specializations and the pioneer phase is over (...). It becomes more professional (...) with all the bureaucracy and efficiency that belongs to it (...). Now we go from a pioneering role into an evaluation role.* [Province representative, interview May 20, 2016]

Conditions of entrepreneurial success in stage IV

The dynamics in this stage show a clash of different conditions of entrepreneurial success which are reflected in the frame contests discussed above. First, impending EU regulations seemed to disallow further extension of the mitten crab production, which impeded the progress of the entire project. Second, the local authorities were unwilling to unconditionally support upscaling of the production activities as this would involve major policy and political investments and because of the uncertainties about the EU regulation. Third, the entrepreneurs did not want to continue at the small, unprofitable experimental scale and emphasized the importance of a covenant. Joint lobbying at the national and European level increased the cooperation within the social network. The financial motives were not thematised but implicit in the lobbying against the classification of the mitted crab as an invasive alien species. Neither capital availability nor altruistic motives were prominently addressed, the former because the EFRO subsidy was acquired, the latter because instrumental considerations of project viability dominated the agenda.

4.6 Discussion

First, our results show that the six selected conditions for entrepreneurial success are a useful sensitizing concept to understand the interactive construction and emerging governance arrangement in EbA projects. Each condition was the object of framing attempts at some stage of the project, albeit with varying intensity over time. Consecutive stages of the project also differed markedly in the conditions that players attempted to shape through framing. Struggles about financial motives and social network formation continued throughout all four stages of the project, while discussions on capital availability, career experience, altruistic motives and policies and regulations each emerged in one stage only. Capital availability was guaranteed by obtaining a subsidy and arguments on prior career experience were used in the upscaling discussion. Altruistic motivations were deliberately placed in the background to take into account the sensitivities related to nature development in the area. The discussion on policies and regulations only started in the last stage of our research, but had severe consequences as it led to a cessation of almost all project activities. This finding demonstrates that the conditions for entrepreneurial success are not adequately understood if treated as static or externally given; they are evidently co-produced through the interaction between the different players, and they are often the object of negotiation, agreement or contestation.

Second, our findings confirm the presence of ongoing and probably unavoidable tensions between public and private actors. These were often expressed as contested spatial and temporal scale frames and as distrust frames (cf. Swart et al., 2014b). The different scale frames were related to different modes of operation of the three actor groups involved. First, civil servants from the ministry and researchers focussed on Lake IJssel and related water retention for safety and freshwater provision for the next 100 years. Second, the province and municipality officials intended to allow the activities on the 20 ha farm as a protected experimental niche for a period of ten years but objected to large-scale transformation of agricultural land. Third, the entrepreneurs saw the project as a first step towards a larger-scale business (i.e. 1000-2000 ha) within a limited amount of time (i.e. few years). The resultant frame contestation (Dewulf, 2013) can be related to two general characteristics of EbA. First, since EbA is supposed to provide public goods and services, it can be difficult to convince private actors to invest (cf. Tompkins and Eakin, 2012). Indeed, discussions in our case could often be traced back to financial motives which require either marketable products or public support, and consequently

many efforts went into acquiring public funding. Second, since EbA involves solutions with long-term effects (unlike the more short-term benefits expected from 'hard' adaptation measures), a costs versus benefits time-scale mismatch looms as the time needed for the benefits to arise may not always coincide with the time when costs are felt (Jones et al., 2012). EbA might therefore need longer-term definitions of returns to investment (Ojea 2015).

Third, our results suggest that the division of labour between public and private parties departs from the liberal model that underlies much of the economic literature on entrepreneurship. The assumption that public actors merely establish the enabling conditions for innovations, e.g. in terms of facilitating policies and regulations, and that private actors develop the actual innovation, does not hold for our case. Here the novel idea to create an inland shore was introduced by a civil servant who was also strongly involved in the elaboration and actual implementation of the project. Simultaneously, the entrepreneurs were lobbying and negotiating at different policy levels to influence the regulations that would affect their plans.

Finally, our findings demonstrate how framing processes connect the different motivations of variegated groups of actors whose collaboration is needed for ecosystem-based adaptation projects to succeed. In our case, water managers, civil servants affiliated with various local authorities, and entrepreneurs had to pool their different yet complementary motives, career experiences and social networks. Their different modes of operation had to be bridged through suitable issue, identity and relationship frames. This might explain the decreased emphasis on altruistic motives and a shared national identity frame during the early stages of the project. At later stages, however, diverging interests – e.g. regarding the scale of the project – had to be reconciled through precise and reliable arrangements, hence the increasing salience of process frames, financial motivations and capital availability. The emerging governance arrangement remained fluid during the two-year period of observation, an unsettled state that was reinforced by contested process frames.

4.7 Conclusion

In this paper, we aimed to understand how a set of conditions proven to be generally conducive for entrepreneurial success in climate change adaptation are shaped over time through the interactions of public and private actors. Taking a case study approach, we analysed the issue, identity, relationship and process frames that emerged during an EbA project in the Netherlands

as a lens to understand the sometimes cooperative, sometimes contested construction of the conditions for entrepreneurial success. Our findings suggest future research on the factors for successful climate change adaptation should incorporate a dynamic perspective, allowing to address the essential element of co-construction of the various enabling conditions for EbA-entrepreneurship. This would in turn permit a more detailed understanding of the processes through which decision makers at various policy levels can influence the conditions for entrepreneurial success. Our results further show the importance of the temporal dimension when analysing EbA initiatives. Various layers of the governance system need to be conducive to entrepreneurial activity at the same time, or in the right sequence. Aligning the temporal scale frames of public and private actors to deal with the public-good nature of EbA is hereby a challenge. The finding that the importance of process frames increases as EbA initiatives progress also has clear practical implications. Projects will be well advised to deliberately take the time to reflect on the diverging and converging framing attempts of their network players. For policy making, this implies that providing space for deliberative and creative processes to align different frames could be an essential part of governance arrangements that increase the likelihood that adaptation projects succeed and that steps are taken to decrease the vulnerability of regions to climate change.

CHAPTER 5

Addressing the challenges related to transforming qualitative into quantitative data in qualitative comparative analysis

Abstract

The use of qualitative data has so far received relatively little attention in methodological discussions on Qualitative Comparative Analysis (QCA). This paper addresses this lacuna by discussing the challenges researchers face when transforming qualitative into quantitative data in QCA. By reviewing 29 empirical studies using qualitative data for QCA, we explore common practices related to data calibration, presentation and sensitivity testing. Based on these three issues, we provide considerations when using qualitative data for QCA, which are relevant both for QCA-scholars working with qualitative data and the wider mixed methods research community involved in quantitizing.

This chapter is accepted for publication as:

De Block, D. and Vis, B. (2018). Addressing the challenges related to transforming qualitative into quantitative data in qualitative comparative analysis. *Journal of Mixed Methods Research.* An earlier version of this chapter is published as working paper in the COMPASSS WP Series, 2017-88.

Qualitative Comparative Analysis (QCA) is an approach that combines quantitative and qualitative research (Ragin, 1987; Ragin, 2006; Rihoux and Ragin, 2009). Its "hybrid" nature (Cragun et al., 2016) adheres to the definition of mixed methods research (MMR) by Johnson et al. (2007: p. 129) as 'an intellectual and practical synthesis based on qualitative and quantitative research (…)'. QCA is a set-theoretical approach that identifies the (minimally) necessary and (minimally) sufficient (combinations of) conditions for an outcome. It does so by using Boolean and/or fuzzy-set algebra to treat cases as configurations of causal conditions and an outcome and by analyzing whether a given (combination of) condition(s) stand(s) in a subset or superset relationship to the outcome (Schneider and Wagemann, 2012). To this end, a study's so-called raw data – either quantitative, qualitative or both – need to be transformed; a process called calibration in QCA (Ragin, 2008). Calibration of qualitative data resembles what in the mixed methods literature is known as *quantitizing*, that is 'the numerical translation, transformation, or conversion of qualitative data'; a process that 'has become a staple of mixed methods research' (Sandelowski et al., 2009: p. 208).

Thirty years after Ragin (1987) introduced the approach in the social sciences, QCA is becoming a "mainstream" approach in several fields, such as sociology and political science (Rihoux et al., 2013); in other (sub-)fields, such as health services research (Summers Holtrop et al., 2016), it remains relatively novel, however. As an approach, QCA is still in development. Several of the current methodological discussions relate to MMR, such as the discussion regarding the (in)compatibility of regression analysis and QCA (Fiss et al., 2013; Thiem et al., 2016a; Vis, 2012). This paper's three objectives focus on a series of related issues that so far have received relatively little attention in methodological discussions about QCA, and that may be particularly relevant for readers of *JMMR*. Our *first objective* is to explore how researchers currently use qualitative data in QCA. Hereby we focus on three key issues: (a) data calibration; (b) data presentation, and (c) sensitivity tests. To achieve this first objective, we review 29 QCA studies that use various types of qualitative data. Appendix G details the selection procedure of the included studies. The *second objective* is to contribute to the standards of good practice in QCA (Schneider and Wagemann, 2010). Therefore, we critically examine how the 29 articles deal with the three key issues (i.e. calibration, sensitivity and presentation) and provide considerations for researchers using qualitative data in QCA. Our *third objective* is to place our findings in the context of MMR. We focus particularly on the discussion about quantitizing,

showing that our considerations provide relevant lessons for the wider mixed-methods research community.

5.1 How to calibrate qualitative data in QCA?

An important issue in QCA is the calibration of the raw data. When using crisp-set QCA, all cases are either "in" (1) or "out" (0) of the sets. In fuzzy-set QCA (fsQCA), the raw data are calibrated from "fully in" (1) and "fully out" (0) of the sets, with additional gradations of set-membership (e.g., "almost fully in" [.83] or "more out than in" [.40]). The 1 and the 0 are two of the so-called qualitative thresholds; the crossover point at 0.5 is the third.

The literature on calibration is mainly concentrated on quantitative data. For example, Ragin (2008: , chapter 5) focuses exclusively on this issue, while providing no practical advice for researchers on how to calibrate qualitative data. The same holds for Schneider and Wagemann (2012: p. 32-41).

The only two studies offering explicit methodological advice on how to calibrate qualitative data in QCA are Basurto and Speer (2012) and Tóth et al. (2017) (see de Block and Vis (2017) for a more extensive discussion). Basurto and Speer (2012) propose a stepwise procedure to calibrate qualitative (interview) data into qualitative classifications with associated fuzzy-set values. Tóth et al. (2017) introduce the so-called Generic Membership Evaluation Template (GMET) to assign membership scores to conditions based on qualitative data. Yet although Basurto and Speer (2012) and Tóth et al. (2017) provide valuable guidelines on how to calibrate qualitative data, some important questions remain. It remains uncertain, for example, how qualitative data can properly inform and justify the determination of the qualitative thresholds – especially regarding the crossover point. What is more, while filling in the GMET is rather straightforward, decisions about how to attribute the final fuzzy set score remain somewhat subjective.

Both Basurto and Speer (2012: p. 169) and Tóth et al. (2017: p. 195) note that existing studies using qualitative data in QCA are typically unclear about how exactly they calibrated their data. The studies usually are not transparent about: (1) where they placed the thresholds for inclusion and exclusion of a set (respectively the 1 and the 0); and (2) how they established the degree to which a case is "in" ($0.5 < x \leq 1$) or "out" of the set ($0 \leq x < 0.5$), that is, the degree of set-

membership. Since results of a QCA analysis can differ substantively depending on researchers' specific choices on these issues, such transparency is important.

5.1.1 Determining the thresholds for inclusion and exclusion of a set

How did the studies we reviewed determine where to place the thresholds for inclusion and exclusion of a set? Table 5.1 summarizes the five main strategies employed, while Appendix H provides additional details for all reviewed studies.

Table 5.1. Different strategies to determine the thresholds for inclusion and exclusion of a set

Strategy	Examples
Develop a rubric/coding scheme to assign codes to outcome and conditions.	Chatterley et al. (2014); Chatterley et al. (2013); Fischer (2015); Henik (2015); Iannacci and Cornford (2017); Kirchherr et al. 2016)
Construct an imaginary case for full-membership based on the case context, and a case for non-membership based on theoretical knowledge. The thresholds for inclusion and exclusion are then placed somewhere in-between these values.	Basurto and Speer (2012); Iannacci and Cornford (2017)
Apply the GMET where qualitative anchor points are based on a combination of the positive or negative direction on a case's membership and the relative importance of the attribute.	Tóth et al (2017)
Conduct a cluster analysis by using, for example, Tosmana (Cronqvist, 2016).	Kim and Verweij (2016); Li et al. (2016); Vergne and Depeyre (2016)
Base the thresholds on a large gap in the numerical data between the various cases (and preferably complement this with other approaches).	Li et al. (2016); Vergne and Depeyre (2016)

A first strategy is developing a rubric or coding scheme to assign codes for the outcome and the conditions. Chatterley et al. (2014), for example, develop a rubric to assign codes based on their data from interviews, focus group and observations (see Appendix I for an overview of the type of qualitative data used in all the reviewed studies). Whereas these codes are useful to rate the conditions and outcome for each case, Chatterley et al. (2014), do not provide a justification for assigning the thresholds for inclusion and exclusion of a set. Kirchherr et al. (2016) base the calibration of some fuzzy-set values on existing quantitative indices and of other values on an iterative process of multiple semi-structured expert interviews and an online survey. While the thresholds for inclusion and exclusion of a set are rather straightforward for data based on

indices (e.g., a ranking is used), it is unclear how Kirchherr et al. (2016) determined thresholds based on the qualitative data.

A second strategy is suggested by Basurto and Speer ((2012), see Iannacci and Cornford (2017) for an application). Basurto and Speer (2012) construct two imaginary ideal cases, one representing full membership in a set (1) and one representing full non-membership (0). The thresholds for inclusion and exclusion of the set, then, are put in between the two "extreme" values.

A third - inductive - strategy that several studies adopt is to set the thresholds using QCA-software, particularly the threshold setter in Tosmana (Cronqvist, 2016). Exploring the possibly large gaps in the data is another inductive strategy. Note that these inductive strategies are applicable only when the raw data are already numerical. Yet for a study based exclusively on qualitative data, these strategies are not an option; as a result, researchers are restricted in these cases to applying Tóth et al.'s (2017) GMET or using one of the first two strategies listed above.

5.1.2 Establishing the degree of set-membership

While the overview in Appendix H shows that almost all fsQCA-studies are careful about establishing the degree of set-membership, it also reveals that many studies are not fully transparent regarding how the qualitative data were used to this end.

For example, Verweij (2015) used both qualitative and quantitative data to calibrate the outcome and the conditions. As with studies using a similar approach (e.g., Vis, 2010), the quantitative material "dominated" the calibration (i.e., it was the benchmark that could be adjusted based on the qualitative material). One of Verweij's (2015) conditions was calibrated based on various qualitative documents, with codes assigned using qualitative data-analysis software. The few small coding contradictions were then re-calibrated in a final step (p. 1883). While the latter is common practice in QCA – as well as in many qualitative studies – it is not clear exactly how and why this re-calibration was done. As a consequence, it is difficult to replicate studies that employ this approach. The same holds for Verweij et al. (2013), who used various qualitative sources to calibrate their outcome and conditions. In line with good QCA-practice, Verweij et al. (2013) published their coding scheme and the resulting scores in an appendix, allowing other researchers to assess whether 'the observations meaningfully capture the ideas contained in the concepts' (Adcock and Collier, 2001: p. 529) and thereby are "valid"

(i.e., that a given value makes sense given existing empirical and theoretical knowledge). Yet, these tables do not include the reasoning behind the coding decisions, and therefore cannot be reproduced fully.

Similarly, Van der Heijden (2015) used a systematic coding scheme and qualitative data analysis software to explore data on voluntary environmental programmes systematically and gain insights 'into the "repetitiveness" and "rarity" of experiences shared by the interviewees, and those reported in the existing information studied' (p. 581). However, Van der Heijden (2015) did not discuss how this information was subsequently used to code cases as "in" or "out" of the set. Other studies go over the coding decisions only briefly (e.g., Chatterley et al. (2014)) or provide no information on how the interview data were translated into the fuzzy set values (e.g., Basurto (2013)). To varying degrees, this lack of transparency inhibits the studies' replicability.

Some studies use multiple coders to establish the degree of set-membership. In Henik (2015), for example, two coders applied a coding rubric on transcribed interviews, with the average of these coders' scores constituting the final set attribute. Henik (2015: p. 445) notes that the coders 'agreed within 0.25 set membership points on more than 90% of the 960 items (…)'. However, it is unclear how qualitatively important differences across coders were addressed, existing when one coder codes an item as being "in" the set and the other as "out". In this regard, a discrepancy of .15 (e.g., .45 vs. 0.6) can be more relevant than one of 0.3 (e.g., 0.6 vs 0.9).

Regarding which values to assign to qualitative data (i.e. the quantitizing), the studies we reviewed offer some suggestions. Table 5.2 lists the strategies, while Appendix H provides a more comprehensive overview.

Table 5.2. Different strategies to determine the degree of set membership

Strategy	Examples
Use pre-determined options in an interview (e.g. Likert scale)	Fischer (2014)
Use a coding scheme (e.g., 4-value and 2-value fuzzy sets) to assign membership scores to attributes and subsequently:	
a. Average the calibrated values.	Kirchherr et al. (2016)
b. Take the minimum value (when all attributes of a concept are necessary).	Chatterley (2014)
c. Take the maximum value (when all attributes are sufficient).	Basurto and Speer (2012)

One strategy is to directly ask interviewees to provide answers on a Likert-type scale (or one based on other pre-determined options). This strategy is applied by Fischer (2014), who calibrated his outcome (policy change) by asking approximately 250 interviewees to rate their perception of policy change from 1 to 5. Next, Fischer (2014) averaged the perceptions of actors and subsequently calibrated these data into fuzzy sets by rescaling the average value to a 0–1 scale. Another strategy is adopted by Kirchherr et al. (2016), who used a 4-value and 2-value coding scheme to assign set-membership scores to the attributes. Subsequently, Kirchherr et al. (2016) averaged the calibrated values for the different attributes of the conditions. They addressed this strategy's potential weakness, as it 'could introduce misfits between the verbal meaning of a concept and its operationalization' (Kirchherr et al., 2016: p. 39), by reviewing all averaged calibrations of the conditions and changing or recalibrating the attributes when they found that the conditions' values did not correspond to their averaged operationalization. Alternatives for taking the average value are substitutability (i.e., taking their maximum value) or taking the weakest link (i.e., the minimum value of the attributes of the concept) (Ragin (2000), see Chatterley et al. (2014) and Basurto and Speer (2012) for examples).

5.1.3 The Meaning of a Zero

A third challenge relating to calibration concerns the zero (0). Conceptually, in QCA the meaning of a zero is clear: fully out of a set. However, discussions among QCA-scholars reveal a challenge when coding qualitative data: how can one differentiate between concepts that are *truly absent* (i.e., where the concept is indeed absent) and which should thus be coded 0, and those concepts that are simply *not mentioned* in, for example, an interview? This question relates to Sandelowski et al.'s (2009: p. 217) observation in the context of quantitizing in MMR that *absent* may refer to different things in interview data: '(…)"it" (a) did not come up; (b) was not seen by the analyst; (c) was forgotten as a factor by the participant; (d) was thought by the participant to be so understood as to not require bringing it up; (e) was a factor, but the participant did not want to bring "it" up; (f) was not brought up because the conversation veered away from "it"; and (g) truly was not a dimension of experience'. This challenge holds not only for other types of qualitative data, such as existing documents or archive material, but also for quantitative data. If a concept is not mentioned in a document, does that mean that it is absent, or just that no information on it is included in the document? Data triangulation is one way to assess the likelihood of these two possibilities. In a QCA analysis, it will oftentimes be useful to explore the zeros in more detail to find out why the condition was absent or why the information was missing.

The large majority of the reviewed studies (n=25) do *not* discuss the meaning of the zero. There can be several reasons for this. First, sufficient information was available to assign "truly absent zeros" to cases. For example, Van der Heijden (2015) reported that he ensured sufficient information on all attributes by first gathering information from websites and reports and then filling in gaps using interview data (Crowley (2012) is another example). A second reason may be that researchers did not differentiate between "truly absent" and "not mentioned". For example, when calibrating their outcome "American states' levels of environmental justice policy", Kim and Verweij (2016) assigned a zero both to states with either "no action" or "no information", which is conceptually problematic. Vergne and Depevre (2016) decided to ask people to not complete their survey when they were not knowledgeable enough, thus circumventing the problem of missing data; however, they also reported that they turned to additional databases when data about a specific attribute was missing, but also noted that sometimes, they did not find more information.

5.2 How to present the calibration process and the data?

To make studies replicable, the data sources and calibration process need to be presented transparently and comprehensively (Gerring, 2012). Ideally, this should also be done concisely, to make the material easily accessible. These goals – transparency and comprehensiveness versus conciseness – often conflict. What is more, even transparency and comprehensiveness may conflict, as researchers aiming to be comprehensive risk burying their readers in details, thereby hindering transparency. How QCA scholars present the calibration process, and hence the actual possibility for replication, varies strongly across the reviewed studies. Table 5.3 summarizes the material from Appendix H on this.

Table 5.3. Different strategies to present the calibration procedure

Approach	Examples
Table in main text, full information	Kirchherr et al. (2016); Tóth et al. (2017) [for 1 GMET])
Table in main text, partial information	Basurto (2013); Chai and Schoon (2016); Chatterley et al. (2014); Chatterley et al. (2013); Crilly (2011); Hodson and Roscigno (2004); Hodson et al. (2006); Iannacci and Cornford (2017); Kim and Verweij (2016); Li et al. (2016); Metelits (2009); Summers Holtrop et al. (2016); Vergne and Depeyre (2016); Verweij (2015); Verweij and Gerrits (2015); Verweij et al. (2013)
Text boxes	Basurto and Speer (2012); Mishra et al. (2017)
Discussed in words in main text, typically partial	Chai and Schoon (2016); Chatterley et al. (2013); Crilly (2011); Henik (2015); Iannacci and Cornford (2017); Kim and Verweij (2016); Kirchherr et al. (2016); Li et al. (2016); Verweij (2015)
Discussed in words in appendix, typically partial	Smilde (2005); Vergne and Depeyre (2016)
Table(s) in appendix, full information	Fischer (2014), Fischer (2015); Iannacci and Cornford (2017); Kirchherr et al. (2016); Li et al. (2016); Thomann (2015); Van der Heijden (2015); Verweij et al. (2013); Wang (2016)
Table(s) in appendix, partial information	Basurto (2013); Hodson and Roscigno (2004)

Table 5.3 demonstrates that most reviewed studies (n= 27) provide some information on the calibration procedure (Aversa et al. (2015) and Crowley (2012) provide too little information). Numerous studies provide substantial information, but not all that would be required for full transparency.

Some studies' data calibration procedures make them easier to replicate than others. Kim and Verweij (2016), for example, included a table with the motivation of the assignment of US states to a specific category based on a combination of descriptions and secondary survey data. Fischer (2014) presented the calibration of outcome and conditions in tables in appendices. Both studies use a rather straightforward approach to calibration by respectively referring to survey results and directly asking interviewees to "score" their outcome and conditions, subsequently taking the average. Hence, replicating these findings is also rather straightforward.

Arriving at similar results becomes more complicated when the data needed for a specific attribute cannot be directly derived from interviewees' answers. While journal space limitations often make the disclosure of all details of the calibration process challenging, using (online) appendices, an option available at a growing number of journals, is one way to give more insight in the argumentation of researchers (Basurto and Speer, 2012). This suggestion is taken up by a variety of the reviewed studies (Basurto, 2013; Fischer, 2014; Kirchherr et al., 2016; Thomann, 2015; Wang, 2016).

5.3 Which sensitivity tests to conduct?

Testing findings' robustness by means of sensitivity analyses should be part of a good QCA study (Schneider and Wagemann, 2012). The methodological literature on QCA pays increasing attention to sensitivity tests (Baumgartner and Thiem, 2017; Marx, 2010; Skaaning, 2011; Thiem, 2014; Thiem et al., 2016a), including how to deal with different types of errors (Maggetti and Levi-Faur, 2013). In addition, the literature criticizing QCA (e.g., Hug, 2013; Lucas and Szatrowski, 2014; Paine, 2016) regularly indicates that the alleged lack of findings' robustness is a key problem (but see Baumgartner and Thiem (2017)).

The QCA literature provides several suggestions on how to assess the robustness of QCA findings using sensitivity tests. A non-exhaustive list includes: (1) dropping or adding cases and conditions; (2) changing fuzzy-set membership functions; (3) altering consistency thresholds

(Schneider and Wagemann, 2012; Thiem, 2014; Thiem et al., 2016b); (4) changing the definitions of the set values; (5) using alternative measures for a concept (Basurto and Speer, 2012); (6) changing the calibration thresholds of raw data into set-membership; and (7) altering the frequency of cases linked to configurations (Skaaning, 2011). These suggestions are not specific to qualitative data. Changing the consistency thresholds, for example, can be done irrespective of whether the data used are qualitative, quantitative, or both (see for examples with qualitative data Tóth et al. (2017) and Kim and Verweij (2016)). Similarly, changing the frequency of cases linked to the configuration can be done irrespective of the kind of data used. Still, the higher the number of cases, the more appropriate this sensitivity test becomes. Since studies using qualitative data often – though not always – have a relatively low number of cases, this will in many cases not be the most important sensitivity test to conduct. Some researchers conduct additional statistical analyses to assess the robustness of their findings, despite criticism about the comparability of the two methods (e.g., Thiem et al., 2016a). For example, Hodson et al. (2006) investigated whether their QCA-generated configurations were associated with the outcome and whether the association was statistically significant. Hodson et al. (2006) also introduced multivariate controls by creating dummy variables specifying key configurations and including them in a linear model. Note that while combining QCA and statistical analyses might be of interest to the readership of JMMR, we do not discuss this further since it is not specific to QCA studies using qualitative data.

Based on the reviewed literature, we selected those sensitivity tests that are relevant for QCA studies using qualitative data. We list these in Table 5.4. Appendix H provides a more detailed overview for all reviewed studies.

Table 5.4 Relevant sensitivity tests for assessing the robustness of QCA-findings based on qualitative data

Approach	Examples
Drop or add cases motivated by extensive case knowledge.	Kirchherr et al. (2016)
Alter the attributes of a condition based on knowledge about the case context.	Kirchherr et al. (2016)
Replace conditions by one of their attributes based on the importance that the data from the interviews, documents, or literature assigned to a specific attribute.	Kirchherr et al. (2016)
Re-run the analysis with a new, more extreme, outcome that has – consequently – a different qualitative breakpoint (anchor point) for being "in" the set. Go back to the qualitative data to calibrate this new outcome (which can be done starting from the original outcome's calibration).	Fiss (2011); Tóth et al. (2017)

First, the available qualitative data can be a strong motivator to decide which cases to drop or add in the sensitivity analysis. Dropping cases can be a useful way to assess findings' robustness. Kirchherr et al. (2016), for example, included an extensive section on robustness in which they motivate their choices to exclude certain cases based on case descriptions presented in an appendix. However, when dropping cases, it is important to make sure that the cases-to-conditions ratio is still acceptable – typically one condition to three cases (Marx, 2010). If this ratio becomes too low, the results become unreliable.

A second type of sensitivity test is conducted by altering the different attributes of the condition (Kirchherr et al., 2016), for example to base the membership score on only one attribute rather than multiple ones. Here as well, the motivation for such choices must be based on knowledge about case context (e.g., that the now omitted attributes introduced noise to the condition's operationalization). Another related option is to replace the condition by one of its attributes, a decision that can, for example, be based on the importance assigned to the specific attribute in the interviews, relevant documents or literature.

Another type of test, which we subsume here under the heading of sensitivity tests but which is technically a test to better determine which factors or mechanisms "drive" the outcome, is conducted by Tóth et al. (2017), who follow Fiss (2011). A new outcome is introduced that is more extreme than the original (in Tóth et al. (2017): very high relational attractiveness of the customer [RAC]). The qualitative threshold (the "anchor point", in Tóth et al.'s (2017)

terminology) for being "in the set" is higher for "very high RAC" than it was for "RAC", meaning that some cases will no longer be "in" the set of this new outcome. The calibration of the outcome requires returning to the qualitative data and assigning appropriate (fuzzy) set values, where the calibration of the original outcome can be used as a starting point.

5.4 Considerations when using qualitative data in QCA

Based on the studies we reviewed, we highlight five considerations for using qualitative data for QCA. First, QCA-researchers should be more explicit about how they arrive at certain thresholds for inclusion and exclusion of a set. Depending on the type of data (to be) collected, these thresholds might, for example, be determined by constructing an imaginary ideal case, or be based on a classification of interview responses.

Second, researchers should be more explicit about how they determined the degree of set-membership. More specifically, the reasoning behind the coding of qualitative data and the subsequent translation of qualitative codes into fuzzy-set scores should be more clearly communicated in articles or (online) appendices (see also point four below). Qualitative data or codes can be linked to values on a Likert-type or other pre-determined numerical scale (potentially based on quantitative material) and subsequently translated into fuzzy-set values. Moreover, rubrics or coding schemes (e.g., with two or four values) or pre-determined qualitative classifications can be used as an intermediate step for assigning fuzzy-set values to qualitative data.

Third, QCA researchers should pay more attention to the zeros in their calibrated data. Crucially, they must be careful about distinguishing between cases whose condition(s) or outcome are coded zero because they are "not mentioned" (or not identified in, for example, documents) versus cases whose condition(s) and those where outcomes are coded zero because they are "truly absent". To avoid this ambiguity when using interview data, researchers should attempt to construct their interview scheme such that all concepts are addressed during the interview (although Sandelowski et al.'s (2009) option – that the analyst did not see "it", even though it was there – would then still be a possibility). Creating a separate section for each condition and the outcome in the interview guideline, as proposed by Basurto and Speer (2012), is one possibility to doing so. The same holds for Tóth et al.'s (2017) suggestion to draw up an initial template based on previous literature. When all concepts are addressed in an interview,

a value of "0" would then be assigned only to attributes or conditions that are truly absent. However, due to the iterative nature of QCA, which allows for the inclusion and exclusion of conditions during the process, a lack of data about one or more attributes or conditions cannot always be avoided.

A similar data deficiency can also occur when analysing pre-existing data for QCA. We provide two options to deal with such data gaps. First, in cases where such an approach is possible, interviewees can be re-contacted about the attributes or conditions for which information is missing. This is the ideal solution, since it allows researchers to establish whether it was indeed absent, or whether it was just not mentioned in the initial interview. When it is not possible to go back to the interviewees, however – for example because of practical constraints –, a second-best option is to conduct sensitivity analyses. Three sensitivity analyses are particularly apt for addressing the zero-issue: (1) removing the conditions where this problem occurs and assessing the effect; (2) assigning the value "0.51" (i.e., just "in" the set) to cases of which the researcher is not sure whether the condition is "truly" absent to differentiate between the two findings; and (3) excluding the cases where the concept is "not mentioned" from the analysis.

Fourth, to increase a study's transparency and comprehensiveness, and hence its replicability, QCA researchers should explicitly delineate the choices they made (to the extent that this is possible given issues of, for example, confidentiality). We agree with Schneider and Wagemann's (2010) advice to publish the raw data matrix in addition to a detailed discussion of the calibration of the set membership scores. When a data set is too large to be published, the original data should be made available on the Internet or on demand. Large datasets, including transcribed interviews and reports, often exist when using qualitative data for QCA. In order to present the data in a transparent yet concise way, a balance should be sought in giving brief explanations and/or illustrations in the main text and using tables in the main text and/or in (online) appendices.

Finally, our review showed that although conducting sensitivity tests in (qualitative) QCA should be common practice, this is still not the case. Various tests are particularly suited to dealing with qualitative data, such as changing the number of cases, altering the conditions, or re-running the analysis with a more extreme outcome.

5.5 Transforming qualitative into quantitative data in QCA: what lessons for mixed-methods research?

The considerations in the previous section are first and foremost meant for QCA-researchers using qualitative data. However, as Cragun et al. (2016) show, QCA's hybrid nature offers several advantages over other methods and is therefore interesting for mixed methods researchers more generally.

Our considerations regarding calibration specifically relate to the discussions in JMMR on quantitizing. Discussions have been held about 'the foundational assumptions, judgments, and compromises involved in converting qualitative into quantitative data (…)' (Sandelowski et al., 2009: p. 208), for example on what and how to count. Debates about how to quantitize qualitative data are not new to MMR (e.g. Boyatzis, 1998), and the topic is usually included in MMR text books (e.g.Miles et al., 2014). Typically, as in Teddlie and Tashakkori (2009), examples are presented as to how qualitative data have been quantitized, or on how researchers have generally proceed, for instance by Sandelowski et al. (2009: p. 218): 'A common approach to quantitizing is to use the results of a prior quantitative analysis of quantitative data as the framework for the conversion of qualitative into quantitative data. This framework provides the decision rules for a directed form of content analysis whereby a priori codes are derived from a quantitative data set and applied to a qualitative data set (…)'. However, as with the studies reviewed above, the more detailed choices made by researchers frequently go undiscussed, alongside their underlying reasoning. Consequently, the methodological MMR literature provides little guidance for researchers seeking to quantitize their qualitative data. Since such choices may also influence the substantive results of an MMR study, they must be clearly communicated. What is more, the transparency and hence replicability of MMR studies would increase if they were more explicit about the choices made and the reasoning underlying these choices regarding quantitizing.

Conversions from qualitative into quantitative data 'are by no means transparent and uncontentious' (Love et al., 2005: p. 287). Our considerations regarding the presentation of the calibration process increase the transparency and replicability of studies where quantitization is used.

Given that quantitizing in MMR is to some extent subjective, it is relevant for MMR to conduct sensitivity tests to assess the robustness of the findings. Some of the sensitivity tests that we

identified as relevant for QCA using qualitative data are also relevant for MMR that includes quantitizing; this is especially the case for studies in which the (in)dependent variables (conditions) include several sub-dimensions (attributes). Specifically, three of the sensitivity tests mentioned above are particularly appropriate to MMR: dropping or adding cases based on extensive case knowledge; altering the attributes of a condition based on knowledge of the case context; and replacing conditions by one of their attributes.

5.6 Considerations on quantitizing beyond the QCA literature

Although this paper focused on QCA studies, research using methodologies other than QCA also provide valuable insights about quantitization. This can be illustrated using examples from various scientific fields. In education research, the study of Gilmore et al. (2014) quantitized data from 65 interviews to assess the relationship of participants' teaching experiences and teaching support systems with changes in their teaching orientation over time. They covered this longitudinal aspect by calculating the changes in coding scores between pre- and post-interviews. Moyer-Packenham et al. (2016) conducted pre- and post-assessments of quantitized video data when studying the role of affordances in children's learning performance. As their study makes clear, using quantitized codes derived from sources based on different points in time is a useful consideration when investigating developments over time.

When considering on how to deal with zeros in the data, Gilmore et al. (2014) suggest using multiple imputation procedures to fill the missing data. In the area of health research, Chang et al. (2009) describe how qualitative labels for the number of respondents per specific finding on antiretroviral adherence – such as "few" or "many" – can be transformed in exact numbers – such as 2 or 50. They conducted an online survey at nursing school faculty to obtain lower and upper limits for specific verbal labels, and subsequently used the responses in regression analyses to estimate a plausible range of respondents in a given study. Sandelowski (2000), in turn, uses the study of Borkan et al. (1991) as an example of quantitizing. In this study, the researchers use narrative analysis to determine the main categories of how elderly people viewed the hip fractures from which they suffered. A series of reliability tests were then conducted to ensure the consistency of the categories. Both studies provide additional insights on the issue of how to establish the degree of set-membership.

An example from economics comes from Vaitkevicius (2013), who suggests a systematic coding procedure based on hermeneutics to code qualitative data and subsequently analyze these data quantitatively. This procedure is, for instance, applicable to code and analyze closed-ended and open-ended questions. A final example also proposes a procedure for open-ended – qualitative – survey questions. Rohrer et al. (2017) suggest the employment of tools from natural language processing to process and analyze potentially large numbers of answers to open ended questions. They demonstrate their procedure by analyzing the more than 35,000 answers to the question "What else are you worried about?" from the participants of a German socio-economic panel study. These examples can be used as a starting point for expanding the list of considerations to be reflected upon in mixed methods research.

5.7 Conclusion

This paper addressed the challenges that researchers face when using qualitative data in QCA, especially when it comes to transforming it into quantitative data. Although QCA training courses are offered worldwide and several textbooks and journal articles that include hands-on instructions have been published, specific guidance for the use of qualitative data in QCA has been largely absent. We addressed this lacuna by exploring the various ways in which researchers currently use qualitative data in QCA and by laying considerations on three key issues: (1) the calibration of qualitative data (known as quantitization in MMR); (2) the presentation of the calibration process and the data, and (3) sensitivity testing. Overall, our study demonstrates that many QCA-studies using qualitative data are not as transparent in their procedures as would be required to enable proper replicability.

We thus presented five main considerations for QCA researchers aiming to enhance their studies' transparency: first, researchers should be more explicit as to how they arrive at the thresholds for inclusion and exclusion of a set; second, they should be clear about how they determined the degree of set-membership; third, more attention should be paid to the "zeros" in the calibrated data; fourth, researchers should make more explicit and present clearly the choices they made during the calibration process; and finally, conducting sensitivity tests should become common practice. These considerations contribute to the methodological discussions on data calibration and quantitization. Moreover, our study provides QCA users, and readers of JMMR more generally, with ideas about how to transform qualitative data into

quantitative form in their empirical studies. Which consideration(s) a given researcher ultimately takes into account will depend, among other things, on the specific research question, the type of data, and available time and resources.

CHAPTER 6

Synthesis

This thesis aspired to address a knowledge gap with regard to entrepreneurship in EbA by further elaborating the conceptual understanding of entrepreneurs' role, the entrepreneurial opportunities that are developed, and the interlinkages between entrepreneurs and opportunities in EbA. It there aimed to contribute to current academic discussions in the adaptation and business literature about the potential and actual role of entrepreneurs in planning and implementing ecosystem-based adaptation.
The overall research objective of this thesis was:

To increase the understanding of how entrepreneurs develop opportunities in ecosystem-based adaptation practice.

To achieve its research objective, the thesis analysed the *strategies* of entrepreneurs to create opportunities in EbA (Chapter 2) and the dynamic process of *shaping the conditions* for successful entrepreneurship in EbA (Chapter 3 and 4). Additionally, Chapter 5 has provided *methodological suggestions* for converting qualitative into quantitative data from case studies, targeting mixed methods researchers. This final chapter reviews the main research findings by first summarising the responses to the research questions (section 6.1) and by reflecting further on the contribution of entrepreneurship to ecosystem-based adaptation and in particular on (a) the connection between entrepreneurial success and successful adaptation (Section 6.2.1) and (b) overcoming barriers to adaptation (Section 6.2.2). Section 6.3 reflects on the development of the main concepts used throughout the research. Section 6.4 reflects on the strengths and limitations of the methodology deployed in this study. Section 6.5 explains the conceptual, methodological and empirical contributions of this thesis. This chapter ends with suggestions to elaborate the conceptual model of entrepreneurial opportunity development in EbA and to study ecosystem creation as recommendations for future research (Section 6.6).

6.1 Main findings on the research questions

This section presents the study's main findings for each research question.

How do public and private entrepreneurs create opportunities in ecosystem-based adaptation?
The main interest behind this research question was to further develop the understanding of the

roles and strategies of entrepreneurs in planning and implementing EbA projects. This question built on studies on entrepreneurship in the context of social-ecological systems that provide a comprehensive overview of the different strategies that entrepreneurs deploy (e.g. Brouwer, 2013; Evans et al., 2015; Meijerink and Huitema, 2010; Olsson et al., 2004; Olsson et al., 2006). To answer the research question, the strategies of entrepreneurs to create opportunities were analysed in two EbA projects in the Netherlands and two in the UK. The results in chapter 2 showed that mutual opportunities in EbA are created through a combination of individual and collective strategies of entrepreneurs from the public domain, business and civil society. Opportunity creation can broadly be divided into two phases based on the type of strategies as well as their interactions. The first phase includes a time of planning and preparation, where strategies such as searching for suitable locations and partnership formation are important. Here, strategies are both developed in sequence and simultaneously. The second phase, the project implementation, is much more dynamic in terms of combined, interrelated and simultaneous strategies. Our findings also indicated that each entrepreneur has its own unique set of skills and network and thereby role in the process. Interestingly, these roles are changing as entrepreneurs take up tasks that usually fall outside their range of activities.

What are the conditions for successful exploitation of entrepreneurial opportunities in ecosystem-based adaptation?

The question provided more insight in the factors that are needed to put EbA-related goods and services on the market. It also addressed the need identified in adaptation literature to come up with a more systematic comparison of adaptation cases to be able to draw lessons for other contexts (Ford et al., 2010; Rudel, 2008; Swart et al., 2014a). The question drew upon the work of Shane (2003) about the factors influencing entrepreneurial opportunity exploitation and on studies from adaptation scholars researching the role of private actors in climate change adaptation (e.g. (Tompkins and Eakin, 2012)). To answer the question, a Qualitative Comparative Analysis of 18 EbA cases in the Netherlands and the UK was conducted, which is presented in chapter 3. The assumption was that 1) altruism combined with capital availability and facilitating policies and regulations, or 2) financial motives combined with capital availability and facilitating policies and regulations were important for successful opportunity exploitation. However, the analysis displayed two specific combinations of conditions that

explain successful opportunity exploitation in EbA. First, facilitating policies and regulations combined with high availability of capital and second, facilitating policies and regulations with strong financial motives. In contrast to literature and thus our expectation, altruism was neither a necessary nor a sufficient condition for success, nor their combination. This indicates the limited importance of altruistic motivations in this specific phase of the opportunity development process. The results suggested that strategies to enhance EbA should concentrate on access to financial capital and facilitating policies and regulations.

How do public and private actors negotiate the conditions for entrepreneurship during an ecosystem-based adaptation project?

The main interest behind this research question was to move from a static towards a more dynamic view on the conditions that are necessary for successful exploitation of opportunities in EbA. The question drew on the concept of framing (Entman, 1993; Gray, 2002). While various studies on the governance of adaptation have addressed issue framing, chapter 4 also addressed identity and relationship framing and process framing (Dewulf et al., 2009). To answer the research question, an in-depth, longitudinal analysis of framing practices by public and private entrepreneurs in an EbA project in the Netherlands was conducted. The expectation was that trust frames and spatial and temporal scales would be prominent, which was confirmed by our findings. The framing analysis showed that six conditions influencing entrepreneurial success (i.e., prior career experience, altruistic motivations, financial motives, social networks, financial capital availability and policies and regulations) are co-produced through the interaction between different players. These conditions are constantly negotiated, agreed or contested by the various entrepreneurs involved, confirming the changing role distribution observed in Chapter 2. The results showed that framing processes connect the different motivations of various actor groups whose collaboration is needed for EbA projects to succeed. However, especially aligning the temporal scale frames of public and private actors to deal with the public-good nature of EbA is a challenge.

How to transform qualitative into quantitative data for Qualitative Comparative Analysis in specific, and mixed-methods research more generally?

The main interest was to provide QCA scholars who use qualitative data for their research and the wider mixed-methods audience with suggestions on how to transform qualitative into quantitative data in a more transparent way. Most of the guidance in QCA is about the calibration of quantitative data (e.g. (Ragin, 2008; Schneider and Wagemann, 2012)). A knowledge gap exist on how to transform quantitative into qualitative data for QCA with only few studies dedicated to this methodological issue (i.e., (Basurto and Speer, 2012; Tóth et al., 2017)). Chapter 5 built on these studies by reviewing 29 QCA studies that use various types of qualitative data and providing suggestions for good practices regarding data calibration, presentation and sensitivity testing when using qualitative data in QCA. The suggestions contribute to the methodological discussions on data calibration and quantitization among scholars conducting mixed methods research more broadly, potentially including climate adaptation scholars.

6.2 Reflections on the contribution of entrepreneurship to ecosystem-based adaptation

6.2.1 Successful entrepreneurship versus successful adaptation

The findings from the papers have raised further questions that could not be pursued in the papers. A key question is whether entrepreneurial success in EbA also amounts to successful adaptation to climate change. The assumption of such a strong and positive link is at the heart of calls for more entrepreneurial approaches to EbA and adaptation. Together with the finding that conducive policies and regulations are one of the key determinants of entrepreneurial success, a proven link between entrepreneurial success and successful adaptation would have important implications for adaptation governance.

The concept of entrepreneurial success in EbA has been elaborated in chapter 3, where it has been defined in terms of successful entrepreneurial opportunity exploitation: gathering and (re)combining resources to introduce new goods and services related to EbA, either through new or established firms and organizations . The term ‘new goods and services’ included not only ecosystem services, but also consultancy services, models, tools and designs. The degree of entrepreneurial success was then determined based on (1) successful implementation of a

sustainable business model, (2) ongoing activities to introduce new goods and services and (3) full-scale operation of the EbA-related products and services beyond the market testing phase.
Successful climate change adaptation can refer to variegated normative frameworks, e.g. sustainability, global and intergenerational equity, or resonance with cultural norms and collectively held community values. Adaptation experts needed several iterations to define what they meant by success (Doria et al., 2009). Depending on the context, adaptation success can include economic, political, institutional, ecological and social dimensions (Moser and Boykoff, 2013). Adger et al. (2005) argue that elements of effectiveness, efficiency, equity and legitimacy are important in judging success, but that the relative weight of each criterion varies across countries, sectors and actors and over time.
Linking entrepreneurial success to successful adaptation is especially challenging given the potentially different objectives and spatial and temporal scales. First, a successful entrepreneurial strategy may have negative impacts on others and in particular compromise their adaptive capacity. Such tensions were visible in those cases where environmental entrepreneurs restored habitat to enable species migration but compromised farmers' income through side effects. In such cases, compensatory strategies are needed to maintain support for both the entrepreneurial as well the adaptation activities, as for example the introduction of innovative finance schemes for environmentally friendly farming activities in the Pastures New case (cf. chapter 2 and 3). Second, the entrepreneurial activities might be successful in the short run or for a small area, but may turn out to be less helpful for longer term systemic adaptation processes (Adger et al., 2005). This is illustrated by the case of the Inlandshore Wieringermeer (chapter 4); while the entrepreneurs aimed for a rapid upscaling of the production activities on their farm, the longer term effects on the regional water provision for domestic and agricultural use were uncertain.
A review of the 18 cases examined in chapter 3 leads to the observation that the main connection between entrepreneurial and adaptation success involved regulating services. Almost all EbA cases in this thesis addressed regulating services (see Table 1.3), i.e. the entrepreneurs contributed with their activities to the introduction and/or maintainanceof storm protection, flood control, water regulation, climate regulation (and migration habitat in this respect), and therefore *potentially* contributed to climate change adaptation in the affected ecosystem. However, the link between entrepreneurial and adaptation success is complex, as the following

three examples illustrate. First, the Abbotts Hall case, which displays successful EbA-entrepreneurship: crops were produced and marketed while simultaneously a managed realignment was established and multiple measures were taken to encourage farmland wildlife. The effects of the measures taken on water movements, water quality and wildlife were monitored. Whereas the benefits to birds and other wildlife were immediately apparent when arable land was turned into coastal marshes in 2002, at hindsight, insufficient monitoring resources were initially devoted to establish the exact impacts on water levels elsewhere in the estuary. The project initiators themselves acknowledged that such knowledge would have been critical part to evaluate the project's contribution to adaptation (Essex Wildlife Trust, 2005), which therefore remains uncertain. Second, in the Building with Nature case, which I coded as an entrepreneurial success, an extensive monitoring program was implemented to measure the effects of the Sand Motor (an artificial peninsula designed to strengthen coastal storm and flood protection) on e.g., seabed, currents, the beach, dune development and leisure activities. Five years after its construction in 2011, the first monitoring results showed some effects on dune development and expansion of the coastal zone, but it was also acknowledged that the monitoring period was too short to answer all questions. Therefore, monitoring will continue and a new evaluation was scheduled for 2021 (Rijkswaterstaat, 2016). Finally, in the Water holding case, which I assessed as entrepreneurial unsuccessful, adaptation results were promising. On the one hand, the project was held up in an extended testing phase and outscaling of consultancy services had not yet materialised as envisioned. On the other hand, the regulating ecosystem service 'water regulation', meant to support water supply not least for food production through increased freshwater for agriculture in dry summers, was improved through freshwater storage and infiltration in creek deposits with controlled drainage systems. From the start of the project in 2011, monitoring activities by research institutes and farmers showed an increasing freshwater lens and numerical models predicted a further increase (Pauw et al., 2015).

All three cases demonstrate that the link between entrepreneurial success and successful adaptation is not straightforward. In the first two cases, entrepreneurial success was accompanied by insufficient monitoring of relevant adaptation parameters – either due to lack of resources or a too short monitoring period. In the third case, while entrepreneurial success was at least delayed, monitoring results for climate change adaptation showed desirable results.

The difficulty to derive more general statements about the relationship between entrepreneurial success and successful adaptation in EbA are compounded by the unsettled and context-dependent criteria for adaptation success, and the often insufficient monitoring efforts. Unless the normative and methodological issues are settled, opinions about the contribution of entrepreneurship to EbA are likely to be coloured by underlying preferences for or against governance models that provide much space for entrepreneurship.

6.2.2 Contribution of entrepreneurship to overcome barriers in ecosystem-based adaptation

The governance of climate adaptation involves the collective efforts of multiple societal actors to address problems, or to reap the benefits, associated with climate change (Huitema et al., 2016). Scholars in the area have generally recognized the complexities in the governance of adaptation and have devoted considerable effort to better understand 'barriers' to successful adaptation (e.g., Adger et al., 2009; Biesbroek et al., 2013; Moser and Ekstrom, 2010). This section discusses how, based on the insights from this thesis, entrepreneurship can contribute to overcome these barriers.

Adaptation barriers are factors that make it more difficult to plan and implement adaptation measures. The concept is often used interchangeably with 'hindrance', 'constraint', or 'obstacle'. Barriers in EbA restrict the variety and effectiveness of options available to actors to reach their objectives, or for a natural system to change in ways that maintain productivity or functioning. The opposite of 'barriers' are 'opportunity', 'driver', and 'stimulus'. Opportunities, for example, make the adaptation process easier to plan and implement by offering enhanced adaptation options (Klein et al., 2014).

Barriers to the planning and implementation of Ecosystem-based Adaptation

Barriers to the planning and implementation of EbA are less systematically discussed in literature than the barriers to adaptation in general (Brink et al., 2016). To obtain an overview of the barriers addressed in EbA literature, I therefore searched for the terms 'barriers', 'hindrance', 'constraint' and 'obstacle' in 35 peer-reviewed papers and 27 reports about EbA published between 2009 and 2017, which in turn had been retrieved through a literature search in Scopus and Web of Science with the search terms 'ecosystem-based adaptation' and

'ecosystem-based approaches for adaptation' and a forward and backward reference search. I grouped the barriers following the categorization used in the IPCC's 5th Assessment Report (Appendix J). Most of the examples from the EbA literature involve knowledge, awareness and technology constraints, financial constraints and governance and institutional constraints. Similar to the argument in Section 6.2.1 that there are differences between successful entrepreneurship and successful adaptation, opportunities for entrepreneurship in EbA cannot be equalled to opportunities for adaptation. Hence, it is likely that the conditions for successful entrepreneurial opportunity exploitation (see Chapters 3 and 4) differ from the conditions for successful ecosystem-based adaptation.

Overcoming barriers in EbA through entrepreneurship

Recent scholarly literature on climate change adaptation has criticized research that merely provide lists with barriers (Biesbroek et al., 2015; Wellstead et al., 2014). One critique is that while most scholars acknowledge that the governance of adaptation is complex, dynamic and erratic, these complexities are often reduced to simplified and static variables that are often presented in isolation from other factors and processes. Consequently, recommendations to address the barriers are then based on incomplete analysis and compromise practical interventions (Biesbroek et al., 2015), when in fact counter-strategies require actors to navigate multiple, interacting barriers in order to achieve desired adaptation objectives (Klein et al., 2014). The case studies presented in this thesis provide examples of how entrepreneurship can contribute to overcome barriers to adaptation. I have concentrated on strategies that can simultaneously address multiple barriers.

Chapter 3 has shown that enabling policies and regulations and high availability of capital were important determinants for entrepreneurial success in the selected EbA cases. At the same time, studies show that current legislation is often restricting or even preventing the implementation of EbA initiatives (Brink et al., 2016; Cowan et al., 2010; Lukasiewicz et al., 2016; Wamsler et al., 2016). However, several of the case studies included uncertainty about the application of regulations to novel contexts. This could provide an opening for entrepreneurs who discover potential opportunities for innovative interpretations of the law and might be willing to risk resources for applications and legal proceedings with uncertain outcome. For example, in the Landbouw op Peil case the entrepreneurs sought what was 'at the margin of what was

permissible ' concerning environmental licencing. In the Inlandshore Wieringermeer case the entrepreneurs pushed for continuation of the project despite restrictive EU regulations, suggesting that the necessary regulations would follow execution of the activities. Chapter 2 has shown that strategies such as lobbying and establishing and maintaining relationships with regulators were also used in this respect.

By investing in legal and political activities with uncertain outcomes, entrepreneurs might not only overcome regulatory constraints, but might also contribute to increased knowledge about regulatory possibilities. The experiences of entrepreneurs with EbA might help to overcome knowledge deficits and technological constraints more generally. Several entrepreneurs explained that showing and sharing EbA in practice was very important to convince local stakeholders and decision makers and raise awareness about soft engineering approaches. Providing this 'evidence' has the potential to speed up innovative EbA because the existence of reference cases might convince governments, investors and other actors of their economic and technical feasibility (Geels et al., 2008).

Knowledge gaps and a lack of data pertain especially to the effectiveness and benefits of EbA, which makes it more difficult to obtain on-going funding for EbA initiatives, which poses a financial constraint (Cowan et al., 2010; Naumann et al., 2011). Lack of knowledge and data is particularly addressed by experimenting, which took place in several EbA cases studied in this thesis. The long-term monitoring activities that accompanied several experiments within the Building with Nature programme enhance the knowledge about the effects of such projects on coastal defence, cost-effectiveness and benefits such as recreation (Rijkswaterstaat, 2016). Such a long-term monitoring endeavour is also very important to counterbalance the barrier of short-term policy cycles that are difficult to reconcile with the long-term time scales of adaptation effects. For example, the active involvement of two major international dredging contractors in the sand motor experiment sent a clear signal to the industry about the business potential of soft engineering approaches, thereby addressing the social and cultural constraints of unwillingness to change established behaviours and favouring business-as-usual approaches (Cowan et al., 2010).

Another social and cultural constraint is the perceived role of, for example, nature managers, farmers and businesses, leading to a lack of trust and entrenched positions (Cowan et al., 2010). The Inlandshore Wieringermeer case in Chapter 4 illustrates this challenge. However, Chapter

2 shows that the roles and responsibilities among these actors shift. In Pastures New, a nature conservation NGO actively sought and found ways to finance their nature conservation and restoration activities on the longer-term by providing consultancy services, thus increasing their profit motivation, thereby addressing financial constraints. Moreover, legislative constraints were addressed by successfully introducing a novel group-wise application for European agro-environmental schemes. The Water holding shows that an increased understanding of the natural system (i.e., knowledge building) combined with establishing a social network can lead to openness for the stakes of other water users such as nature protection agencies or recreationists.

The lack of available funding for EbA initiatives (Brink et al., 2016; Chong, 2014; Cowan et al., 2010) is addressed by entrepreneurship through the creation of innovative (financial) arrangements. In the CAFCA case, the entrepreneur supported the use of climate bonds and pension funds to contribute to adaptation measures. In the Wallasea Island case, an innovative partnership was formed that allowed to exchange excavated material and enabled one party to establish a novel managed realignment scheme and the other party to commit to its sustainability goals. Thus, next to a more direct form of providing financial capital, entrepreneurs in the cases found innovative means to establish EbA through a combination of, amongst others, social network building, profit orientation and career experience. One specific knowledge constraint noted by Lukasiewicz (2016), namely a lack of training in business management skills which would support setting up and running a small business, could also be addressed by involving entrepreneurs in an EbA project through their career experience and profit motivation features. In conclusion, entrepreneurs can potentially contribute to overcome multiple barriers in EbA, most notably restricting policies and regulations and lack of financial capital. Their experience, social network and focus on profit making could contribute to the establishment and longer-term economic sustainability of EbA initiatives.

6.3 Reflections on the study's main concepts

Chapter 1 provided definitions of the main concepts used in this thesis, i.e., ecosystem-based adaptation, ecosystem services, entrepreneurs, opportunities, opportunity creation and exploitation. The subsequent chapters however, include partly varying definitions which reflect

the ongoing thought process during the thesis. This section reflects on the evolution of the key concepts throughout the thesis.

6.3.1 Entrepreneurs

When starting the research, my ambition was to focus on private sector entrepreneurs in EbA. My interest in the topic had been aroused by influential studies published at that time which highlighted the economic value of ecosystem services (TEEB, 2012). Accordingly, my initial understanding of entrepreneurs was based on concepts from the entrepreneurship literature, in particular Schumpeter's theory (1934), and more recent work about the role of sustainability entrepreneurs in addressing environmental challenges (Parrish, 2010; Schaefer et al., 2015; Schaltegger and Wagner, 2011). As a result, my understanding of entrepreneurs in the first chapter that I wrote (Chapter 3 of this thesis) involved that of sustainable entrepreneurship and I followed Shepherd and Patzelt's (2011, p. 142) definition: 'sustainable entrepreneurship focuses on the preservation of nature, life support and community in the pursuit of perceived opportunities to bring into existence future products and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy and society'. Two of the criteria for case selection were (1) existence or development of a business model and (2) presence of entrepreneurial opportunities (Appendix A). The ensuing prevalence of private sector entrepreneurs was implicit in the selection criteria, but not purposefully intended. Nature conservation NGO's, for example, could just as well be selected given the increased pressure to identify new opportunities for self-financing and to develop innovative business models (Zahra et al., 2009). This is illustrated by the two cases where EbA was implemented without the involvement of private sector actors, but by civil society entrepreneurs, i.e. a nature conservation NGO (Abbotts Hall) and an individual citizen (Green Climate Belt) respectively. Both cases displayed a strong focus on marketing the products that were derived from the EbA projects (food production and biomass, respectively). Hence, at the end of the first part of the research (which addressed what is now research question 2), I had already broadened my view of entrepreneurs towards the inclusion of civil society actors, thereby still denoting entrepreneurs as private entrepreneurs following the categorization also used by Meijerink and Dicke (2008) that private or non-state actors can be grouped into two categories: private sector actors, who are looking for possibilities to make profit, and civil

society actors, such as NGO's and citizens, who mainly pursue non-commercial aims. Research questions 1 and 3 were subsequently addressed. In the cases involved in chapter 2 and 4, public sector actors played a prominent role. Since their strategies displayed key features of entrepreneurial activity – in particular creation of opportunities and devotion of resources to projects with uncertain outcomes – while they were bound to the role expectations and responsibilities of public sector representatives, these actors were included as public entrepreneurs. As a result, this thesis has considered private sector and civil society entrepreneurs, and to a lesser extent public sector entrepreneurs. Despite the differences in their primary roles, they share a willingness to invest resources (e.g. time, energy, money) in EbA, i.e. in projects with uncertain gains, and they participate in the creation and exploitation of opportunities to realise EbA projects.

6.3.2 Ecosystem services

First, entrepreneurship in EbA does not solely focus on provisioning services as might be expected with the majority of entrepreneurs coming from the private sector (Table 1.2). On the contrary, none of the cases discussed in this thesis focus solely on provisioning services, whereas 17 of the 19 cases include one and often more than one type of regulating service. The two cases that do not explicitly target regulating services (i.e., Butterfly Beef and Pastures New) focus on supporting services to create migration habitat. While the prevalence of regulating services in the cases might be surprising from an entrepreneurship perspective, from an (ecosystem-based) adaptation point of view it is less unexpected. Regulating ecosystem services are essential for climate change adaptation and disaster risk reduction, for example through flood protection preparedness to drought (Munang et al., 2013a). By selecting *Ecosystem-based* Adaptation cases, the focus on regulating services was implicit but not initially intended.

Second, from the prevalence of regulating services we can derive expectations about the conditions for successful entrepreneurship. The dominantly public good nature of these services suggests that for entrepreneurs in EbA, altruism is a more important motivation than profit. Also, to the extent that regulating services are non-excludable and non-rival, it is difficult to generate revenue through their marketization. This is likely to have implications for the success condition 'capital availability'. To the degree that regulating services are difficult to market,

revenues obtained from the regulating services directly is likely to be less important than 'external capital' (i.e., capital without pay-back obligation, e.g., subsidies, government funding and philanthropy, cf. chapter 3).

Third, the cultural ecosystem services included in the case studies were especially recreation, educational and aesthetic values (i.e., in 9 cases). While cultural services provide opportunities for non-commercial use (Costanza et al., 1997), they can support income generation. Recreational ecosystem services can allow entrepreneurs to derive revenue from, for example, eco-tourism and sport fishing. Aesthetic values can be an indirect source of income by attracting more visitors to an area. Educational values can be marketed if they are met with a willingness to pay for educational experiences.

These observations raise interesting questions about the contribution of 'private' entrepreneurs to the provision of ecosystem services with dominantly public good characteristics, in particular regulating services for climate change adaptation. According to the finding in this thesis, the profit motive generally attributed to private sector entrepreneurs does not necessarily dominate their interests, nor does it necessarily prevent an interest in the maintenance of public good-type ecosystem services. However, the conditions under which private sector entrepreneurship can benefit climate change adaptation that is based on ecosystem services with public good characteristics requires further research.

6.3.3 Entrepreneurship in EbA: economic, environmental, social or sustainable?

Chapter 1 already vented the idea that its multiple potential benefits might make EbA attractive to a wide range of entrepreneurs, including economic, environmental, social and sustainable entrepreneurs. To better understand which of these types were present in the EbA cases analysed in this thesis, I used data gathered for the qualitative comparative analysis in Chapter 3. In the analysis presented there, the prevalence of four conditions for successful entrepreneurship in EbA was expressed on a scale from zero to one based on interviews, project documents, field visits and project meetings. Two of these conditions relate to actor attributes which can broadly be linked to the four different types of entrepreneurship. The first condition, altruism, contained the indicators 'empathy', 'climate change awareness' and 'enhancement of biodiversity', which can be reinterpreted as approximation indicators of social goals, adaptation goals and environmental goals respectively. The values derived for the second condition,

'financial motives', can serve as an indicator for economic goals. While the indicators developed to assess the prevalence of conditions for entrepreneurial success might not be a perfect measure of different types of entrepreneurial goals, they are useful to obtain a first idea which types of entrepreneurs were attracted to the EbA projects included in this study (Fig. 6.1).

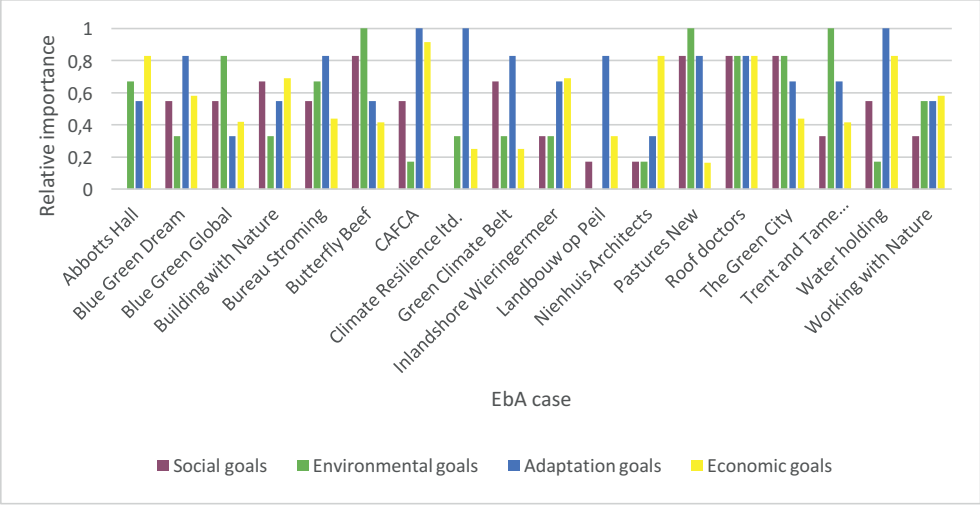

Fig. 6.1. Different goals pursued in EbA cases analysed in this thesis. Note that Wallasea is not included since this case was not analysed in Chapter 3 because it did not fit the selection criterion 'inclusion of a business model as part of the project' (see Appendix A).

Figure 6.1 shows that no type of entrepreneur was prevailing in our EbA cases. In 15 out of 18 cases, entrepreneurship included all four types of goals, albeit to a different extent. Climate change adaptation was an important goal in almost all cases. This might seem obvious, but especially the early EbA literature indicates that many projects that qualify as EbA originally started out for other reasons, for example to fulfil the EU habitat directive (Doswald and Osti, 2011; Naumann et al., 2011). Figure 6.1 shows that most of the projects in our case studies were *intentionally* designed or changed to manage the impacts of climate change, to reduce vulnerability or to enhance adaptive capacity (Dupuis and Biesbroek, 2013).

To obtain a more detailed overview of the types of entrepreneurship in EbA, I compared the goals pursued (Figure 6.1) with the ecosystem services addressed in each case (Table 1.3), yielding the following observations.

Economic entrepreneurship: First, one cluster of entrepreneurs was identified that used regulating services to improve the production of provisioning services and as such generate income. These include the Inlandshore Wieringermeer, Landbouw op Peil and the Water holding where investments in water regulation and soil formation measures stimulated the development of agricultural and aquacultural products. A distinct, but related, cluster of entrepreneurs used the development of regulating services as the core of new business models (i.e., CAFCA and Working with Nature) or to provide consultancy services (i.e., Nienhuis Architects). This cluster comes closest to economic entrepreneurship, where entrepreneurs are mostly driven by personal financial gain (Parrish, 2010; Tilley and Young, 2009). However, Figure 6.1 also shows that in none of these cases, economic goals were the sole ones, but that social, biodiversity and adaptation goals were also pursued to various degrees. Therefore, the Abbotts Hall also falls into this cluster. Here, the income derived from the agricultural products did not directly flow to the conservation activities of the responsible Wildlife Trust, but the farm activities were aimed to stimulate biodiversity.

Social entrepreneurship: A second cluster of cases comes closest to social entrepreneurship in terms of pursuing social and economic goals by creating new ventures or managing existing organizations in an innovative manner (Zahra et al., 2009). This type has been found in three cases – Building with Nature, Blue Green Dream and Blue Green Global –, where regulating services were used to both provide economic means and pursue social goals.

Environmental entrepreneurship: A third cluster of cases comes closes to the definition of environmental entrepreneurship, focusing on preservation of natural capital, including the conservation of mineral resources, biodiversity and water (Keijzers, 2002). Three cases – Butterfly Beef, Pastures New and Trent and Tame Futurescapes – fall into this category. Here, nature conservation and restoration are at the core, and efforts to improve the livelihoods of farmers or provide recreation are used as a means to pursue the environmental goals.

Sustainable entrepreneurship: A final cluster of cases can be categorised as sustainable entrepreneurship, comprising four cases – Roof Doctors, Bureau Stroming, Green Climate Belt and Green City. For these entrepreneurs, contributing to biodiversity, social wellbeing and

adaptation were primary purposes of their enterprises, and market-based income was valued as a means of achieving these goals (Parrish, 2010). For example, the business model of the Roof Doctors was a combination of consultancy services, design and maintenance of green and blue roofs, thus developing provisioning services (e.g., agricultural products from rooftop farms), regulating services (e.g., local climate regulation through vegetation roofs), supporting services (e.g., strengthening biodiversity by providing host and food plants for butterflies) and cultural services (e.g., aesthetic values provided by vegetation roofs).

In conclusion, the finding that different types of entrepreneurs are attracted to EbA projects confirms the assumption proposed in Chapter 1. This implies that the goals and activities of entrepreneurs in EbA differ. While some entrepreneurs will be more oriented towards reaching social goals related to EbA (Naumann et al., 2013), others will be more interested in environmental aspects, the financial gains or the economic sustainability of a project. Policy makers and people involved in planning of EbA should be aware of these potentially varying goals of entrepreneurs, which can enhance the value of a project but can also lead to tensions, as shown in Chapter 4.

6.4 Reflections on the study's methodology

Case study research as the main research design frame applied in this thesis allowed me to address the four research questions and achieve the overall research objective. The variable-oriented strategy deployed in the comparative case studies (i.e., four cases in Chapter 2 and 18 cases in Chapter 3) allowed for a certain degree of conceptual generalizability, whereas the in-depth single case study (Chapter 4) added a contextual and longitudinal aspect to this thesis. As such, both case study approaches complemented each other. Combining qualitative and quantitative methods for data collection and analysis allowed to achieve the following four broad rationales for mixed method studies as identified by Greene et al. (1989). First, triangulation, i.e., seeking convergence and corroboration of results from different methods studying the same phenomenon, thereby increasing the validity of the findings (Yin, 2003). Second, complementarity, meaning to combine methods and thereby compensating the inherent weaknesses of one method by the strengths of others. For example, in Chapter 3 qualitative data were collected from project documents, participant observation during project meetings and field visits. These were complemented with a QCA, thus deriving numerical values for the

qualitative data. The challenges encountered during the transformation of the qualitative data into numerical values formed the rationale for Chapter 5. Third, development, i.e., using the results from one method to inform the deployment of another method. This was most visible in Chapter 4, where I used the conditions identified in Chapter 3 as a basis for studying the dynamic development of an EbA project. Finally, expansion, meaning the use of different methods for different conceptual components of the research. This is reflected in the overall approach of addressing the three different conceptual perspectives, i.e., actors (Chapters 2 and 4), conditions (Chapters 3 and 4) and interactions between the actors and conditions (Chapter 4).

At the same time there are also limitations to this study's methodological choices. While the individual chapters address limitations related to the methods used in each specific study, the following three limitations apply to the overall methodological design. The first limitation refers to the generalizability of the findings and results from the case selection process. First, probability sampling has a higher ability to generalize results compared to non-probability sampling (Ritchie et al., 2003). However, the QCA approach taken in this study required relatively time-consuming data collection and analysis, which for practical reasons limited the number of cases that could possibly be included. The numbers required for statistically grounded generalizability could therefore never be achieved. Instead, the purposive sampling strategy deployed in this thesis led to the selection of 19 EbA cases in the Netherlands and the UK. The focus on these two countries was based on several characteristics that make them likely forerunners in EbA entrepreneurship and therefore fertile sampling grounds: Both are (1) high-income developed countries with (2) significant adaptation challenges, (3) are considered forerunners in adaptation efforts and (4) have a reputation for their enterprise-friendly culture. For the purpose of the research – to identify determinants of entrepreneurial success – these were background variables. The combination of a need for adaptation, a generally entrepreneurial culture and advanced adaptation policies led me to expect that I would find a sufficient number of entrepreneurial approaches to EbA in both countries. This expectation was indeed confirmed. At the same time, the difference in the policy and regulatory framework as well as the financial regimes led us to expect variation in these two factors, which are among the independent variables included in the model. In contrast, we had no a priori assumptions about cross-country differences regarding the prevalence of financial vs. altruistic motivations,

the other two independent variables. However, it should be noted that the unit of analysis was not the country but the case of EbA entrepreneurship. In this study, we were not interested in a cross-country comparison but in the exploration of causal factors of success of EbA entrepreneurs.

We would expect that the inclusion of cases from other countries, e.g. Eastern and Southern European countries, and developing countries, with very different policies, regulations and financial markets and an often more risky business environment, might affect the outcome of the analysis (Khattri et al., 2010). This implies that the conditions for success identified in Chapter 3 might not to the same degree explain success in such other contexts. This might in turn imply that different strategies might be required, as identified in Chapter 2. Additional research into these factors in other countries would provide more information about whether the findings presented here are applicable to other social and geographical contexts.

The second limitation is also related to the selection of cases from the Netherlands and the UK. The development of new procedural instruments for climate adaptation in the UK compared to the embedding within existing decision structures in the Netherlands (Biesbroek, 2014) might imply that policies and regulations as an explanatory factor for successful opportunity exploitation in EbA might be applicable to a different extent in the context of the UK and in the Netherlands. Also, the difference in division of responsibilities to manage flood risks (Wiering et al., 2015) might show differences in strategies deployed by public and private actors between the two countries (Chapter 2). Further, policies and regulations regarding flood risks might be of greater importance in the Netherlands because of the sole responsibility of the state in this field, whereas profit motivations might play a more important role in the UK where insurance companies share more responsibility. The division of responsibilities among different actors in the UK may also influence the types of capital that are available. While the aim of this research was not to compare entrepreneurial opportunity development in the UK and the Netherlands but rather distil lessons about entrepreneurship in EbA, a closer look to the institutional settings in the two countries would enable to draw recommendations that would better fit the specific institutional environments.

The third limitation relates to the use of QCA. Several studies criticize QCA as an approach. Lucas and Szatrowski (2014), for example, question QCA's epistemological claims, while Paine (2016) criticizes the sharp distinction between statistical and set-theoretical methods

often made by QCA scholars. These studies, however, have received their fair share of criticism themselves (see Fiss et al., 2014; Ragin, 2014; Thiem et al., 2016a). While I have taken note of these discussions, here I want to address a specific limitation experienced in this thesis, namely the condition-case ratio. Although there are no strict rules, generally, this ratio is set at one condition per 3-5 cases (Marx, 2010). Resultantly, some conditions that seemed (very) important according to the entrepreneurship literature needed to be excluded. This literature indicates that other actor attributes and contextual components might also be important, for example, prior knowledge of customer demands, managerial capability and stakeholder support (Choi and Shepherd, 2004; Fuentes Fuentes et al., 2010). Social capital is specifically relevant in this respect (Davidsson and Honig, 2003; De Carolis and Saparito, 2006; Fuentes Fuentes et al., 2010). Indeed, Chapter 4 shows that other conditions, such as prior career experience and social network, are important. Therefore, new studies can include these and other conditions, but this also implies that a larger number of cases should be included.

6.5 Scientific contribution

This thesis provides the following scientific contributions. First, it increases the *conceptual understanding* of entrepreneurship in adaptation. While several studies address the provision of or responsibilities for adaptation by private actors (e.g., Klein et al., 2017; Mees et al., 2012; Runhaar et al., 2016; Tompkins and Eakin, 2012), this research differentiates itself by explicitly using insights from the entrepreneurship and business and management literature. Chapter 1 introduces economic, environmental, social and sustainable entrepreneurship which is reflected upon in Section 6.3.3. Chapter 2, 3 and 4 draw on the entrepreneurship literature to construct a conceptual stage model of the opportunity development process based on the strategies of entrepreneurs and conditions for success, which is linked in Chapter 6 to the literature on the barriers to adaptation. By establishing entrepreneurship as the central element, this thesis provides an additional perspective to the governance of adaptation literature.

Second, Chapter 3 and 5 provide insights in a method for *systematic comparison* of a medium number of cases (i.e., Qualitative Comparative Analysis). Thus far, QCA received little attention in adaptation research. QCA has already been applied several times in business and management studies (see for recent examples on social entrepreneurship Mastrangelo et al. (2017) and Rey-Martí et al. (2016) and on environmental entrepreneurship Scarpellini et al.

(2017)). Also in environmental sciences more generally QCA has gained a foothold (see for recent examples in water governance Jager (2016) and Knieper and Pahl-Wostl (2016)). However, the application of QCA is much less common in adaptation research. One plausible explanation is that adaptation research itself is a relatively new field. However, applying QCA to study adaptation efforts is worthy of further exploration. Chapter 3 showed that by conducting QCA, more general observations can be made about conditions for success. This makes QCA in principle well-suited to answer questions such as 'what are the conditions that are necessary or sufficient in explaining why adaptation is or is not successful'? (Swart et al., 2014a: p. 6). Further, Chapter 3 showed that QCA can help to inductively build a conceptual causal model, while Chapter 5 provided lessons about transforming qualitative into quantitative data for QCA. Both elements can support fundamental inquiry and concept development around adaptation (Ford et al., 2010; Rudel, 2008).

Finally, Chapter 5 makes a *methodological contribution* to the QCA literature and the more general literature on mixed methods. By constructing an overview of how existing studies use qualitative data for QCA and deriving good practices from these studies, a guidance has been provided for future QCA and mixed methods researchers dealing with this issue. The positive response during a QCA expert workshop and on a working paper dealing with the same topic confirmed the importance of this contribution.

6.6 Recommendations for future research

This thesis explored the development of opportunities by public and private entrepreneurs in 19 ecosystem-based adaptation projects. The multidisciplinary research contributes to the knowledge base about entrepreneurship in the governance of adaptation literature. Together, the results from Chapter 2, 3 and 4 provide insights that can be used for a conceptual model of opportunity development in EbA. For the first stage (i.e., opportunity creation), strategies deployed by entrepreneurs were analysed. Also, the conditions needed for a successful subsequent stage (i.e., opportunity exploitation) were identified. Additionally, the dynamic development of these and other conditions through time were analysed. To further advance the knowledge about entrepreneurship in adaptation, the conceptual model can be elaborated by including the following four components. First, the number of conditions for successful entrepreneurship can be expanded. Chapter 3 addresses four conditions influencing

entrepreneurial success, while Chapter 4 includes two additional ones. However, the entrepreneurship literature suggests several other conditions that can be of influence, such as education (an actor attribute) and the socio-cultural environment (a contextual component). While the iterative process of selecting four conditions in Chapter 3 and six conditions in Chapter 4 was based on the required case-condition ratio (Marx, 2010) and expert judgment on the relevance for EbA, future research could include more conditions to develop the conceptual causal model. This would, however, require a larger number of cases.

Second, the strategies for opportunity creation identified in Chapter 2 partially overlap with the strategies of entrepreneurs to exploit opportunities as observed in Chapter 4. Therefore, the conceptual model can be expanded by also looking at the strategies of entrepreneurs in opportunity exploitation, and as such elaborate the sequential perspective on strategies deployed introduced in Chapter 2. A third suggestion is to include an additional perspective in the model by including the discovery view on the emergence of opportunities. As Chapter 2 explains, a discussion in the entrepreneurship literature is ongoing about whether opportunities are discovered, created or both (Alvarez and Barney, 2007; Miller, 2007). In this thesis, the creation view is followed, but the conceptual model can be build further by including the discovery of opportunities in EbA. Thereby, issues such as whether discovery indeed takes place, which strategies are used for discovery, and similarities and differences between strategies for opportunity discovery and creation can be addressed. Also, research can be done as to which of the two views is more appropriate for analysing entrepreneurship in EbA. Finally, the conceptual model can be refined by critically analysing the stages of opportunity development. By assuming that opportunity creation precedes exploitation (McMullen and Shepherd, 2006), a stage model of opportunity development was used as a heuristic device in this thesis. The rationale behind this was that for opportunities to be exploited, they first need to be successfully created, whereas in this thesis also examples of unsuccessful exploitation were considered in Chapter 3. Dividing the opportunity development process in these two stages has helped to reconstruct the process in more detail. However, other scholars have argued that rather than directional, sequential and ordered, the entrepreneurial innovation process is an iterative process of shaping, elaborating and refining ideas (Dimov, 2007). While the latter view has been adopted *within* the opportunity creation (Chapter 2) and exploitation process (Chapter 3 and 4), future research should explore this dynamic perspective *across* the different phases.

Opportunity exploitation can follow creation, but new opportunities can be created again following new ideas from exploitation, etc. Also, strategies used to create opportunities can also be used for opportunity exploitation. This view provides a more dynamic component to the conceptual model.

Future research should also explain in more detail the role of 'ecosystem creation' in adaptation. While there is still no agreed definition of EbA (Milman and Jagannathan, 2017), the EbA literature often refers to management, conservation and restoration of ecosystems to implement EbA (e.g., Grantham et al., 2011; Hills et al., 2013; Jones et al., 2012; Munang et al., 2013b; Pramova et al., 2012; Roberts et al., 2012; Saleem Khan et al., 2012). Conservation is understood here as the protection or maintenance of existing and well-functioning ecosystems with natural levels of biodiversity, whereas restoration refers to the recovery of degraded, impoverished ecosystems (CBD, 2009). A distinction can thus be made between EbA strategies that conserve or manage ecosystems and those that promote restoration of degraded or completely transformed systems (Jones et al., 2012). An additional type of ecosystem intervention has been identified in this thesis. Besides conserving well-functioning or restoring degraded ecosystems also new ecosystems are constructed to enhance adaptation. The core of this intervention type is the integration of ecosystem services in the design of land and water systems, thus replacing or complementing 'hard' infrastructure. This type of intervention is referred to as 'ecosystem creation': the design and construction of new ecosystems to optimize ecosystem services for climate change adaptation. This type of EbA has only recently been distinguished in the literature. Brink et al. (2016) differentiate between actions that benefit adaptation through maintenance, preservation, restoration or creation of ecological structures, while Zolch et al. (2018) categorize EbA measures based on conservation, restoration, sustainable management and creation of ecosystems, the latter including measures for urban greening. 'Creation' is also discussed in the literature on nature-based solutions. Eggermont et al. (2015) state that the type of NBS that they denote as design and management of new ecosystems (including the creation of new ecosystems such as green walls to mitigate heat island effects) is 'often exemplified by the European Commission for turning natural capital into a source for green growth and sustainable development' (p. 245). Based on this description and the findings from this thesis that entrepreneurs contribute to the maintenance and enhancement of both public and private goods through development of novel business models

and introducing innovative ways to finance EbA, one would assume that entrepreneurs are relatively more often involved in creation cases than in any of the other types. From the 19 cases analysed in this thesis, nine can be categorized as creation case. Given that creation hass only relatively recently been identified as an 'EbA-type', this finding supports the assumption. Therefore, future research could look specifically into the development of new ecosystem services, markets for these services and actor constellations involved in ecosystem creation, possibly in combination with other ecosystem interventions. This is especially relevant in the light of uncertainties about the range of potential future climatic conditions under which a particular EbA is effective. Restoration, for example, cannot be a business-as-usual intervention under climate change (Jones et al., 2012).

The necessary responses to maintain essential ecosystem services in the face of climate change can potentially strain the public capacity for adaptation, necessitating more involvement of the private sector and civil society (Klein et al., 2017). This thesis has contributed to the knowledge on the involvement of private, public and civil society entrepreneurs in ecosystem-based adaptation. While entrepreneurs are certainly not the sole actors needed for adaptation, given the looming climate change and biodiversity challenges, the inclusion of entrepreneurs in adaptation may be worthy of further exploration in adaptation science and practice.

Bibliography

Adcock R and Collier D. (2001) Measurement Validity: A Shared Standard for Qualitative and Quantitative Research. *The American Political Science Review* 95: 529-546.

Adger WN, Arnell NW and Tompkins EL. (2005) Successful adaptation to climate change across scales. *Global Environmental Change* 15: 77-86.

Adger WN, Lorenzoni I and O'Brien KL. (2009) *Adapting to climate change: thresholds, values, governance,* Cambridge: Cambridge University Press.

Adger WN, Quinn T, Lorenzoni I, et al. (2013) Changing social contracts in climate-change adaptation. *Nature Climate Change* 3: 330-333.

Alvarez SA and Barney JB. (2007) Discovery and creation: alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal* 1: 11-26.

Alvarez SA and Busenitz LW. (2001) The entrepreneurship of resource-based theory. *Journal of Management* 27: 755-775.

Andersson KP and Ostrom E. (2008) Analyzing decentralized resource regimes from a polycentric perspective. *Policy Sciences* 41: 71-93.

Andrade Pérez A, Herrera Fernandez B and Cazzolla Gatti R. (2010) *Building resilience to climate change: ecosystem-based adaptation and lessons from the field,* Gland: IUCN.

Ardichvili A, Cardozo R and Ray S. (2003) A theory of entrepreneurial opportunity identification and development. *Journal of Business Venturing* 18: 105-123.

Ash N and Price J. (2008) ELAN - the Ecosystems and Livelihoods Adaptation Network: Enabling biodiversity and people to adapt to a changing climate. ELAN information document, UNFCCC CoP 14. Poznan.

Aversa P, Furnari S and Haefliger S. (2015) Business Model Configurations and Performance: A qualitative Comparative Analysis in Formula One Racing, 2005-2013. *Industrial and Corporate Change* 24: 655-676.

Basurto X. (2013) Linking multi-level governance to local common-pool resource theory using fuzzy-set qualitative comparative analysis: Insights from twenty years of biodiversity conservation in Costa Rica. *Global Environmental Change* 23: 573-587.

Basurto X and Speer J. (2012) Structuring the Calibration of Qualitative Data as Sets for Qualitative Comparative Analysis (QCA). *Field Methods* 24: 155-174.

Baumgartner M. (2015) Parsimony and Causality. *Quality and Quantity* 49: 839-856.

Baumgartner M and Thiem A. (2017) Model Ambiguities in Configurational Comparative Research. *Sociological Methods & Research* 46: 954-987.

Berg-Schlosser D and De Meur G. (2009) Comparative research design: case and variable selection. In: Rihoux B and Ragin CC (eds) *Configurational comparative methods. Qualitative Comparative Analysis (QCA) and related techniques.* Thousand Oaks and London: Sage.

Berkhout F, Hertin J and Gann DM. (2006) Learning to adapt: Organisational adaptation to climate change impacts. *Climatic Change* 78: 135-156.

Bhidé AV. (2000) *The origin and evolution of new businesses,* Oxford: Oxford University Press.

Biesbroek GR. (2014) Challenging barriers in the governance of climate change adaptation. Wageningen: Wageningen University.

Biesbroek GR, Klostermann JM, Termeer CAM, et al. (2013) On the nature of barriers to climate change adaptation. *Regional Environmental Change* 13: 1119–1129.

Biesbroek R, Dupuis J, Jordan A, et al. (2015) Opening up the black box of adaptation decision-making. *Nature Climate Change* 5: 493.

Blumer HC. (1954) What is Wrong with Social Theory? *American Sociological Review* 19: 3-10.

Borkan JM, Quirk M and Sullivan M. (1991) Finding meaning after the fall: Injury narratives from elderly hip fracture patients. *Social Science & Medicine* 33: 947-957.

Bourne A, Holness S, Holden P, et al. (2016) A socio-ecological approach for identifying and contextualising spatial ecosystem-based adaptation priorities at the sub-national level. *PLoS ONE* 11.

Boyatzis RE. (1998) *Transforming Qualitative Information: Thematic Analysis and Code Development,* Thousand Oaks: Sage.

Brink E, Aalders T, Ádám D, et al. (2016) Cascades of green: A review of ecosystem-based adaptation in urban areas. *Global Environmental Change* 36: 111-123.

Brouwer S. (2013) Policy Entrepreneurs and Strategies for Change. The Case of Water Management in the Netherlands. *Faculteit der Aard- en Levenswetenschappen.* Amsterdam: Vrije Universiteit.

Brouwer S and Biermann F. (2011) Towards Adaptive Management: Examining the Strategies of Policy Entrepreneurs in Dutch Water Management. *Ecology and Society* 16.

Bulkeley H and Castán Broto V. (2013) Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers* 38: 361-375.

Cash DW, Adger WN, Berkes F, et al. (2006) Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World. *Ecology and Society* 11.

CBD. (1992) Convention on Biological Diversity, United Nations.

CBD. (2009) Connecting biodiversity and climate change mitigation and adaptation. Report of the second ad hoc technical expert group on biodiversity and climate change. Technical series No 41. Montreal: Secretariat of the Convention on Biological Diversity.

CBD. (2011) Report of the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity. X/33. Biodiversity and climate change. Report UNEP/CBD/COP/10/27. Montreal: Secretariat of the Convention on Biological Diversity.

Chai Y and Schoon M. (2016) Institutions and government efficiency: Decentralized irrigation management in China. *International Journal of the Commons* 10: 21-44.

Chang Y, Voils CI, Sandelowski M, et al. (2009) Transforming Verbal Counts in Reports of Qualitative Descriptive Studies Into Numbers. *Western Journal of Nursing Research* 31: 837-852.

Chatterley C, Javernick-Will A, Linden KG, et al. (2014) A qualitative comparative analysis of well-managed school sanitation in Bangladesh. *BMC Public Health* 14.

Chatterley C, Linden KG and Javernick-Will A. (2013) Identifying pathways to continued maintenance of school sanitation in Belize. *Journal of Water Sanitation and Hygiene for Development* 3: 411-422.

Choi YR and Shepherd DA. (2004) Entrepreneurs' decisions to exploit opportunities. *Journal of Management* 30: 377-395.

Chong J. (2014) Ecosystem-based approaches to climate change adaptation: progress and challenges. *International Environmental Agreements: Politics, Law and Economics* 14: 391-405.

Cohen B and Winn MI. (2007) Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing* 22: 29-49.

Coleman H, Karbassi L, Kasten T, et al. (2011) Adapting for a green economy: companies, communities and climate change. UN Global Compact, UN Environment Programme, Oxfam and the World Resources Institute.

Colls A, Ash N and Ikkala N. (2009) *Ecosystem-based adaptation: a natural response to climate change,* Gland: IUCN.

Companys Y and McMullen J. (2007) Strategic Entrepreneurs at Work: The Nature, Discovery, and Exploitation of Entrepreneurial Opportunities. *Small Business Economics* 28: 301-322.

Costanza R, D'Arge R, De Groot R, et al. (1997) The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.

Costanza R and Daly HE. (1992) Natural Capital and Sustainable Development. *Conservation Biology* 6: 37-46.

Costanza R, de Groot R, Braat L, et al. (2017) Twenty years of ecosystem services: How far have we come and how far do we still need to go? *Ecosystem Services* 28: 1-16.
Cowan C, Epple C, Korn H, et al. (2010) Working with nature to tackle climate change. Report of the ENCA / BfN workshop on "Developing ecosystem-based approaches to climate change – why, what and how". Isle of Vilm: International Academy for Nature Conservation.
Cragun D, Pal T, Vadaparampil ST, et al. (2016) Qualitative Comparative Analysis: A Hybrid Method for Identifying Factors Associated With Program Effectiveness. *Journal of Mixed Methods Research* 10: 251-272.
Crilly D. (2011) Predicting Stakeholder Orientation in the Multinational Enterprise: A Mid-Range Theory. *Journal of International Business Studies* 42: 694-717.
Cronqvist L. (2016) Tosmana. Trier: University of Trier.
Crowley M. (2012) Control and Dignity in Professional, Manual and Service-Sector Employment. *Organization Studies* 33: 1383-1406.
Daily GC. (1997) *Nature's services: societal dependence on natural ecosystems,* Washington: Island Press.
Davidsson P and Honig B. (2003) The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing* 18: 301-331.
de Block D and Vis B. (2017) Addressing the Challenges in Using Qualitative Data in Qualitative Comparative Analysis. *COMPASSS Working Paper* 2017-88.
De Carolis DM and Saparito P. (2006) Social Capital, Cognition, and Entrepreneurial Opportunities: A Theoretical Framework. *Entrepreneurship Theory and Practice* 30: 41-56.
De Groot JIM and Steg L. (2009) Mean or green: which values can promote stable pro-environmental behavior? *Conservation Letters* 2: 61-66.
De Meur G, Rihoux B and Yamasaki S. (2009) Addressing the critiques of QCA. In: Rihoux B and Ragin CC (eds) *Configurational Comparative Methods. Qualitative Comparative Analysis (QCA) and related techniques.* Thousand Oaks and London: Sage.
de Vries JR, Beunen R, Aarts N, et al. (2014) The pivot points in planning: How the use of contracts influences trust dynamics and vice versa. *Planning Theory* 13: 304-323.
Dean TJ and McMullen JS. (2007) Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing* 22: 50-76.
Delmas MA and Burbano VC. (2011) The drivers of greenwashing. *California Management Review* 54: 64-87.
Deltacommissie. (2014) Deltabeslissing IJsselmeergebied. Den Haag: Ministry of Infrastructure and the Environment and Ministry of Economic Affairs.
Dewulf A. (2013) Contrasting frames in policy debates on climate change adaptation. *Wiley Interdisciplinary Reviews: Climate Change* 4: 321-330.
Dewulf A, Gray B, Putnam L, et al. (2009) Disentangling approaches to framing in conflict and negotiation research: A meta-paradigmatic perspective. *Human Relations* 62: 155-193.
Dewulf A, Meijerink S and Runhaar H. (2015) Editorial: The governance of adaptation to climate change as a multi-level, multi-sector and multi-actor challenge: a European comparative perspective. *Journal of Water and Climate Change* 6: 1-8.
Dimov D. (2007) Beyond the Single-Person, Single-Insight Attribution in Understanding Entrepreneurial Opportunities. *Entrepreneurship Theory and Practice* 31: 713-731.
Doria MdF, Boyd E, Tompkins EL, et al. (2009) Using expert elicitation to define successful adaptation to climate change. *Environmental Science & Policy* 12: 810-819.
Doswald N, Munroe R, Roe D, et al. (2014) Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base. *Climate and Development* 6: 185–201.
Doswald N and Osti M. (2011) Ecosystem-based approaches to adaptation and mitigation – good practice examples and lessons learned in Europe. BfN-Skripten 306. Cambridge: UNEP-WCMC.

Drucker PF. (1985) *Innovation and entrepreneurship: practice and principles,* London: Heinemann.
Dudley N, Stolton S, Belokurov A, et al. (2010) Natural solutions. Protected areas helping people cope with climate change. Gland, Washington DC, New York: IUCN-WCPA, TNC, UNDP, WCS, The World Bank & WWF.
Dupuis J and Biesbroek R. (2013) Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies. *Global Environmental Change* 23: 1476-1487.
Dupuis J and Knoepfel P. (2013) The Adaptation Policy Paradox: the Implementation Deficit of Policies Framed as Climate Change Adaptation. *Ecology and Society* 18.
EC. (2013) An EU strategy on adaptation to climate change. Brussels: European Commission.
EC. (2015) Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities. Final report of the Horizon 2020 expert group on nature-based solutions and re-naturing cities. Brussels: European Commission.
EEA. (2013) Adaptation in Europe: addressing risks and opportunities from climate change in the context of socio-economic developments. Copenhagen: European Environmental Agency.
Eggermont H, Balian E, Azevedo JMN, et al. (2015) Nature-based solutions: New influence for environmental management and research in Europe. *GAIA* 24: 243-248.
Eisenack K and Stecker R. (2012) A framework for analyzing climate change adaptations as actions. *Mitigation and Adaptation Strategies for Global Change* 17: 243-260.
Engel S, Pagiola S and Wunder S. (2008) Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics* 65: 663-674.
Entman RM. (1993) Framing: Toward Clarification of a Fractured Paradigm. *Journal of Communication* 43: 51-58.
Essex Wildlife Trust. (2005) Abbotts Hall Farm Fact Sheet 9. Lessons Learned from Realignment. Colchester: Essex Wildlife Trust.
Evans LS, Hicks CC, Cohen PJ, et al. (2015) Understanding leadership in the environmental sciences. *Ecology and Society* 20: 50.
Feindt PH and Netherwood A. (2011) Making sense of climate change. Notes on interpretive policy analysis and discourse analysis in sustainability research. In: Blyton P and Franklin A (eds) *Researching Sustainability: A guide to social science methods and practice.* London: Earthscan.
Fischer M. (2014) Coalition Structures and Policy Change in a Consensus Democracy. *Policy Studies Journal* 42: 344-366.
Fischer M. (2015) Institutions and Coalitions in Policy Processes: A Cross-sectoral Comparison. *Journal of Public Policy* 35: 245-268.
Fiss PC. (2011) Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research. *Academy of Management Journal* 54: 393-420.
Fiss PC, Marx A and Rihoux B. (2014) Comment: Getting QCA Right. *Sociological Methodology* 44: 95-100.
Fiss PC, Sharapov D and Cronqvist L. (2013) Opposites Attract? Opportunities and Challenges for Integrating Large-N QCA and Econometric Analysis. *Political Research Quarterly* 66: 191-198.
Flyvbjerg B. (2006) Five misunderstandings about case-study research. *Qualitative Inquiry* 12: 219-245.
Folke C, Carpenter SR, Walker B, et al. (2010) Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15.
Ford JD, Keskitalo ECH, Smith T, et al. (2010) Case study and analogue methodologies in climate change vulnerability research. *Wiley Interdisciplinary Reviews: Climate Change* 1: 374-392.
Fuentes Fuentes MdM, Arroyo MR, Bojica AM, et al. (2010) Prior knowledge and social networks in the exploitation of entrepreneurial opportunities. *International Entrepreneurship and Management Journal* 6: 481-501.

Geels FW, Hekkert MP and Jacobsson S. (2008) The dynamics of sustainable innovation journeys. *Technology Analysis & Strategic Management* 20: 521-536.
Geneletti D and Zardo L. (2016) Ecosystem-based adaptation in cities: An analysis of European urban climate adaptation plans. *Land Use Policy* 50: 38-47.
George AL and Bennett A. (2005) *Case studies and theory development in the social sciences,* Cambridge: MIT Press.
Gerring J. (2012) *Social science methodology: a unified framework,* Cambridge: Cambridge University Press.
Gifford S. (2005) Risk and Uncertainty. In: Acs ZJ and Audretsch DB (eds) *Handbook of entrepreneurship research. An interdisciplinary survey and introduction.* Boston: Kluwer academic publishers.
Gilmore J, Maher MA, Feldon DF, et al. (2014) Exploration of factors related to the development of science, technology, engineering, and mathematics graduate teaching assistants' teaching orientations. *Studies in Higher Education* 39: 1910-1928.
Grantham HS, McLeod E, Brooks A, et al. (2011) Ecosystem-based adaptation in marine ecosystems of tropical Oceania in response to climate change. *Pacific Conservation Biology* 17: 241–258.
Gray B. (2002) Framing of Environmental Disputes. In: Lewicki R, Gray B and Elliott M (eds) *Making Sense of Intractable Environmental Conflicts. Conflicts and Cases.* Washington DC, USA: Island Press.
Greene JC, Caracelli VJ and Graham WF. (1989) Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis* 11: 255-274.
Hall JK, Daneke GA and Lenox MJ. (2010) Sustainable development and entrepreneurship: Past contributions and future directions. *Journal of Business Venturing* 25: 439-448.
Halme M and Korpela M. (2014) Responsible Innovation Toward Sustainable Development in Small and Medium-Sized Enterprises: a Resource Perspective. *Business Strategy and the Environment* 23: 547-566.
Hart SL. (2007) *Capitalism at the crossroads: aligning business, earth and humanity,* Upper Saddle River: Wharton School Publishing.
Hekkert MP, Suurs RAA, Negro SO, et al. (2007) Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change* 74: 413-432.
Henik E. (2015) Understanding whistle-blowing: a set-theoretic approach. *Journal of Business Research* 68: 442-450.
Hills T, Carruthers TJB, Chape S, et al. (2013) A social and ecological imperative for ecosystem-based adaptation to climate change in the Pacific Islands. *Sustainability Science* 8: 455–467.
Hodson R and Roscigno VJ. (2004) The Organizational and Social Foundations of Worker Resistance. . *American Sociological Review* 69: 14-39.
Hodson R, Roscigno VJ and Lopez SH. (2006) Chaos and the Abuse of Power: Workplace Bullying in Organizational and Interactional Context. *Work and Occupations* 33: 382-416.
Howell R and Allen S. (2017) People and Planet: Values, Motivations and Formative Influences of Individuals Acting to Mitigate Climate Change. *Environmental Values* 26: 131-155.
Hug S. (2013) Qualitative Comparative Analysis: How Inductive Use and Measurement Error Lead to Problematic Inference. *Political Analysis* 21: 252-265.
Huitema D, Adger WN, Berkhout F, et al. (2016) The governance of adaptation: choices, reasons, and effects. Introduction to the Special Feature. *Ecology and Society* 21.
Huitema D and Meijerink S. (2010) Realizing water transitions: The role of policy entrepreneurs in water policy change. *Ecology and Society* 15.
Iannacci F and Cornford T. (2017) Unravelling Causal and Temporal Influences Underpinning Monitoring Systems Success: A Typological Approach. *Information Systems Journal*: 1-24.

Ikkala N and Martinez C. (2008) Adaptation to climate change – IUCN position paper. *Fourteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (CoP14).* Poznan.

IPCC. (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment. Report of the Intergovernmental Panel on Climate Change,* Cambridge: Cambridge University Press.

Jager NW. (2016) Transboundary Cooperation in European Water Governance – A set-theoretic analysis of International River Basins. *Environmental Policy and Governance* 26: 278-291.

Johnson BB. (2012) Climate Change Communication: A Provocative Inquiry into Motives, Meanings, and Means. *Risk Analysis* 32: 973-991.

Johnson RB, Onwuegbuzie AJ and Turner LA. (2007) Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research* 1: 112-133.

Jones HP, Hole DG and Zavaleta ES. (2012) Harnessing nature to help people adapt to climate change. *Nature Climate Change* 2: 504–509.

Juhola S, Keskitalo ECH and Westerhoff L. (2011) Understanding the framings of climate change adaptation across multiple scales of governance in Europe. *Environmental Politics* 20: 445-463.

Karp DG. (1996) Values and their Effect on Pro-Environmental Behavior. *Environment and Behavior* 28: 111-133.

Keijzers G. (2002) The transition to the sustainable enterprise. *Journal of Cleaner Production* 10: 349-359.

Khan A and Amelie V. (2015) Assessing climate change readiness in Seychelles: implications for ecosystem-based adaptation mainstreaming and marine spatial planning. *Regional Environmental Change* 15: 721-733.

Khattri A, Parameshwar D and Pellech S. (2010) Opportunities for Private Sector Engagement in Urban Climate Change Resilience Building. Report by Intellectual Capital Advisory Services Pvt. Ltd. (Intellecap) with the support of the Asian Cities Climate Change Resilience Network (ACCCRN) and the Rockefeller Foundation, Intellecap, Hyderabad and the Rockefeller Foundation, Bangkok.

Kim Y and Verweij S. (2016) Two effective causal paths that explain the adoption of US state environmental justice policy. *Policy Sciences*: 1-19.

Kingdon JW. (1984) *Agendas, alternatives, and public policies,* Boston: HarperCollins.

Kirby DA. (2003) *Entrepreneurship,* Maidenhead: McGraw-Hill Education.

Kirchherr J, Charles KJ and Walton MJ. (2016) Multi-causal pathways of public opposition to dam projects in Asia: A fuzzy set qualitative comparative analysis (fsQCA). *Global Environmental Change* 41: 33-45.

Kirzner IM. (1973) *Competition and entrepreneurship,* Chicago: University of Chicago Press.

Kirzner IM. (1997) Entrepreneurial discovery and the competitive market process: an Austrian approach. *Journal of Economic Literature* 35: 60-85.

Klein J, Juhola S and Landauer M. (2017) Local authorities and the engagement of private actors in climate change adaptation. *Environment and Planning C: Politics and Space* 35: 1055-1074.

Klein PG. (2008) Opportunity discovery, entrepreneurial action, and economic organization. *Strategic Entrepreneurship Journal* 2: 175-190.

Klein RJT, Midgley GF, Preston BL, et al. (2014) Adaptation opportunities, constraints, and limits. In: Field CB, Barros VR, Dokken DJ, et al. (eds) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge and New York.

Klöckner CA. (2013) A comprehensive model of the psychology of environmental behaviour—A meta-analysis. *Global Environmental Change* 23: 1028-1038.

Knieper C and Pahl-Wostl C. (2016) A Comparative Analysis of Water Governance, Water Management, and Environmental Performance in River Basins. *Water Resources Management* 30: 2161-2177.
Knight FH. (1921) *Risk, Uncertainty and Profit,* Boston: Houghton Mifflin.
Lambooy T and Levashova Y. (2011) Opportunities and challenges for private sector entrepreneurship and investment in biodiversity, ecosystem services and nature conservation. *International Journal of Biodiversity Science, Ecosystem Services & Management* 7: 301-318.
Laufer WS. (2003) Social Accountability and Corporate Greenwashing. *Journal of Business Ethics* 43: 253-261.
Lems P, Aarts N and van Woerkum CMJ. (2013) When Policy Hits the Ground. An Empirical Study of the Communication Practices of Project Managers of a Water Board in Conversations for Collaborative Governance. *Environmental Policy and Governance* 23: 234-246.
Li Y, Kopennjan J and Verweij S. (2016) Governing Environmental Conflicts in China: Under What Conditions do Local Governments Compromise? *Public Administration* 94: 806-822.
Love K, Pritchard C, Maguire K, et al. (2005) Qualitative and quantitative approaches to health impact assessment: An analysis of the political and philosophical milieu of the multimethod approach. *Critical Public Health* 15: 275-289.
Lucas SR and Szatrowski A. (2014) Qualitative Comparative Analysis in Critical Perspective. *Sociological Methodology* 44: 1-79.
Lukasiewicz A, Pittock J and Finlayson M. (2016) Institutional challenges of adopting ecosystem-based adaptation to climate change. *Regional Environmental Change* 16: 487-499.
MA. (2005) Ecosystems and human well-being: synthesis. Washington DC: Island Press.
Maggetti M and Levi-Faur D. (2013) Dealing with Errors in QCA. *Political Research Quarterly* 66: 198-204.
Marx A. (2010) Crisp-set qualitative comparative analysis (csQCA) and model specification: Benchmarks for future csQCA applications. *International Journal of Multiple Research Approaches* 4: 138-158.
Massey E, Huitema D, Garrelts H, et al. (2015) Handling adaptation policy choices in Sweden, Germany, the UK and the Netherlands. *Journal of Water and Climate Change* 6: 9-24.
Mastrangelo LM, Benitez DG and Cruz-Ros S. (2017) How Social Entrepreneurs can Influence their Employees' Commitment. *Journal of Promotion Management* 23: 437-448.
Mazmanian DA, Jurewitz J and Nelson HT. (2013) A Governing Framework for Climate Change Adaptation in the Built Environment. *Ecology and Society* 18.
McAfee K. (2012) The Contradictory Logic of Global Ecosystem Services Markets. *Development and Change* 43: 105-131.
McCauley DJ. (2006) Selling out on nature. *Nature* 443.
McMullen J, Plummer L and Acs Z. (2007) What is an Entrepreneurial Opportunity? *Small Business Economics* 28: 273-283.
McMullen JS and Shepherd DA. (2006) Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *The Academy of Management Review* 31: 132-152.
Mees H. (2017) Local governments in the driving seat? A comparative analysis of public and private responsibilities for adaptation to climate change in European and North-American cities. *Journal of Environmental Policy & Planning* 19: 374-390.
Mees HLP, Driessen PPJ and Runhaar HAC. (2012) Exploring the Scope of Public and Private Responsibilities for Climate Adaptation. *Journal of Environmental Policy & Planning* 14: 305-330.
Meijerink S and Dicke W. (2008) Shifts in the Public–Private Divide in Flood Management. *International Journal of Water Resources Development* 24: 499-512.
Meijerink S and Huitema D. (2010) Policy entrepreneurs and change strategies: Lessons from sixteen case studies of water transitions around the globe. *Ecology and Society* 15.

Mercer J, Kelman I, Alfthan B, et al. (2012) Ecosystem-based adaptation to climate change in Caribbean small island developing states: integrating local and external knowledge. *Sustainability* 4: 1908–1932.

Metelits CM. (2009) The Consequences of rivalry: Explaining insurgent violence using fuzzy sets. *Political Research Quarterly* 62: 673-684.

Miles MB, Huberman M and Saldaña J. (2014) *Qualitative Data Analysis: A Methods Sourcebook,* Thousand Oaks: SAGE.

Miller KD. (2007) Risk and rationality in entrepreneurial processes. *Strategic Entrepreneurship Journal* 1: 57-74.

Milman A and Jagannathan K. (2017) Conceptualization and implementation of ecosystems-based adaptation. *Climatic Change* 142: 113-127.

Milman A and Warner BP. (2016) The interfaces of public and private adaptation: Lessons from flooding in the Deerfield River Watershed. *Global Environmental Change* 36: 46-55.

Ministerie van Infrastructuur en Milieu. (2015) Projectplan Achteroever Wieringermeer. Innoveren met water en 'agri' in de Wieringermeer. Wieringerwerf: Ministerie van Infrastructuur en Milieu, Provincie Noord-Holland, Hoogheemraadschap Hollands Noorderkwartier, Gemeente Hollands Kroon.

Mintrom M. (2000) *Policy entrepreneurs and school choice,* Washington, D.C.: Georgetown University Press.

Mintrom M and Norman P. (2009) Policy entrepreneurship and policy change. *Policy Studies Journal* 37: 649-667.

Mishra A, Ghate R, Maharjan A, et al. (2017) Building Ex Ante Resilience of Disaster-Exposed Mountain Communities: Drawing Insights from the Nepal Earthquake Recovery. *International Journal of Disaster Risk Reduction* 22: 167-178.

Moser SC and Boykoff MT. (2013) *Successful adaptation to climate change: Linking science and policy in a rapidly changing world*.

Moser SC and Ekstrom JA. (2010) A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences* 107: 22026-22031.

Moyer-Packenham PS, Bullock EK, Shumway JF, et al. (2016) The role of affordances in children's learning performance and efficiency when using virtual manipulative mathematics touch-screen apps. *Mathematics Education Research Journal* 28: 79-105.

Munang R, Thiaw I, Alverson K, et al. (2013a) The role of ecosystem services in climate change adaptation and disaster risk reduction. *Current Opinion in Environmental Sustainability* 5: 47-52.

Munang R, Thiaw I, Alverson K, et al. (2013b) Climate change and ecosystem-based adaptation: a new pragmatic approach to buffering climate change impacts. *Current Opinion in Environmental Sustainability* 5: 67–71.

Naumann S, Anzaldua G, Berry P, et al. (2011) Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe. Final report to the European Commission. DG Environment. Ecologic Institute, Berlin and Environmental Change Institute, Oxford University for the Environment, Oxford.

Naumann S, Davis M, Munang R, et al. (2013) The social dimension of ecosystem-based adaptation. UNEP Policy Series: Ecosystem Management. Nairobi: UNEP.

Nieto M and González-Álvarez N. (2014) Social capital effects on the discovery and exploitation of entrepreneurial opportunities. *International Entrepreneurship and Management Journal* 12: 507-530.

Noble IR, Huq S, Anokhin YA, et al. (2014) Adaptation needs and options. In: Field CB, Barros VR, Dokken DJ, et al. (eds) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge and New York.

OECD. (2008) 'Climate change', in OECD Environmental Outlook to 2030. Paris: OECD publishing.
Ojea E. (2015) Challenges for mainstreaming Ecosystem-based Adaptation into the international climate agenda. *Current Opinion in Environmental Sustainability* 14: 41-48.
Olsson P, Folke C and Hahn T. (2004) Social-ecological transformation for ecosystem management: The development of adaptive co-management of a wetland landscape in southern Sweden. *Ecology and Society* 9.
Olsson P, Gunderson LH, Carpenter SR, et al. (2006) Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society* 11.
Osterwalder A, Pigneur Y and Clark T. (2010) *Business model generation: a handbook for visionaries, game changers, and challengers,* Hoboken: Wiley.
Ostrom E and Cox M. (2010) Moving beyond panaceas: A multi-tiered diagnostic approach for social-ecological analysis. *Environmental Conservation* 37: 451-463.
Pahl-Wostl C and Knieper C. (2014) The capacity of water governance to deal with the climate change adaptation challenge: Using fuzzy set Qualitative Comparative Analysis to distinguish between polycentric, fragmented and centralized regimes. *Global Environmental Change* 29: 139-154.
Paine J. (2016) Set-Theoretic Comparative Methods: Less Distinctive Than Claimed. *Comparative Political Studies* 49: 703-741.
Parrish BD. (2010) Sustainability-driven entrepreneurship: Principles of organization design. *Journal of Business Venturing* 25: 510-523.
Pasquini L and Cowling RM. (2015) Opportunities and challenges for mainstreaming ecosystem-based adaptation in local government: evidence from the Western Cape, South Africa. *Environment, Development and Sustainability* 17: 1121-1140.
Patzelt H and Shepherd DA. (2011) Recognizing Opportunities for Sustainable Development. *Entrepreneurship Theory and Practice* 35: 631-652.
Paudyal K, Baral H and Keenan RJ. (2016) Local actions for the common good: Can the application of the ecosystem services concept generate improved societal outcomes from natural resource management? *Land Use Policy* 56: 327-332.
Pauw PS, van Baaren ES, Visser M, et al. (2015) Increasing a freshwater lens below a creek ridge using a controlled artificial recharge and drainage system: a case study in the Netherlands. *Hydrogeology Journal* 23: 1415-1430.
Penner LA, Dovidio JF, Piliavin JA, et al. (2005) Prosocial Behavior: Multilevel Perspectives. *Annual Review of Psychology* 56: 365-392.
Pijnappels M and Dietl P. (2013) *Adaptation inspiration book: 22 implemented cases of local climate change adaptation to inspire European citizens,* Groningen: Drukkerij Tienkamp.
Postel SL and Thompson BH. (2005) Watershed protection: Capturing the benefits of nature's water supply services. *Natural Resources Forum* 29: 98-108.
Pramova E, Locatelli B, Brockhaus M, et al. (2012) Ecosystem services in the National Adaptation Programmes of Action. *Climate Policy* 12: 393–409.
Ragin C and Davey S. (2014) fs/QCA [Computer Programme], Version 2.5. Irvine: University of California.
Ragin CC. (1987) *The Comparative Method. Moving beyond Qualitative and Quantative Strategies,* Berkeley: University of California Press.
Ragin CC. (2000) *Fuzzy-set social science,* Chicago and London: The University of Chicago Press.
Ragin CC. (2006) Set relations in social research: Evaluating their consistency and coverage. *Political Analysis* 14: 291-310.
Ragin CC. (2008) *Redesigning social inquiry: fuzzy sets and beyond,* Chicago: University of Chicago Press.
Ragin CC. (2014) Comment:Lucas and Szatrowski in Critical Perspective. *Sociological Methodology* 44: 80-94.

Ragin CC, Shulman D, Weinberg A, et al. (2003) Complexity, Generality, and Qualitative Comparative Analysis. *Field Methods* 15: 323-340.
Renko M, Shrader RC and Simon M. (2012) Perception of entrepreneurial opportunity: A general framework. *Management Decision* 50: 1233-1251.
Rey-Martí A, Ribeiro-Soriano D and Sánchez-García JL. (2016) Giving back to society: Job creation through social entrepreneurship. *Journal of Business Research* 69: 2067-2072.
Rihoux B, Alamos-Concha P, Bol D, et al. (2013) From Niche to Mainstream Method? A Comprehensive Mapping of QCA Applications in Journal Articles from 1984 to 2011. *Political Research Quarterly* 66: 175-184.
Rihoux B and De Meur G. (2009) Crisp-Set Qualitative Comparative Analysis (csQCA). In: Rihoux B and Ragin C (eds) *Configurational Comparative Methods. Qualitative Comparative Analysis (QCA) and related techniques.* Thousand Oaks and London: Sage.
Rihoux B and Ragin CC. (2009) *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques,* Los Angeles: Sage.
Rijkswaterstaat. (2016) De Zandmotor: Aanjager van Innovatief Kustonderhoud. Tussenresultaten 2011-2015.
Ritchie J, Lewis J and El Am G. (2003) Designing and selecting samples. In: Ritchie J and Lewis J (eds) *Qualitative research practice. A guide for social science students and researchers.* Thousand Oaks: SAGE Publications Inc.
Roberts D, Boon R, Diederichs N, et al. (2012) Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by-doing" at the local government coal face. *Environment and Urbanization* 24: 167–195.
Rohlfing I and Schneider CQ. (2013) Improving Research On Necessary Conditions: Formalized Case Selection for Process Tracing after QCA. *Political Research Quarterly* 66: 220-235.
Rohrer JM, Brümmer M, Schmukle SC, et al. (2017) "What else are you worried about?" – Integrating textual responses into quantitative social science research. *PLoS ONE* 12.
Rosenau JN and Czempiel EO. (1992) *Governance without government: order and change in world politics,* Cambridge: Cambridge University Press.
RSPB, Crossrail, ABP MER, et al. (2012) Wallasea Island Wild Coast Project. Essex: RSPB, Crossrail, ABP MER and Essex County Council.
Rudel TK. (2008) Meta-analyses of case studies: A method for studying regional and global environmental change. *Global Environmental Change* 18: 18-25.
Runhaar HAC, Uittenbroek CJ, van Rijswick HFMW, et al. (2016) Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors. *Regional Environmental Change* 16: 1389-1400.
Saleem Khan A, Ramachandran A, Usha N, et al. (2012) Predicted impact of the sea-level rise at Vellar-Coleroon estuarine region of Tamil Nadu coast in India: Mainstreaming adaptation as a coastal zone management option. *Ocean and Coastal Management* 69: 327–339.
Sandelowski M. (2000) Focus on research methods: Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing and Health* 23: 246-255.
Sandelowski M, Voils CI and Knafl G. (2009) On Quantitizing. *Journal of Mixed Methods Research* 3: 208-222.
Sarasvathy SD, Dew N, Ramakrishna Velamur S, et al. (2005) Three Views of Entrepreneurial Opportunity. In: Acs ZJ and Audretsch DB (eds) *Handbook of entrepreneurship research. An interdisciplinary survey and introduction.* Boston: Kluwer academic publishers.
SBSTA. (2011) Ecosystem-based approaches to adaptation: compilation of information. Bonn: Subsidiary Body for Scientific and Technological Advice, United Nations Framework Convention on Climate Change.

SBSTA. (2013) Report on the technical workshop on ecosystem-based approaches for adaptation to climate change. FCCC/SBSTA/2013/2. Bonn: Subsidiary Body for Scientific and Technological Advice, United Nations Framework Convention on Climate Change.
Scarpellini S, Ortega-Lapiedra R, Marco-Fondevila M, et al. (2017) Human capital in the eco-innovative firms: a case study of eco-innovation projects. *International Journal of Entrepreneurial Behaviour and Research* 23: 919-933.
Schaefer K, Corner PD and Kearins K. (2015) Social, Environmental and Sustainable Entrepreneurship Research: What Is Needed for Sustainability-as-Flourishing? *Organization & Environment* 28: 394-413.
Schaltegger S, Hansen EG and Lüdeke-Freund F. (2016) Business Models for Sustainability: Origins, Present Research, and Future Avenues. *Organization & Environment* 29: 3-10.
Schaltegger S and Wagner M. (2011) Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business Strategy and the Environment* 20: 222-237.
Schneider CQ and Wagemann C. (2010) Standards of Good Practice in Qualitative Comparative Analysis (QCA) and Fuzzy-Sets. *Comparative Sociology* 9: 397-418.
Schneider CQ and Wagemann C. (2012) *Set-theoretic methods for the social sciences: a guide to qualitative comparative analysis,* Cambridge: Cambridge University Press.
Schneider T. (2014) Responsibility for private sector adaptation to climate change. *Ecology and Society* 19.
Schumpeter J. (1934) *The theory of economic development,* Cambridge: Harvard University Press.
Shane S. (2003) *A general theory of entrepreneurship: the individual-opportunity nexus,* Cheltenham: Edward Elgar.
Shane S and Eckhardt J. (2005) The Individual-Opportunity Nexus. In: Acs ZJ and Audretsch DB (eds) *Handbook of entrepreneurship research. An interdisciplinary survey and introduction.* Boston: Kluwer academic publishers.
Shane S, Locke EA and Collins CJ. (2003) Entrepreneurial motivation. *Human Resource Management Review* 13: 257-279.
Shane S and Venkataraman S. (2000) The promise of entrepreneurship as a field of research. *The Academy of Management Review* 25: 217-226.
Shepherd DA and Patzelt H. (2011) The New Field of Sustainable Entrepreneurship: Studying Entrepreneurial Action Linking "What Is to Be Sustained" With "What Is to Be Developed". *Entrepreneurship: Theory and Practice* 35: 137-163.
Short JC, Ketchen Jr DJ, Shook CL, et al. (2010) The concept of "Opportunity" in entrepreneurship research: Past accomplishments and future challenges. *Journal of Management* 36: 40-65.
Simons H. (2009) *Case study research in practice,* London: SAGE.
Skaaning S-E. (2011) Assessing the Robustness of Crisp-set and Fuzzy-set QCA Results. *Sociological Methods & Research* 40: 391-408.
Smilde D. (2005) A Qualitative Comparative Analysis of Conversion to Venezuelan Evangelicalism: How Networks Matter. *American Journal of Sociology* 111: 757-796.
Steffen W, Richardson K, Rockström J, et al. (2015) Planetary boundaries: Guiding human development on a changing planet. *Science* 347.
Stern PC. (2000) New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues* 56: 407-424.
Summers Holtrop J, Potworowski G, Green LA, et al. (2016) Analysis of Novel Care Management Programs in Primary Care: An Example of Mixed Methods in Health Services Research. *Journal of Mixed Methods Research*.
Swart R, Biesbroek R and Capela Lourenço T. (2014a) Science of adaptation to climate change and science for adaptation. *Frontiers in Environmental Science* 2: 1-8.
Swart R, Sedee AGJ, de Pater F, et al. (2014b) Climate-Proofing Spatial Planning and Water Management Projects: An Analysis of 100 Local and Regional Projects in the Netherlands. *Journal of Environmental Policy & Planning* 16: 55-74.

Tashakkori A and Creswell JW. (2017) Editorial: The New Era of Mixed Methods. *Journal of Mixed Methods Research* 1: 3-7.

Teddlie C and Tashakkori A. (2009) *Foundations of Mixed Methods Research: Integrating Qualitative and Quantitative Approaches in the Social and Behavioral Sciences,* Thousand Oaks: SAGE.

TEEB. (2012) *The economics of ecosystems and biodiversity in business and enterprise,* London and New York: Earthscan.

Teece DJ. (2010) Business models, business strategy and innovation. *Long Range Planning* 43: 172-194.

Thiem A. (2014) Membership Function Sensitivity of Descriptive Statistics in Fuzzy-set Relations. *International Journal of Social Research Methodology* 17: 625-642.

Thiem A, Baumgartner M and Bol D. (2016a) Still Lost in Translation! A Correction of Three Misunderstandings Between Configurational Comparativists and Regressional Analysts. *Comparative Political Studies* 49: 742-774.

Thiem A, Spöhel R and Duşa A. (2016b) Enhancing Sensitivity Diagnostics for Qualitative Comparative Analysis: A Combinatorial Approach. *Political Analysis* 24: 104-120.

Thomann E. (2015) Customizing Europe: Transposition as Bottom-up Implementation. *Journal of European Public Policy* 22: 1368–1387.

Thompson G. (1991) *Markets, Hierarchies and Networks: The Coordination of Social Life,* London: Sage.

Tilley F and Young W. (2009) Sustainability Entrepreneurs. Could They Be the True Wealth Generators of the Future? *Greener Management International* 55: 79-92.

TNC. (2008) A shared vision for long-term cooperative action. Submission by The Nature Conservancy on the Assembly Document ("Ideas and Proposals on paragraph 1 of the Bali Action Plan"). Arlington: The Nature Conservancy.

TNC. (2009) Adapting to climate change. Ecosystem-based approaches for people and nature. Arlington: The Nature Conservancy.

Tompkins EL and Eakin H. (2012) Managing private and public adaptation to climate change. *Global Environmental Change* 22: 3-11.

Tóth Z, Henneberg SC and Naudé P. (2017) Addressing the 'Qualitative' in fuzzy set Qualitative Comparative Analysis: The Generic Membership Evaluation Template. *Industrial Marketing Management* 63: 192-204.

UNEP, UNDP and IUCN. (2013) Making the case for ecosystem-based adaptation. Building resilience to climate change. Nairobi: UNEP.

UNISDR. (2007) Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. United Nations Office for Disaster Risk Reduction.

Uy N, Takeuchi Y and Shaw R. (2012) An ecosystem-based resilience analysis of Infanta, Philippines. *Environmental Hazards* 11: 266–282.

Vaitkevicius S. (2013) Rethinking the Applicability of Hermeneutic Systems for Coding and Statistical Analysis of Authorial Intentions in Economics. *Inzinerine Ekonomika-Engineering Economics* 24: 415-423.

van der Heijden J. (2015) The role of government in Voluntary Environmental Programmes: A fuzzy set qualitative comparative analysis. *Public Administration* 93: 576-592.

van Lieshout M. (2014) Framing scales and scaling frames: the politics of scale and its implications for the governance of the Dutch intensive agriculture. Wageningen: Wageningen University.

van Lieshout M, Dewulf A, Aarts N, et al. (2011) Do Scale Frames Matter? Scale Frame Mismatches in the Decision Making Process of a "Mega Farm" in a Small Dutch Village. *Ecology and Society* 16.

van Slobbe E, Vriend HJ, Aarninkhof S, et al. (2013) Building with Nature: in search of resilient storm surge protection strategies. *Natural Hazards* 66: 1461–1480.

Vasileiadou E and Botzen WJW. (2014) Communicating adaptation with emotions: the role of intense experiences in raising concern about extreme weather. *Ecology and Society* 19.

Veerman C. (2008) Working together with water. A living land builds for its future. Den Haag: Secretariat Delta Committee.
Veraart JA, van Duinen R and Vreke J. (2017) Evaluation of Socio-Economic Factors that Determine Adoption of Climate Compatible Freshwater Supply Measures at Farm Level: a Case Study in the Southwest Netherlands. *Water Resources Management* 31: 587-608.
Vergne J-P and Depeyre C. (2016) How Do Firms Adapt? A Fuzzy-Set Analysis of the Role Cognition and Capabilities in U.S. Defense Firms' Responses to 9/11. *Academy of Management Journal* 59: 1653-1680.
Verweij S. (2015) Producing Satisfactory Outcomes in the Implementation Phase of PPP infrastructure Projects: A Fuzzy Set Qualitative Comparative Analysis of 27 Road Constructions in the Netherlands. *International Journal of Project Management* 33: 1877-1887.
Verweij S and Gerrits LM. (2015) How Satisfaction Is Achieved in the Implementation Phase of Large Transportation Infrastructure Projects: A Qualitative Comparative Analysis Into the A2 Tunnel Project. *Public Works Management & Policy* 20: 5-28.
Verweij S, Klijn E-H, Edelenbos J, et al. (2013) What Makes Governance Networks Work? A Fuzzy Set Qualitative Comparative Analysis of 14 Dutch Spatial Planning Projects. *Public Administration* 91: 1035-1055.
Victor DG, Zhou D, Ahmed EHM, et al. (2014) Introductory Chapter. In: Edenhofer O, Pichs-Madruga R, Sokona Y, et al. (eds) *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge and New York: Cambridge University Press.
Vignola R, Harvey CA, Bautista-Solis P, et al. (2015) Ecosystem-based adaptation for smallholder farmers: Definitions, opportunities and constraints. *Agriculture, Ecosystems & Environment* 211: 126-132.
Vignola R, Locatelli B, Martinez C, et al. (2009) Ecosystem-based adaptation to climate change: what role for policy-makers, society and scientists? *Mitigation and Adaptation Strategies for Global Change* 14: 691–696.
Vink MJ, Boezeman D, Dewulf A, et al. (2013) Changing climate, changing frames: Dutch water policy frame developments in the context of a rise and fall of attention to climate change. *Environmental Science & Policy* 30: 90-101.
Vis B. (2010) *Politics of Risk-Taking: Welfare State Reform in Advanced Democracies,* Amsterdam: Amsterdam University Press.
Vis B. (2012) The Comparative Advantages of fsQCA and Regression Analysis for Moderately Large-N Analyses. *Sociological Methods and Research* 41: 168-198.
Wamsler C. (2015) Mainstreaming ecosystem-based adaptation: transformation toward sustainability in urban governance and planning. *Ecology and Society* 20.
Wamsler C, Luederitz C and Brink E. (2014) Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environmental Change* 29: 189-201.
Wamsler C, Niven L, Beery TH, et al. (2016) Operationalizing ecosystem-based adaptation: harnessing ecosystem services to buffer communities against climate change. *Ecology and Society* 21.
Wang W. (2016) Exploring the Determinants of Network Effectiveness: The Case of Neighborhood Governance Networks in Beijing. *Journal of Public Administration Research and Theory* 26: 375-388.
WB. (2009) Convenient solutions to an inconvenient truth: ecosystem-based approaches to climate change. Washington DC: Environmental Department, The World Bank.
WBCSD. (2008) Adaptation: An issue brief for business. Geneva: WBCSD.
WBCSD. (2012) Biodiversity and ecosystem services scaling up business solutions: Company case studies that help achieve global biodiversity targets. Geneva: WBCSD.

Weinhofer G and Busch T. (2013) Corporate Strategies for Managing Climate Risks. *Business Strategy and the Environment* 22: 121-144.

Wellstead A, Rayner J and Howlett M. (2014) Beyond the black box: Forest sector vulnerability assessments and adaptation to climate change in North America. *Environmental Science & Policy* 35: 109-116.

Wertz-Kanounnikoff S, Locatelli B, Wunder S, et al. (2011) Ecosystem-based adaptation to climate change: what scope for payments for environmental services? *Climate and Development* 3: 143–158.

Westley FR, Tjornbo O, Schultz L, et al. (2013) A theory of transformative agency in linked social-ecological systems. *Ecology and Society* 18.

Wiering M, Green C, van Rijswick M, et al. (2015) The rationales of resilience in English and Dutch flood risk policies. *Journal of Water and Climate Change* 6: 38-54.

Yin RK. (2003) *Case study research: design and methods,* Thousand Oaks: Sage.

Zahra SA, Gedajlovic E, Neubaum DO, et al. (2009) A typology of social entrepreneurs: Motives, search processes and ethical challenges. *Journal of Business Venturing* 24: 519-532.

Zölch T, Wamsler C and Pauleit S. (2018) Integrating the ecosystem-based approach into municipal climate adaptation strategies: The case of Germany. *Journal of Cleaner Production* 170: 966-977.

APPENDICES

Appendix A. Purposive sample design

This appendix covers the steps taken to design and implement a purposive sampling strategy for this thesis, based on Ritchie et al. (2003). The steps are (1) identifying the study population, (2) choosing selection criteria, (3) prioritizing the selection criteria, (4) designing a sample matrix and assigning quotas, and (5) implementing the sample design (Figure A1).

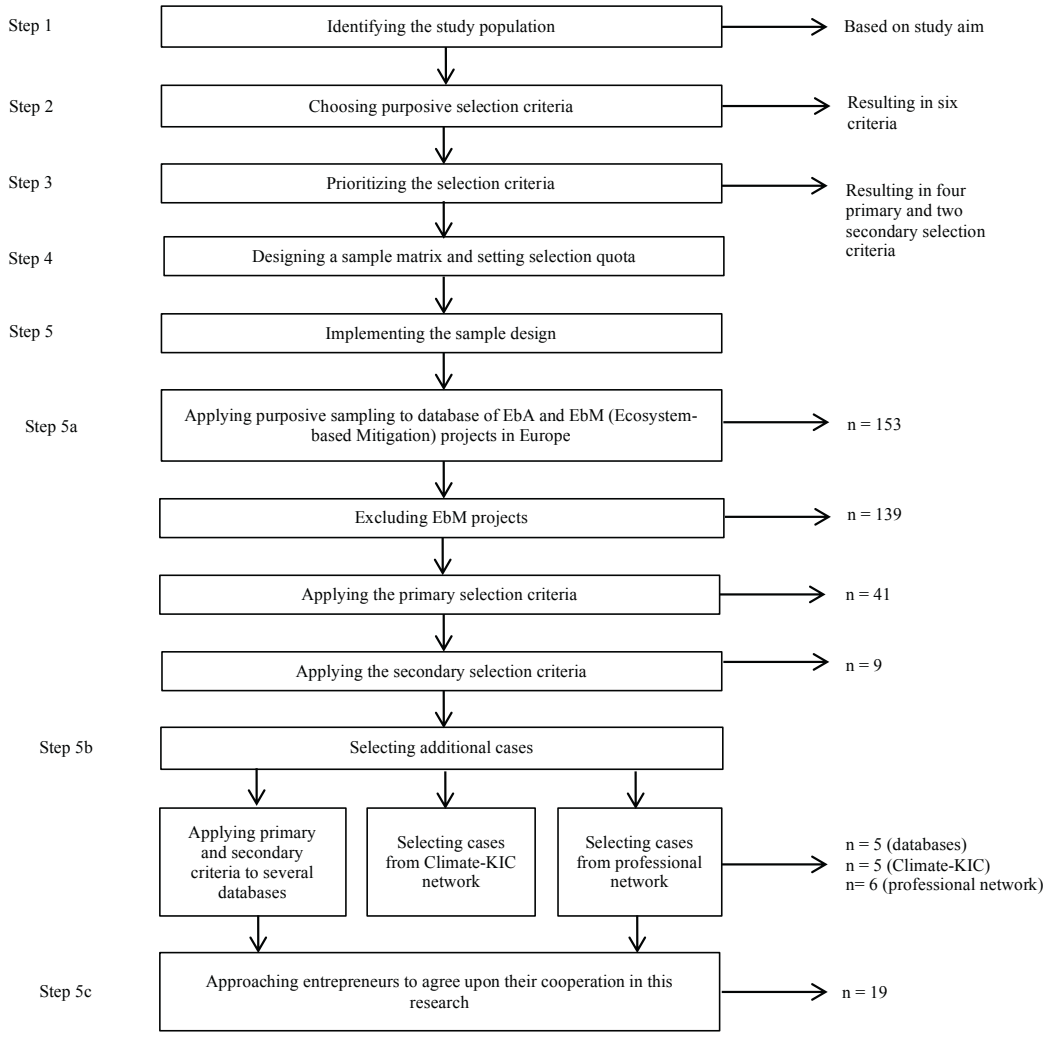

Figure A1. Diagram of the purposive sampling strategy

1. Identifying the population for study

The overall research objective for this thesis was to increase the understanding of how entrepreneurs develop opportunities in ecosystem-based adaptation practice. Accordingly, the study population was identified as 'entrepreneurs involved in ecosystem-based adaptation projects and programmes in Europe'.

2. The choice of purposive selection criteria

A database of 153 European EbA and ecosystem-based mitigation cases (Naumann et al., 2011) formed the starting point for the selection of cases. The following criteria, based on characteristics outlined in the database, were considered for purposive selection:

Type

Projects or programmes should involve land use change or 'real action on the ground'. Initiatives focussing *solely* on education, awareness raising, capacity building, etc. were excluded.

Phase

Projects or programmes are ongoing or implemented/completed. Entrepreneurial strategies and development of opportunities can only be analysed during or after an initiative. For this reason, 'proposed' and 'planned' projects were excluded.

Geographical scale

Projects or programmes take place at the local or regional level. Studying cases at these levels permitted greater case intimacy and, as a result, generated more in-depth knowledge about the entrepreneurial process.

Funding

Projects or programmes are financed privately, publicly or through public-private partnerships (PPPs). This variety in funding sources ensured diversity in the sample and increased the likelihood that entrepreneurs from both the public and private sector are identified.

Business model

There was the possibility of including a business model as part of the project or programme (e.g. farmers are involved, ecotourism is part of the project, there is a search for alternative livelihoods), which increased the likelihood of entrepreneurs being involved.

Entrepreneurial opportunities

Ideas are developed and actions are undertaken that enable the creation of (new) ecosystem services, markets for these services and/ or actor constellations.

3. Prioritizing the selection criteria

The six identified purposive selection criteria were divided into primary and secondary criteria. In practice, this meant that potential cases were initially selected on the basis of the primary criteria. This selection was subsequently screened and assessed using the secondary criteria (Table A1).

Table A1. Primary and secondary case selection criteria

Primary criteria	Secondary criteria
1. Type	1. Business model
2. Phase	2. Entrepreneurial opportunities
3. Geographical scale	
4. Funding	

4. Designing a sample matrix and assigning quotas for case selection

A sample matrix (Table A2) was constructed, based on the primary selection criteria. This served two principal aims: to ensure that all relevant groups were covered and to ensure a degree of diversity. The secondary criteria increased the likelihood that entrepreneurs were present and were considered in a subsequent selection stage. Each cell in the table represents an EbA project or programme with specific characteristics. A number of sample units to be selected (quota) was assigned to each cell. The aim was to select 12–24 cases, based on the case analysis methods selected for this thesis and an estimation of the available time for data selection and analysis. The matrix was used to ensure that the final selection of cases matched the sample

design. For example, the range 1–2 in the upper left cell means that from one to two local, ongoing EbA projects or programmes had to be found that were privately funded.

Table A2. Sample matrix showing the quota for case selection

	Local		**Regional**	
	Ongoing	**Implemented/ Completed**	**Ongoing**	**Implemented/ Completed**
Private funding	1–2	1–2	1–2	1–2
Public funding	1–2	1–2	1–2	1–2
PPP	1–2	1–2	1–2	1–2

5. Implementing the sample design

Selecting entrepreneurs active in EbA proved to be the most challenging part of the purposive sampling methodology. Applying the primary and secondary selection criteria already increased the likelihood that entrepreneurs were present in a certain project or programme. Key people involved in the project or programme were then contacted by email or phone and asked whether any entrepreneurs were involved. When any relevant actors involved in a case met the selection criteria and agreed to participate, a note was made of which quotas they filled. Each time someone was recruited, the sample was reviewed against the quota requirements in the sample matrix to identify the remaining gaps. Of the initial database of 153 cases, nine cases met the selection criteria. The search was therefore extended to the following additional databases that were accessed in February and March 2014:

http://www.grabs-eu.org/casestudies.php

http://www.klimaatbuffers.nl/english-homepage-2

http://www.innoverenmetwater.nl/

http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/6547.php

Also, cases were selected from the Climate-KIC network in which I was involved as well as via other professional contacts. At this stage, additional cases from the UK and the Netherlands were sourced, for the reasons outlined in section 1.4.2 of this thesis. Table A3 presents the results of the purposive sampling strategy.

Table A3. Sample design after implementing the purposive sampling methodology

	Local		**Regional**	
	Ongoing	**Implemented/ Completed**	**Ongoing**	**Implemented/ Completed**
Private funding	Roof Doctors The Green City			Butterfly Beef Pastures New
Public funding	Blue-Green Dream Blue-Green Global Nienhuis Landscape Architects	Bureau Stroming	Green Climate Belt Wallasea	Landbouw op Peil Working with Nature
Public and private funding	CAFCA Inland Shore Wieringermeer Water Husbandry	Abbotts Hall Building with Nature	Trent and Tame Futurescape	

NB: Climate Resilience ltd. is included as a case in this thesis, but does not fit the primary criterion 'type', i.e., 'real action on the ground'. However, I decided to include it in Chapter 3 as it offered interesting insights in entrepreneurship in EbA from a consultant point of view.

As can be seen in Table A3, not all type of projects or programmes could be identified. Finding EbA initiatives that were solely privately funded proved especially challenging. However, I continued with the sample of 18 cases (and Climate Resilience ltd., see heading of the table) since the majority of the cells contained cases (9 out of 12).

Appendix B. Description of the calibration procedure

Application of fsQCA required a conversion of the qualitative data to fuzzy-set membership values. We developed a specific comparative research design following the stepwise approach proposed by Basurto and Speer (2012) for structuring the calibration of qualitative data as fuzzy sets. First, we identified a preliminary list of indicators for the conditions and outcome based on entrepreneurship and adaptation literature. We started with a review of 15 papers published between 2001 and 2014 on entrepreneurial opportunity exploitation (e.g. Companys and McMullen, 2007; Fuentes Fuentes et al., 2010; Nieto and González-Álvarez, 2014; Shane, 2003), which we obtained through a Scopus search and snowballing. The review resulted in a longlist of 18 conditions influencing opportunity exploitation. We subsequently discussed the relevance of each condition for EbA, resulting in the exclusion of ten conditions, e.g. age of the entrepreneur and the amount of taxes. The third step consisted of a review of 17 peer-reviewed papers (e.g. Jones et al., 2012; Munang et al., 2013b; Vignola et al., 2009) and 27 other documents on EbA (e.g. Colls et al., 2009; Doswald and Osti, 2011; Naumann et al., 2011; SBSTA, 2013; WB, 2009) published between 2008 and 2014. These documents were fully read and relevant components were assigned to one of the eight conditions. Two conditions that were largely unaddressed in EbA literature were then excluded. An iterative process of refining the conditions and indicators took subsequently place during the interview coding phase, leading to a final list used as a guidance for coding the qualitative data. Although entrepreneurship and adaptation literature pointed at specific conditions and indicators to be included, how to measure their intensity and which thresholds to use was more difficult to obtain from this literature. Therefore, and due to the exploratory nature of our study, we chose to code the interviews using a seven scale classification, based on the level of detail in the data. The seven coding values correspond with a specific fuzzy-set value (Table B1). Based on the distinction between ‘little prominence’ and ‘somewhat prominent’ we decided to put the threshold between cases in and out of the set between coding value four and five, indicated by fuzzy-set values 0.55 and 0.33, respectively.

Table B1. Coding values and corresponding fuzzy-set values

Coding value	Description	Fuzzy value	The element is ...
1	Very prominent; spontaneously mentioned	1	Fully in
2	Very prominent; in response to a question	0.83	Mostly in
3	Somewhat prominent; spontaneously mentioned	0.67	More in than out
4	Somewhat prominent; in response to a question	0.55	Just in
5	Little prominence; spontaneously mentioned	0.33	More out than in
6	Little prominence; in response to a question	0.17	Mostly out
0	Absent	0	Fully out

Since little information exists on measurement and operationalization of entrepreneurial opportunity exploitation, we based the coding and related fuzzy-set values of the outcome partially on literature and complemented this with descriptions by interviewees and case knowledge. The following factors from literature were used to indicate the extent of opportunity exploitation:

- Implementation of sustainable business model. This relates to the economic sustainability of the case, which is determined by, for example, whether payments of customers received from value delivered is converted into profit and whether the case is dependent on subsidies and funds (Teece, 2010).
- Involvement and activities undertaken related to the introduction of the EbA-related products or services. Since an essential component of opportunity exploitation is the gathering and (re)combination of resources, whether or not these activities are (still) undertaken is used as a measurement of the extent of opportunity exploitation.
- Whether or not EbA-related products or services are operated at full-scale, meaning that they are beyond the market testing phase (Choi and Shepherd, 2004). Pilot projects or experiments are an important step in developing EbA (van Slobbe et al., 2013). However, full exploitation means products or services are beyond the experimental phase, and this is used as a measurement of the extent of opportunity exploitation.

Based on the level of detail in our data, we distinguished four degrees of opportunity exploitation with related fuzzy-set values: successful opportunity exploitation when all three factors were present (1), somewhat successful opportunity exploitation when two out of three

Table B2. Example of coding procedure and resultant fuzzy-set values for indicators and outcome of the Pastures New case

	Coding value	Fuzzy-set value	Motivation
Opportunity exploitation (Outcome)	NA	1	The Dorset Wildlife Trust advises farmers in Dorset about possibilities to apply for agro-environment schemes. While these consultancy services were initiated as part of a project, they now run independently and provide revenues for the Trust. Activities are ongoing and beyond the testing-phase.
Empathy – connectivity to place	5	0.33	Connectivity to place is not directly apparent from the interview. However, based on a field visit and informal conversations we concluded that although not very explicit, there is a special connection of the entrepreneurs to the case location.
Empathy – solidarity with others	2	0.83	The prominent presence of solidarity was expressed in the interview through recurrent and extensive reference to the cooperation with and support for the farming community in the area. The prominence of this indicator was confirmed through communications on the website and in the project report.
Climate change awareness and risk perception	2	0.83	Climate change adaptation plays a prominent role in the rationale behind the case and is elaborated upon after asking about it. Climate resilience is further referred to and explained in the project report.
Enhancement of biodiversity and ecosystem services	1	1	Biodiversity enhancement is the main aim of the initiative. It is spontaneously mentioned and extensively referred to in the interview, as well as addressed on the website and in the project report.
Profit maximization	0	0	The answers on a number of questions indicate that the interviewees do not aim to maximise the economic gains of the Wildlife Trust.
Development of business models	5	0.33	Although the interviewees are trying to think about ways to make grassland restoration economically sustainable and mention this spontaneously, the motivation to implement business models is not prominently expressed in the interview.
Availability of external capital	1	1	Availability of funding from charitable trusts and other sources are spontaneously mentioned at the start of the interview for making the initiative financially possible. These sources are also mentioned in the project report.
Availability of internal capital	4	0.55	The Trust invested 20% of their own money into the initiative as it was contributing to their core aims. This answer was obtained during a supplementary interview.
Availability of revenues	2	0.83	The interviewees indicate that there is currently enough interest of farmers for their consultancy services to continue with the initiative and even expand it.
Influence of international, national and local policies	1	1	The EU agricultural policy is very prominently referred to in the interview as it is the core subject of the consultancy services the Trust offers. The importance of this indicator is confirmed in the project report.
Influence of regulations	6	0.17	Influencing regulations are neither mentioned in the main nor in the supplementary interview. However, the project document briefly refers to a specific procurement rule, hence the value 6 for this indicator.

factors were present (irrespective which two; we thus attributed an equal weight to each factor) (0.67), under-exploitation of opportunities when one out of three factors was present (0.33) and unsuccessful opportunity exploitation when none of the factors was present (0). Table B2 gives an example of how we assigned fuzzy-set values to the outcome and to each indicator for a specific case, Pastures New.

Data on the outcome, conditions and indicators were collected by means of semi-structured interviews, observations and literature (Table B3). Overall, we interviewed 28 entrepreneurs, some of whom were involved in more than one case. In the latter case we interviewed at least one other entrepreneur involved in the project. The same entrepreneurs were involved in two cases, which could potentially compromise the variance of the actor attributes. However, our interviews showed that the difference between the condition 'financial motives' in the two cases was considerable, and therefore we included both projects as separate cases. An interview guideline consisting of seven sections was created. We started with an introductory section, followed by five sections on respectively the outcome and the four conditions. The seventh section consisted of a table listing all indicators which' importance interviewees needed to rate on a five-point Likert scale, ranging from extremely important to not at all important for successful introduction of products and services. We used this table to verify the answers to previous questions as a variance on the specifying questions proposed by Basurto and Speer (2012). Subsequently, the interviews were independently coded by two researchers using Atlas.ti 7 software. The initial list with indicators provided the code names and was complemented with open coding. Each interview quotation received a value from 0 to 6 to indicate its prominence. The coding values of both researchers were systematically compared and discussed. In case of differences in values, the data was assessed again and literature and case knowledge was used to come to a mutually agreed and final coding value – and corresponding fuzzy-set value – for each indicator per case.

Table B3. Type and number of data sources collected in the 18 EbA cases

Case name	Number of persons interviewed	Additional information sources
Abbotts Hall	1	Project factsheets (12), field visit (1)
Blue Green Dream	2	Supplementary interview (1)
Blue Green Global	1	Website (1)
Building with Nature	3	Project document (1), informal meetings (6)
Bureau Stroming	2	Websites (2)
Butterfly Beef	2	Supplementary interview (1), field visit (1), project documents (2), website (1)
CAFCA	1	Project documents (2)
Climate Resilience ltd.	1	Supplementary interview (1)
Green climate belt	1	Website (1), media coverage (2), factsheet (1)
Inlandshore Wieringermeer	2	Project meetings (12), field visits (4), informal meetings (8), project documents (2)
Landbouw op Peil	1	Project document (1), website (1)
Nienhuis Landscape Architects	1	Supplementary interview (1), website (1)
Pastures New	2	Supplementary interview (1), field visit (1), informal meeting (1), project documents (2), website (1)
Roof doctors	1	Website (1)
The Green City	1	Website (1), project documents (4)
Trent and Tame Futurescape	1	Project documents (3), website (1)
Water holding	5	Project meeting (1), field visit (1), website (1)
Working with Nature	2	Project meetings (4), project documents (2)

Subsequently, each fuzzy-set value was revised and adjusted if deemed necessary by going through one indicator across all cases. As such, we could evaluate whether the fuzzy-set value differences between cases reflected real differences according to our case knowledge and whether the interview data were well captured by the fuzzy-set values. We found discrepancies for a few cases and went back to the interview data to revise and adjust the fuzzy-set value, in order to verify the adequate representation of the case evidence in the fuzzy-set values. Subsequently, we aggregated the fuzzy-set values of all indicators into the condition to which they belong by means of 'compensation', i.e. taking the arithmetic mean. This was seen as the

best option to represent the indicators, after also considering taking the weakest link (i.e. minimum value among the indicators) and substitutability (i.e. taking the maximum value among the indicators) (Ragin, 2000). The reason for this choice lies in the data: coding values of each indicator include a subjective influence that is inherent to individual judgments. Taking the minimum or maximum value among the indicators would mean it would reflect the value of a single indicator. To limit the influence of a single indicator and increase the robustness of aggregation, we applied the arithmetic mean (Pahl-Wostl and Knieper, 2014). Each indicator was assigned the same weight, except for connectivity to place and solidarity with others. The average value of these two (sub)indicators was taken. This value was subsequently averaged with the other two indicators constituting 'altruism'. The values per indicator and final aggregation of fuzzy-set values into the four conditions is presented in Table B4.

Table B4. Fuzzy-set values per indicator and outcome and final aggregated fuzzy-set values into the four conditions. The indicators are abbreviated

Cases	AL	*Emp: Conn*	*Emp: Sol*	*Bio*	*CC*	FM	*Prof max*	*Dev bus*	CA	*External*	*Internal*	*Revenues*	PR	*Policies*	*Regul*	OE
Abbotts Hall	**0.55**	0.83	0	0.67	0.55	**0.83**	0.83	0.83	**0.63**	1	0.33	0.55	**0.83**	0.83	0.83	**1**
Blue Green Dream	**0.48**	0	0.55	0.33	0.83	**0.58**	0.83	0.33	**0.29**	0.33	0	0.55	**0.17**	0.17	0.17	**0.33**
Blue Green Global	**0.48**	0	0.55	0.83	0.33	**0.42**	0.17	0.67	**0.41**	0.67	0	0.55	**0.17**	0.17	0.17	**0.33**
Building with Nature	**0.41**	0	0.67	0.33	0.55	**0.69**	0.55	0.83	**0.72**	0.67	0.83	0.67	**0.75**	0.83	0.67	**0.67**
Bureau Stroming	**0.73**	0.83	0.55	0.67	0.83	**0.44**	0.33	0.55	**0.39**	0.17	0	1	**0.69**	0.83	0.55	**1**
Butterfly Beef	**0.71**	0.33	0.83	1	0.55	**0.42**	0	0.83	**0.18**	0	0.55	0	**0.83**	0.83	0.83	**0**
CAFCA	**0.48**	0	0.55	0.17	1	**0.92**	1	0.83	**0.56**	0.67	0.67	0.33	**0.17**	0.17	0.17	**0.33**
Climate Resilience ltd.	**0.44**	0	0	0.33	1	**0.25**	0.17	0.33	**0.61**	0	0.83	1	**0.75**	0.83	0.67	**1**
Green Climate Belt	**0.61**	0.67	0.67	0.33	0.83	**0.25**	0.33	0.17	**0.66**	0.33	0.83	0.83	**0.33**	0.33	0.33	**0.33**
Inlandshore Wieringermeer	**0.41**	0.67	0.33	0.33	0.67	**0.69**	0.55	0.83	**0.46**	0.83	0	0.55	**0.33**	0.33	0.33	**0.33**
Landbouw op Peil	**0.33**	0.17	0.17	0	0.83	**0.33**	0.33	0.33	**0.78**	1	1	0.33	**0.42**	0.17	0.67	**0.67**
Nienhuis Architects	**0.20**	0	0.17	0.17	0.33	**0.83**	0.83	0.83	**0.33**	0	0.33	0.67	**0.61**	0.67	0.55	**1**
Pastures New	**0.80**	0.33	0.83	1	0.83	**0.17**	0	0.33	**0.79**	1	0.55	0.83	**0.59**	1	0.17	**1**
Roof doctors	**0.69**	0	0.83	0.83	0.83	**0.83**	0.83	0.83	**0.61**	0.33	0.83	0.67	**0.17**	0.33	0	**0.67**
The Green City	**0.64**	0	0.83	0.83	0.67	**0.44**	0.33	0.55	**0.74**	0.55	0.67	1	**0.61**	0.67	0.55	**0.67**
Trent and Tame Futurescapes	**0.61**	0	0.33	1	0.67	**0.42**	0	0.83	**0.64**	0.83	0.55	0.55	**0.83**	0.83	0.83	**0.67**
Water holding	**0.48**	0	0.55	0.17	1	**0.83**	0.83	0.83	**0.74**	0.55	0.83	0.83	**0.75**	0.83	0.67	**0.33**
Working with Nature	**0.42**	0	0.33	0.55	0.55	**0.58**	0.83	0.33	**0.48**	0.33	0.55	0.55	**0.17**	0.17	0.17	**0**

Appendix C. Case overview

Case	Description	Goods or services introduced
Abbotts Hall	A Wildlife Trust managing a farm as an independent entity, combining profitable farming with environmental stewardship and nature-based coastal protection	Agricultural products derived from farming in an environmental-friendly way and ecosystem services (flood protection and recreation)
Blue Green Dream	A consortium of companies and knowledge institutes develop and market models and tools that quantify and integrate various benefits of green and blue infrastructure in cities	Models and tools for integrating blue and green infrastructure
Blue Green Global	A start-up aiming at developing and marketing models and tools that quantify, integrate and optimize water resources use in urban areas	Models and tools for optimizing water resources use in urban areas
Building with Nature	A consortium of companies, knowledge institutes and governmental bodies develop and market design principles for using natural processes in coastal engineering to create economic and ecological values	Consultancy services about nature-based coastal engineering
Bureau Stroming	A consultancy firm develops plans and strategies to realize 'climate buffers'; nature areas specifically designed for climate change adaptation	Consultancy services and project realisation of climate buffers
Butterfly Beef	A Wildlife Trust aims to build a conservation accredited brand for beef from traditional breeds with low stocking density, thereby preserving nature areas which function as wildlife corridor under climate change	Conservation accredited beef
CAFCA	A consultancy firm develops a method to accelerate adaptation to extreme events by joining existing spatial planning developments and introducing various investment forms	Consultancy services and project development about adaptation in urban water management
Climate Resilience ltd.	A consultancy firm is set up which provides advice to the public sector about climate change adaptation issues, specifically related to conservation and biodiversity	Consultancy services about climate change impacts, adaptation and vulnerability in relation to the natural environment
Green Climate Belt	An organization involving plant breeders is set up to create a green climate belt around an urbanized area using climate adaptive plant species	A green belt partially consisting of climate adaptive plant species providing biomass and contributing to biodiversity, air quality, recreation and tourism

Case	Description	Goods or services introduced
Abbotts Hall	A Wildlife Trust managing a farm as an independent entity, combining profitable farming with environmental stewardship and nature-based coastal protection	Agricultural products derived from farming in an environmental-friendly way and ecosystem services (flood protection and recreation)
Blue Green Dream	A consortium of companies and knowledge institutes develop and market models and tools that quantify and integrate various benefits of green and blue infrastructure in cities	Models and tools for integrating blue and green infrastructure
Blue Green Global	A start-up aiming at developing and marketing models and tools that quantify, integrate and optimize water resources use in urban areas	Models and tools for optimizing water resources use in urban areas
Building with Nature	A consortium of companies, knowledge institutes and governmental bodies develop and market design principles for using natural processes in coastal engineering to create economic and ecological values	Consultancy services about nature-based coastal engineering
Bureau Stroming	A consultancy firm develops plans and strategies to realize 'climate buffers'; nature areas specifically designed for climate change adaptation	Consultancy services and project realisation of climate buffers
Butterfly Beef	A Wildlife Trust aims to build a conservation accredited brand for beef from traditional breeds with low stocking density, thereby preserving nature areas which function as wildlife corridor under climate change	Conservation accredited beef
CAFCA	A consultancy firm develops a method to accelerate adaptation to extreme events by joining existing spatial planning developments and introducing various investment forms	Consultancy services and project development about adaptation in urban water management
Climate Resilience ltd.	A consultancy firm is set up which provides advice to the public sector about climate change adaptation issues, specifically related to conservation and biodiversity	Consultancy services about climate change impacts, adaptation and vulnerability in relation to the natural environment
Green Climate Belt	An organization involving plant breeders is set up to create a green climate belt around an urbanized area using climate adaptive plant species	A green belt partially consisting of climate adaptive plant species providing biomass and contributing to biodiversity, air quality, recreation and tourism

Case	Description	Goods or services introduced
Inlandshore Wieringermeer	A consortium of businesses, knowledge institutes and governmental bodies combine flexible water storage to anticipate droughts with economic and social functions	Products from aquaculture and floating and brackish agriculture
Landbouw op Peil	A water board provides consultancy services to farmers introducing and testing soil and water conservation measures to deal with excess and too little water	Consultancy services to farmers about innovative ways to manage the water resources on their land under a changing climate
Nienhuis Landscape Architects	A landscape architecture firm dealing with spatial issues, amongst others related to climate change, is set up	Plans and visions introducing landscape designs which deal with, amongst others, flood risks and water safety issues
Pastures New	A Wildlife Trust starts to provide consultancy services to farmers about a more environmental-friendly management of their land, thereby maintaining wildlife migratory routes	Consultancy services to farmers about groupwise application for agro-environment schemes
Roof doctors	A firm is set up which transforms roofs in urban areas into zones for biodiversity, water storage, cooling, recreation and energy- and food production	Design, construction and maintenance of green and blue roofs in urban areas
The Green City	An organization involving horticulturalists raises awareness about the societal benefits of vegetation in cities, i.e. climate change adaptation, biodiversity, health and economic values	Advice, construction and maintenance of green spaces in urban areas
Trent and Tame Futurescape	A nature conservation NGO and mineral companies cooperate to extract minerals in combination with *ex-ante* and *ex-post* habitat restoration, thereby creating wildlife migration corridors	Mineral extraction in combination with habitat restoration
Water holding	A consultancy firm together with farmers develop underground water storage in winter as buffer for dry summers	Consultancy services about the organisational aspects of a water holding, e.g. water distribution and marketing
Working with Nature	A consortium of businesses and knowledge institutes identifies business concepts and prototypes around Building with Nature	Business prototypes on mangrove restoration, room for the river, sand nourishment and re-use of dredged material

Appendix D. Determination of consistency threshold for sufficient combinations of conditions

In determining the consistency threshold, we started from the argument that the minimum consistency score for sufficient conditions is 0.75. However, high confidence in the precision and validity of the calibration procedure as well as a relatively low number of cases under investigation leads to a higher threshold value. Moreover, often a gap exists between rows with relatively high and low consistency values that can guide the decision of where to put the threshold (Schneider and Wagemann, 2012). In our data, the largest gap was observed between consistency value 0.90 (row 5) and 0.85 (row 6). Therefore, in combination with the previous two arguments to have a higher consistency threshold, we decided to put the consistency threshold at 0.85.

Appendix E. Sufficiency analysis

Identification of the sufficient conditions requires logically minimizing the various sufficiency statements contained in the truth table, i.e. all rows with a value 1 in the outcome column, by means of the rules of Boolean algebra. The fsQCA software produces three solution terms. First, the conservative solution is only based on those truth table rows which correspond to empirically observed cases[2]. Second, the intermediate solution draws on all empirically observed truth table rows and those combination of conditions which do not correspond to empirical cases (logical remainders), but which contribute to parsimony of the solution terms and can be assumed to produce the outcome of interest (here: opportunity exploitation)[3]. Third, the parsimonious solution is based on all empirically observed cases as well as those truth table rows contributing to the parsimony of the solution term. According to Baumgartner (2015), intermediate and conservative solutions are unsuitable for discovering causal dependencies or testing causal hypotheses. Unlike current customs in QCA literature to select the intermediate solution to strike a balance between complexity and parsimony (Ragin, 2008), Baumgartner (2015) urges the use of the parsimonious solution when looking for causal relationships. Moreover, the conservative and intermediate solution contain redundant conditions, whereas the parsimonious solution excludes these. Therefore, we decided to use the parsimonious solution for our analysis.

[2] The conservative solution produced is CA*PR + ~AL*FM*PR → OE
[3] The intermediate solution produced is PR*CA + PR*FM*~AL → OE

Appendix F. Additional details of the alternative parsimonious solution term

	CA + PR → OE
Raw coverage	0.77
Unique coverage	0.06
Covered cases	Abbotts Hall Building with Nature Climate Resilience ltd. Landbouw op Peil Pastures New Roof doctors The Green City Trent and Tames Futurescapes
Consistency	0.79
Solution coverage	0.87
Solution consistency	0.73

Appendix G. Selection procedure of studies included in the literature review

Our criteria for selecting QCA studies using qualitative data were: applying a QCA analysis, using qualitative data, refereed journal articles, English language. To find the studies that meet these criteria, we used a variety of search strategies. We consulted the bibliography on the COMPASSS website, which is a worldwide network of scholars and practitioners working with QCA (www.compasss.org, last accessed November 2016). We examined the articles' potential relevance based on mentioning the use of qualitative data in the titles and/or abstracts. When considered relevant, we read the methods section to see whether qualitative data had been used. This search process led to the selection of three papers. Additionally, we used Scopus to find articles that referenced one of the few methodological studies on how to use qualitative data in QCA: Basurto and Speer (2012) (n=10, accessed on October 20, 2016). We selected four relevant ones, using the same strategy as with the COMPASSS bibliography. A similar search on ISI Web of Science yielded no additional articles. We further determined the relevance of the seven articles discussed by the other methodological study on how to use qualitative data in QCA: Tóth et al. (2017). This resulted in three additional papers. Finally, we derived 19 papers based on references in already selected papers (i.e., snowballing) and through suggestions for relevant articles from our network. This search process resulted in a total of 29 articles.

Appendix H. Overview of the studies using qualitative data for QCA

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Aversa et al. (2015)	The authors use csQCA. They use their qualitative data to code the cases as being "in" (1.0) or "out" (0) of a set. However, it is not clear what are the sets (conditions). Probably the ones listed in Table 5 and 6, but the calibration of these conditions is not discussed.	NA (csQCA)	Not discussed	Besides some information on the calibration of the outcome, calibration of the conditions is not discussed and/ or presented.	None
Basurto (2013)	Some conditions have continuous values based on percentages, others are dichotomous (presence/ absence or many/ few). The conditions with semi-continuous values have a five-point scale and the threshold lies between "more often than not" (0.6) and "less often than not" (0.4).	Either based on the assigned value (expressed in percentages) or, in case of multiple measures constituting one condition, on averaging the measures.	Not discussed	A table in the main text states the types of states per condition (e.g., four-value) and defines them. No information is given on how the interview data translate into the values. The appendix contains tables with fuzzy-set values of all conditions and the outcome.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Basurto and Speer (2012)	Full membership and non-membership are determined by constructing imaginary cases. The cross-over point is set in between. All values are based on theoretical and case knowledge.	The relevant interview codes for each case are matched with a predetermined qualitative classification and related (four-value) fuzzy-sets. Values for one condition obtained by taking the maximum value of the sub-measures, since they are substitutable.	Not discussed	The paper contains text boxes with examples on how the data are calibrated. The empirical data are merely used to illustrate the proposed calibration procedure.	None
Chai and Schoon (2016)	A software program is used to divide the outcome into four segments with related fuzzy values. The conditions are coded either present or absent, whereby the reasoning is at times not that straightforward. NB: With only crisp conditions, there is no point in having a fuzzy outcome .	NA (csQCA)	Not discussed	The authors state they use the approach by Basurto and Speer (2012), but do not state how. The dichotomized data are presented in a table in the main text.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Chatterley et al. (2013)	A coding scheme is presented with qualitative descriptions (derived from literature) representing the membership (1) and non-membership (0) values for the conditions and the outcome.	NA (csQCA)	Not discussed	A detailed coding scheme is included in the main text. The dichotomized data are also presented, whereby some values are supported by quotes in the text.	None
Chatterley et al. (2014)	No information is provided on how the thresholds are determined.	Values for outcome and conditions obtained by taking the minimum value of the sub-measures.	Not discussed	A coding rubric is presented with qualitative descriptions representing the four-value fuzzy-set for each condition and the outcome. Some of the values are supported by quotes in the text.	None
Crilly (2011)	The outcome's thresholds are based on interviews, as are the values in-between (four-value fuzzy-set). The decision is explained clearly and illustrated with an example from the interviews.	The calibration of the seven conditions in four fuzzy values is mostly done by using "external", typically quantitative or quantified standards (e.g., human development report, or the amount	Not discussed	A table with the calibrated data per case is provided (fuzzy-set data table). For the calibration of the outcome, illustrative examples from the interviews are provided; the calibration of the conditions is explained clearly in the main text.	The author followed Epstein et al. (2008) and re-ran the analysis with a reduced consistency threshold of 0.85 (p. 712).

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
		of corporate revenues). The author discusses clearly how these measures are "translated" into the fuzzy values.			
Crowley (2012)	A coding instrument for the workplace ethnographies is developed by four researchers and adjusted on the basis of eight (out of 154) workplace ethnographies. The codes for the >10 conditions and outcomes are displayed in a table and include Likert scales (1-none 2-little 3-average 4-high 5-very high) and present/absent scoring. How the thresholds have been established for the dichotomous conditions and outcomes is clear; for the Likert-ones, there is no information.	One condition (local government influence) is calibrated based on the interview data, which is also clearly explained.	NA (information on all conditions and the outcome available)	There is no information on this in the main text or in an appendix.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Fischer (2014)	For two of the three conditions, Fischer takes the observed maximum (1.0) and observed minimum values (0), and uses the median observed value as crossover point (.5). For the third condition, he takes the theoretical maximum (1.0) and minimum (0).	NB: Not a best practice is that the conditions are void of a direction (e.g. strategic orientation or local government influence).	Not discussed	Tables with how the outcome and conditions were calibrated and what were the resulting membership scores are presented in an appendix. The main text includes a table with the fuzzy set data.	None
Fischer (2015)	The thresholds are determined using the substantive knowledge from the qualitative material. A coding rubric, including a description for determining the three thresholds, is presented in the appendix.	For assigning values to one of the conditions, the author uses the direct method of calibration. For the other two conditions, he uses a 7-value fuzzy-set, whereby he avoids assigning the score 0.5 to cases.	Not discussed	Tables with how the outcome and conditions were calibrated and what were the resulting membership scores are presented in an appendix. The main text includes a table with the fuzzy set data.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Henik (2015)	A coding rubric is presented with qualitative descriptions representing the four or two- fuzzy-values for each condition and the outcome. NB: The calibration scheme includes 0.5, which should be avoided.	A coding rubric is applied on the interview transcripts by 2 coders. The averages of their scores are the final set attribute. The author notes that the coders 'agreed within 0.25 set membership points on more than 90% of the 960 items (…)' (p. 445). In a few cases, this seemed to depend also on quantified measures (e.g., the anger scale).	Not discussed	The coding rubric is included in the main text.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Hodson and Roscigno (2004)	The authors use csQCA. They use their qualitative data to code the cases as being "in" (1.0) or "out" (0) of a set using different categories for the concepts, e.g. average or less versus more than average, or no versus yes.	NA (csQCA)	Not discussed	The binary coding categories for the concepts and outcome are presented in tables in the main text and appendix. A footnote in the main text indicates that the code sheet, coding protocol and data are available on a website, but this link is not/ no longer valid. As such, it is unclear how the qualitative data are assigned to the categories.	The authors only discuss how they addressed the sensitivity of the coding exercise (i.e. by recoding a 10% sample of cases as a reliability check) and not the QCA analysis.
Hodson et al. (2006)	The authors use csQCA. They use their qualitative data to code the cases as being "in" (1.0) or "out" (0) of a set using different categories for the concepts and outcome, e.g. adequate or less versus good or exceptional.	NA (csQCA)	Not discussed	The binary coding categories for the concepts and outcome are presented in tables in the main text. A note indicates that the codesheet, coding protocol and data are available on a website, but this link is not/ no longer valid. As such, it is unclear how the qualitative data are assigned to the categories.	The authors ask whether each QCA-generated configuration is associated with the outcome and whether the association is statistically significant. They also introduce multivariate controls. This is

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
					accomplished by creating dummy variables specifying key configurations and entering these into a general linear model with appropriate controls. This multivariate analysis assists in evaluating the robustness of the configurational findings and also in evaluating possible alternative explanations for the outcome.

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Iannacci and Cornford (2017)	Using the proposal by Basurto & Speer (2012) to formulate ideal cases or types at the extremes, to determine the (1) and the (0).	As "deviations" from the ideal type (see column 2), based on a coding rubric and summary statements based on the collected material.	Not discussed.	Calibration of the outcome and the conditions is presented in the main text (both in words and in tables) and in the appendix in a comprehensive fashion (e.g., coding rubric, summary statements, coding examplars). The fuzzy set data are presented in a table in the main text.	None. Still, by applying also process tracing, the authors can assess the relevance of the QCA-findings.
Li et al. (2016)	Crisp-set QCA is used. The outcome is expressed as project relocations or cancellations (1) and project continuations (0). The threshold for the condition "scale of protests" is based on a big gap in the data (i.e. number of participants) combined with a value derived through cluster analysis using Tosmana QCA software.	NA (csQCA)	Not discussed	Calibration of the outcome and the conditions is presented in a table in the main text and the raw data are summarized in a table in the appendix. Justification for assigning the set membership scores can partially be derived from the case descriptions in another table in the main text.	The authors make two comments about the robustness and validity. First, that a different cross-over point based on Tosmana cluster analysis does not influence the calibration. Second, that the 'symmetric nature of this finding strengthens the validity of the results of

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
					the respective analyses for the occurrence and non-occurrence of the outcome' (p. 14).
Kim and Verweij (2016)	The qualitative anchors are determined based on existing indices and by using the Tosmana threshold setter (that is, cluster analysis).	Mainly from existing indices and by using the Tosmana software.	For calibrating their outcome, the authors assigned a zero both to "no action" or "no information", which is conceptually not fully clear.	The three qualitative thresholds are presented in a table. The argumentation for these scores are discussed in the main text.	Sensitivity analysis based on different consistency cut-offs.
Kirchherr et al. (2016)	The authors used a four-value and two-value coding scheme to assign fuzzy-set values to either conditions or outcome, or to their attributes. Some of the fuzzy-set values were based on existing quantitative indices, whereas others were based on interview and survey data.	The authors averaged the calibrated values for the condition's different sub-dimensions to derive at the fuzzy-set value of the condition. Subsequently, they reviewed all averaged calibrations of the conditions and changed or recalibrated the sub-dimensions when the conditions' values were not face valid.	Not discussed	Calibration of each condition and the outcome is presented in the text, tables and an online appendix. The online appendix also provides information on the raw data, sensitivity analysis and calibration of conditions using various qualitative data sources.	Three types of sensitivity analyses were conducted – dropping cases; introduction of additional conditions; and alternative measures for a concept –, yielding a total of 11 sensitivity analyses, which are explained both in writing and in a table.

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Metelits (2009)	The interview material is used to establish the qualitative breakpoints, as well as the other values of the six-value fuzzy set for the outcome and the three conditions. *How* exactly the author has used the interview material to this end is not spelled out.	By means of the interview material. The author discusses per case the fuzzy-set scores for the outcome and the conditions, even though it is not always clear *how* she has made this judgment.	Not discussed	Tables with fuzzy values for the nine cases are provided per group of cases (i.e., 3 groups) and jointly in the main text.	None
Mishra et al. (2017)	The authors use four-value fuzzy sets. Most of their data is qualitative. They develop coding schemes for the conditions (or their sub-measures) and the outcome and illustrate this for one of their conditions in a table.	See also column 2. The authors finalized their calibration process with a final triangulation of the scores with field notes/observations and secondary data.	Not discussed	The authors present an example in a table in the main text. The calibrated data are not included in the paper or in an appendix.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Smilde (2005)	The author uses csQCA. He uses his qualitative (life-history interview) data to code the cases as being "in" (1.0) or "out" (0) of a set (such as the condition "life problems"). He discusses his coding rules in an appendix and offers examples of cases that would be coded out of a set and that would be coded in of a set.	NA (csQCA)	Not discussed	The author discusses his coding rules in an appendix and offers examples. The calibrated data are not included in the paper or in an appendix.	None
Summers Holtrop et al. (2016)	No information is provided on how the thresholds are determined. Moreover, the qualitative descriptions representing the fuzzy-values for each condition (Table 6) sometimes span values both 'in' and 'out' of the set (e.g. 0.2-0.8), which is confusing.	First, a scoring system was created using a 1-5 Likert-type scale to assign values to a list of attributes, based on qualitative information. The resulting quantitative scores were then analysed using basic descriptive statistics to determine which attributes would be used for the QCA	Not discussed	A table in the main text describes two case examples of how the qualitative information and the quantitative Likert-type assessment ratings informed the fsQCA values for the five conditions and the outcome. A second table in the main text presents the list of conditions, an overall explanation of each condition, and the calibrated score given	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
		analysis. Then, the quotations and codes were taken together to determine how the interviewees discussed each selected attribute, resulting in a score from 1-5. These were then converted into fuzzy-set scores, which were based on 'in-depth analysis and thematic analysis of features and context' (p. 20).		for each condition with an explanation of the various categories for the calibration values.	
Thomann (2015)	For the outcome, the author uses the theoretical maximum of the developed customization index (1.0) and its theoretical minimum (0), with 1.5 (on a scale of 4) as crossover point (0.5). For the conditions, the author uses a combination of existing indices that constitute the attributes of	See column 2.	Not discussed	The calibration procedure is discussed in an appendix. This appendix also presents the raw data matrix and the fuzzy membership scores.	The author conducted an analysis of the negation of the outcome.

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
	an index that was calibrated indirectly, and conditions that were calibrated using the qualitative material, typically the interviews. The author clearly states the reasoning behind the thresholds. For one condition, the thresholds are based on the sample range (1.0 and 0) and its mean (0.5), so as to avoid unrealistic scenarios.				
Tóth et al. (2017)	The thresholds are based on the GMET (Generic Membership Evaluation Template). Full membership (1.0) is given when overall intense and various positive dimensions; full non-membership (0) is given when overall intense and various negative dimensions.	The value of each attribute is determined by both its intensity/ relative importance and by the positive or negative direction on the membership. The 'more in than out' category is characterized by mostly but not exclusively positive dimensions, whereas the	Not discussed	The Generic Membership Evaluation Template (GMET) is used to assign fuzzy values to conditions and outcome. The GMET is filled in for one condition as an example. The GMET for the remaining conditions is neither presented in the paper nor in an appendix.	Sensitivity analysis based on different consistency cut-offs.

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
		'more out than in' value is described by mostly but not exclusively negative dimensions in relation to the case's condition membership.			
Van der Heijden (2015)	The author describes the assignment of the three thresholds for the outcomes and the conditions in the appendix. He has used the empirical material to inform this assignment, but does not discuss how exactly he has used the material to this end.	The author uses a four-value fuzzy set for the outcomes and conditions.	The author makes sure he receives enough information on all indicators to obtain a valid measurement. To this end, he starts by using information from websites, existing reports and other sources. Novel data on the cases are subsequently obtained through a series of interviews to fill in gaps in the data from other sources.	The calibration of the data, including the setting of the thresholds, is discussed in an online appendix.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Vergne and Depeyre (2016)	The threshold for the outcome is based on an expert survey giving answers on a scale from 1-7. Value 4 indicates the crossover point, and intended to capture the average. The threshold for one of the conditions is based on a clear gap in the data around the 0.5 qualitative anchor, allowing to use the raw measure of the condition.	For the outcome, the scores of 5 experts (see column 2) are averaged into the final set membership scores. The authors indicate that in 59% of the cases, experts were in agreement (p. 1662). Them using the average scoring "averages out" the qualitative differences across the experts (e.g., one scoring 3, which would be out of the set, and another scoring 5, that is out of the set), but this may not result in a valid measurement. Calibration of one condition is based on letters	The option "I don't know" is deliberately excluded in the expert survey. When someone was insufficiently knowledgeable, the authors ask that person not to complete the survey at all (p. 1661, note 8). When data about a specific indicator are missing, the authors turn to additional databases for information (but report that they sometimes did not find more information) (p. 1679).	The calibrated sets are presented in a table in the main text. Further details about the calibration are presented in an appendix. Figures in the main text provide qualitative illustrations of set memberships based on the letters to shareholders.	The authors conduct an additional analysis in which they did include directional expectations. Additionally, they conduct robustness analyses using alternative measures for one indicator and the outcome.

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
		to shareholders. Based on these letters, four values are given to each case (e.g. 0 indicating "not paying any attention" and 0.33 indicating "paying some attention").			
Verweij (2015)	Determined based on existing indicators (such as project size), qualitative data (such as summaries by managers) and by using the Tosmana threshold setter (that is, cluster analysis).	To establish the degree of membership in the 4-value fuzzy sets, the author uses mainly existing indicators (such as project size), qualitative data (such as management summaries) and the Tosmana software.	Not discussed	The "raw" data and membership scores are provided in a table in the main text. The reasoning behind this is discussed in the main text.	The author also conducts an analysis of the negation of the outcome.
Verweij and Gerrits (2015)	The qualitative data are used to determine the multi-value scores (0, 1 or 2) and the Boolean ones (0 and 1). These scores are recalibrated in a second round because they yield too many logical contradictions.	The conditions are broken down into categories. A value is assigned to each category which is then used for the mvQCA analysis. Summaries in a	Not discussed	Three tables in the main text respectively present a qualitative description of each case, the category assigned to each case, and the value assigned to each category as part of the mvQCA.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
		table provide some justification for why specific values are assigned to certain categories.			
Verweij et al. (2013)	The qualitative anchors are determined based on existing indicators (such as the number of actors involved) and by the interview and secondary data.	Quantitative and/ or qualitative case description for each condition are translated into fuzzy-set scores. The authors first score the cases individually. A subsequent iterative dialogue of several rounds between researchers' theoretical and substantive case knowledge is used to amend each other's scores. This results in the assignment of case membership scores on each condition (based on averaging the indicators).	Not discussed	The scores on each separate indicator are presented in tables in the appendices. Some scores are based on quantitative data (e.g. number of actors involved). A qualitative description with corresponding qualitative scores (e.g. high-moderate-low) is given for the other indicators.	None

Author(s)	CALIBRATION			PRESENTATION	SENSITIVITY
	How is the threshold for inclusion and exclusion of a set determined?	**How is the degree of set-membership established?**	**How is differentiated between "truly absent" and "not mentioned" indicators?**	**How is the calibration procedure presented?**	**Which sensitivity tests are conducted?**
Wang (2016)	Based on the existing "raw" data (see column 3), whereby the coding decision is not explained very clearly (e.g., why are neighbourhoods below the 27% percentile clearly poorly governed, i.e. fuzzy value 0)?	The author discusses in much detail how he measured the outcome and the causal conditions. The result hereof are the "raw" data, which are also used in a network analysis and in a linear regression. How these "raw" data are translated into fuzzy values is discussed in an appendix. Some choices are explained well, but others less so (see also column 2). NB: The score of 0.5 is given, which is problematic.	Not discussed	In an appendix. There is no table summarizing the calibration procedure.	Alternative specifications of the calibration thresholds, specifically – following Fiss (2011)–, of two new crossover points for the fuzzy conditions. The new crossover points are provided in a table, as are the changes (or lack therefore) in the causal paths and the biggest change in coverage or consistency.

Note: NA means not applicable.

Appendix I. Types of qualitative data used in the reviewed studies

Type of qualitative data	Reviewed studies
Interviews	Basurto (2013); Basurto and Speer (2012); Chai and Schoon (2016); Chatterley et al. (2014); Chatterley et al. (2013); Crilly (2011); Fischer (2014); Henik (2015); Iannacci and Cornford (2017); Kirchherr et al. (2016); Li et al. (2016); Metelits (2009); Smilde (2005); Summers Holtrop et al. (2016); Tóth et al. (2017); Van der Heijden (2015); Vergne and Depeyre (2016); Verweij (2015); Verweij and Gerrits (2015); Wang (2016)
Existing documents/ archive material; ethnographies	Basurto (2013); Basurto and Speer (2012); Chai and Schoon (2016); Crilly (2011); Crowley (2012); Fischer (2014); Hodson and Roscigno (2004); Hodson et al. (2006); Iannacci and Cornford (2017); Kim and Verweij (2016); Kirchherr et al. (2016); Li et al. (2016); Van der Heijden (2015); Vergne and Depeyre (2016); Verweij (2015); Verweij and Gerrits (2015); Verweij et al. (2013)
Data from observations (e.g. photos, site visits)	Chatterley et al. (2014); Chatterley et al. (2013); Mishra et al. (2017); Summers Holtrop et al. (2016); Verweij and Gerrits (2015); Wang (2016)
Focus groups	Chatterley et al. (2014); Chatterley et al. (2013); Mishra et al. (2017)
Participant observation	Smilde (2005); Verweij and Gerrits (2015); Verweij et al. (2013)

Appendix J. Overview of the barriers for planning and implementation of Ecosystem-based Adaptation

Type of barrier	Explanation	Examples from EbA literature
Knowledge, awareness and technology constraints	Knowledge deficits, impediments to information flows and limits in availability, access, acceptability and effectiveness of technologies	Lack of well documented examples of EbA or monitoring of their effectiveness (Cowan et al., 2010). Novelty of ecosystem-based approaches means that there is a lack of information and data on the benefits, costs and effectiveness of this approach (Cowan et al., 2010). Decision makers, politicians and the public have little understanding of and confidence in the benefits of EbA, especially in Europe where they are less common (Cowan et al., 2010). General lack of awareness and understanding of ecosystem-based approaches at all levels (from the European to the local level). This may become manifest in confusion about concepts and terminology and a lack of understanding about the multiple functions and services that a particular ecosystem might provide and thus the multiple benefits of EbA (Naumann et al., 2011). Municipalities are still often unsure of what climate change is, what adaptation means, what ecosystem services are, and what EbA options are available (Pasquini and Cowling, 2015). Lack of knowledge about the role of ecosystem services in adaptation (Pramova et al., 2012). Poor quality information about baseline conditions (Chong, 2014). Lack of know-how and tools (Brink et al., 2016). Inadequate expertise and knowledge in understanding synergies between climate change adaptation and economic planning (Khan and Amelie, 2015). Lack of training in business management skills which would support setting up and running a small business to support land management (Lukasiewicz et al., 2016).
Financial constraints	Access to financial capital	Lack of funds (Brink et al., 2016). Lack of substantial financial resources (Chong, 2014). Available funding streams may be inflexible and targeted for the delivery of engineered solutions such that an ecosystem-based solution is more difficult to fund (Cowan et al., 2010). Difficulties of obtaining on-going funding, and/or uncertainties related to the amount of future maintenance costs (Cowan et al., 2010). Lack of long-term funding to establish monitoring programs (Lukasiewicz et al., 2016). Ignorance about available funding for EbA (Naumann et al., 2011). Funding arrangements are undertaken with a focus on conserving existing biodiversity in situ rather than restoring degraded habitat that may be important refugia for biodiversity under climate change (Lukasiewicz et al., 2016).

Type of barrier	Explanation	Examples from EbA literature
Human resource constraints	The foundation for intelligence gathering, the uptake and use of technology, as well as leadership regarding the prioritization of adaptation policies and measures and their implementation	Lack of substantial human resources (Chong, 2014). Significant human capacity is needed to pursue EbA, since a wide variety of partners and stakeholders must participate in the design and implementation (Naumann et al., 2011).
Social and cultural constraints	Social and cultural factors that are linked to societal values, world views, and cultural norms and behaviours. These factors can influence perceptions of risk, what adaptation options are considered useful and by whom, as well as the distribution of vulnerability and adaptive capacity among different elements of society	Perceived role of nature managers, farmers, businesses and other compartmentalized sector stakeholders. This leads to a lack of trust and understanding and entrenched positions (Cowan et al., 2010). Unwillingness to change established behaviours and practice favours business-as-usual approaches (Cowan et al., 2010). Cultural and organizational inertia resulting from expertise and skills being historically focussed on delivering engineered solutions (Cowan et al., 2010). EbA goes against traditional planning (Wamsler et al., 2016). Lack of local support due to 'NIMBYism' and a failure to see climate change as an immediate risk (Brink et al., 2016).
Governance and institutional constraints	Governance, institutional arrangements, and legal and regulatory issues	Governance and integration of adaptation across institutions, sectors or territories at various scales is still in its infancy, posing problems for EbA which are often local in nature, but require national and/or transboundary cooperation (Cowan et al., 2010). EbA often require cross-sector working, which is challenging in part due to the sectoral organisation of institutions, funding mechanisms etc. (Cowan et al., 2010).

	Difficulties in proceeding with multi-sectoral planning since EbA requires involving both the sectors that manage ecosystems and those that benefit from ecosystem services (Pramova et al., 2012).
	Political and economic cycles are often short-term and focused on quick, current practice-fixes (such as hard engineered solutions), the long-term costs and benefits of different approaches can be seen as irrelevant to decision-makers (Cowan et al., 2010).
	The use of EbA may require simultaneous recognition of regulations pertaining to different policy fields and/ or sectors (Naumann et al., 2011).
	Sectoral and top-down institutional set-up (Khan and Amelie, 2015).
	Legal requirements preventing ecologically beneficial actions (Lukasiewicz et al., 2016).
	Poor implementation and enforcement of existing environment-related legislation which could support EbA (Cowan et al., 2010).
	Unsupportive legal frameworks such as environmental and building permits (Brink et al., 2016).
	Lack of legal support for incorporation of green roofs and green space factors into building requirements (Wamsler et al., 2016).
	Weak governance of natural resources, poor enforcement of laws and the exclusion of local people from participation in ecosystem management (Chong, 2014).
	Regulatory structures, property rights and social norms constrain a holistic systemic approach (Lukasiewicz et al., 2016).
	Challenging multiagency cooperation (Lukasiewicz et al., 2016).
	Institutional and legislative fragmentation, which makes it difficult to adopt local planning frameworks for implementing EbA. Often, the portions of a landscape on which the relevant ecosystem services depend fall under the ownership and management of numerous actors (Pasquini and Cowling, 2015).
	Compartmentalization and silo-type approaches, for instance professionals with different educational background with different objectives and interests (Brink et al., 2016).
	The multiple benefits of EbA can lead to unclear financial responsibilities for their implementation and maintenance (Wamsler et al., 2016).

Note: The 5th assessment report of IPCC also distinguishes physical constraints (i.e. the physical environment including the climate itself), biological constraints (i.e. biological (including behavioural, physiological, and genetic) tolerances of individuals, populations, and communities to climate change and extremes) and economic constraints (broader macroeconomic considerations such as economic development and trends in globalization). These are not included in the table.

Summary

Climate change adaptation and halting biodiversity loss are among the main challenges of our times. One widely propagated strategy to address both issues is ecosystem-based approaches to adaptation (EbA), where ecosystem services and biodiversity are secured and used to help society adapt to climate change. Several scholars argue that entrepreneurship, by introducing novel ideas and innovative solutions, can contribute to the planning and implementation of EbA. The thesis aspires to address a knowledge gap with regard to entrepreneurship in EbA by further elaborating the conceptual understanding of the role of entrepreneurs in EbA, the entrepreneurial opportunities that are developed in EbA and the interlinkages between entrepreneurs and opportunities This thesis addresses these issues with a strong empirical focus. It presents several systematic within and between case study analyses on entrepreneurship in EbA. The main aim of this thesis is to better understand how entrepreneurs develop opportunities in EbA practice. The study connects entrepreneurship theory to adaptation literature and uses qualitative and quantitative research methods to analyse entrepreneurship in EbA from three complementary perspectives: actors, contextual factors and the interactions between them.

The first part of the thesis compares cases of entrepreneurship in EbA in the Netherlands and the UK. Both Chapters 2 and 3 analyse how entrepreneurs develop opportunities in EbA. Data for the case comparison were obtained through semi-structured interviews, project literature, observation of project meetings and field visits. Chapter 2 compares the processes of opportunity creation through interacting strategies of entrepreneurs in four EbA cases. The results show that opportunity creation in EbA is a dynamic process where strategies are developed both individually and collectively, strategies interact and mutual opportunities for public and private entrepreneurs are created. Also, entrepreneurs with a governmental, business and civil society background take over each other's roles. Chapter 3 analyses 18 EbA cases where opportunities have been exploited to different extent. Qualitative Comparative Analysis (QCA) identifies whether combinations of the actor attributes 'altruism' and 'financial motives' and the contextual components 'policies and regulations' and 'capital availability' are necessary or sufficient for successful opportunity exploitation. The findings show that two specific

combinations of conditions explain success: facilitating policies and regulations with either high capital availability or with strong financial motives. Contrary to expectation, altruism was neither a necessary nor a sufficient condition for successful exploitation, or part of a combination of conditions for success.

The second part of the thesis (Chapter 4) explores the dynamic process of shaping the conditions for successful entrepreneurship through interactions between entrepreneurs and other actors. To this end, an EbA case in the Netherlands where public and private entrepreneurs cooperate was observed for two years. Data from meeting reports, project documents, and participant observation of public events and from fields visits were used, complemented with interviews with key players. A frame analysis shows that six conditions for entrepreneurial opportunity exploitation (i.e., the four conditions mentioned before as well as previous career experience and a social network) were constantly negotiated and shaped by the entrepreneurs and other actors involved. Aligning the temporal scale frames of public and private actors appeared especially challenging.

The third part of the thesis (Chapter 5) discusses QCA as a methodology for systematic comparison of a medium number of cases using qualitative data. Through a literature review of 29 empirical studies using qualitative data for QCA, lessons are derived about data calibration, data presentation and sensitivity testing which apply to mixed-methods research more generally.

The last part of the thesis (Chapter 6) shows that EbA projects analysed in this research aimed to provide at least some public goods. Hence, the presence of entrepreneurs does not entail a sole focus on the provision of private, marketable goods. The public goods involved were often regulatory ecosystem services that contribute to climate change adaptation, indicating the connection between successful entrepreneurship and adaptation success. The chapter shows that entrepreneurs can contribute to overcoming several barriers to adaptation in different ways.

Overall, this thesis provides a conceptual contribution to the governance of adaptation literature by developing a conceptual model of the opportunity development process by entrepreneurs in EbA. By developing and applying a systematic method for case comparison (QCA), this research offers a methodological contribution to mixed method research.

Samenvatting

Aanpassing aan klimaatverandering en het stopzetten van het verlies aan biodiversiteit behoren tot de belangrijkste uitdagingen van deze tijd. Een mogelijke strategie om beide problemen aan te pakken richt zich op ecosystemen (EbA, hetgeen staat voor Ecosystem-based Adaptation). Hierbij worden ecosysteemdiensten en biodiversiteit veiliggesteld waardoor samenlevingen worden ondersteunt zich aan te passen aan klimaatverandering. Wetenschappers betogen dat ondernemerschap, door het introduceren van nieuwe ideeën en innovatieve oplossingen, kan bijdragen aan de planning en implementatie van EbA. Naar ondernemerschap op het gebied van milieu en omgeving wordt veel onderzoek gedaan. Dit proefschrift draagt daaraan bij door zich specifiek op ondernemerschap in EbA te richten. Dit wordt gedaan door middel van het uitbreiden van het conceptuele begrip van de rol van ondernemers in EbA, de kansen voor ondernemers die worden ontwikkeld in EbA en de relatie tussen ondernemers en kansen verder uit te werken. Dit proefschrift adresseert deze onderwerpen door middel van een sterke empirische focus op cases van ondernemerschap in EbA, waarbij zowel binnen cases gekeken wordt als vergelijkingen tussen cases worden uitgevoerd. Het hoofddoel van dit proefschrift is om beter te begrijpen hoe ondernemers in de praktijk kansen ontwikkelen in EbA. De studie verbindt theorieën over ondernemerschap met literatuur over klimaatadaptatie en gebruikt kwalitatieve en kwantitatieve onderzoeksmethoden om ondernemerschap in EbA vanuit drie, elkaar aanvullende, perspectieven te analyseren: actoren, contextuele factoren en de interacties hiertussen.

Het eerste deel van het proefschrift vergelijkt casussen van ondernemerschap in EbA in Nederland en het Verenigd Koningrijk. De hoofdstukken 2 en 3 analyseren hoe ondernemers kansen in EbA ontwikkelen. De gegevens voor het vergelijken van de casussen werden verkregen door middel van semigestructureerde interviews, projectliteratuur, observatie van projectbijeenkomsten en veldbezoeken. Hoofdstuk 2 vergelijkt in vier casussen de processen voor het creëren van kansen door middel van interactieve strategieën van ondernemers. De resultaten tonen aan dat het creëren van kansen in EbA 1) een dynamisch proces is waarbij ondernemers zowel individuele als collectieve strategieën hanteren, 2) strategieën met elkaar interacteren en 3) er wederzijdse kansen voor publieke en private ondernemers worden

ontwikkeld. Ook nemen ondernemers vanuit de overheid, het bedrijfsleven en het maatschappelijk middenveld elkaars rol over. Hoofdstuk 3 analyseert 18 EbA casussen waarbij kansen in verschillende mate zijn benut, hetgeen leidde tot succesvolle en minder succesvolle uitkomsten. Een kwalitatieve vergelijkende analyse (QCA) onderzoekt welke condities tot succes leiden. Geanalyseerd wordt of combinaties van de condities die gerelateerd zijn aan de ondernemers (d.w.z. altruïsme' en financiële motieven) en de condities die de context bepalen (d.w.z. beleid en regelgeving en beschikbaarheid van kapitaal), noodzakelijk of voldoende zijn voor een succesvolle benutting van kansen. De bevindingen tonen aan dat twee specifieke combinaties van condities succes verklaren: het faciliteren van 'beleid en regelgeving' met ofwel de 'beschikbaarheid van kapitaal' ofwel met sterke 'financiële motieven'. In tegenstelling tot de verwachting is 'altruïsme' noch een noodzakelijke noch een toereikende voorwaarde, of een deel van een combinatie voor de succesvolle benutting van kansen door ondernemers in EbA.

Het tweede deel van het proefschrift (hoofdstuk 4) verkent hoe ondernemers de condities voor succes zelf vormgeven door middel van een dynamisch proces met veel interacties tussen ondernemers en andere actoren. Hiertoe werd een EbA casus in Nederland (een project in de Wieringermeer) waar publieke en private ondernemers samenwerken gedurende twee jaar geobserveerd. Gegevens uit vergaderverslagen, projectdocumenten en observatie van projectdeelnemers zijn gebruikt, aangevuld met interviews met de belangrijkste spelers. Een frame analyse laat zien dat zes voorwaarden voor het benutten van kansen door ondernemers (d.w.z. de vier eerder genoemde voorwaarden aangevuld met 'eerdere loopbaanervaring' en een 'sociaal netwerk') voortdurend werden onderhandeld en gevormd door de ondernemers en andere betrokken actoren. Het op één lijn brengen van de tijdsschaal die publieke en private actoren hebben, bleek met name een uitdaging te zijn.

Het derde deel van het proefschrift (hoofdstuk 5) behandelt QCA als een methodologie voor het systematisch vergelijken van een gemiddeld aantal casussen die gebruik maken van kwalitatieve gegevens. Door middel van een literatuurstudie van 29 empirische studies die gebruik maken van kwalitatieve gegevens voor QCA worden lessen getrokken met betrekking tot de kalibratie van de onderzoeksgegevens, de presentatie van deze gegevens en de toepasbaarheid van gevoeligheidstests. Deze lessen kunnen worden toegepast in onderzoek gebruik makend van een mix tussen kwalitatieve en kwantitatieve methoden in het algemeen.

Het laatste deel van het proefschrift (hoofdstuk 6) laat zien dat EbA projecten die in dit onderzoek zijn geanalyseerd, allemaal tot doel hadden om ten minste een aantal publieke goederen aan te bieden. De aanwezigheid van ondernemers betekent dus niet automatisch dat er alleen gefocust wordt op private en verhandelbare goederen. De publieke goederen zijn vaak regulerende ecosysteemdiensten die bijdragen aan klimaatadaptatie, waarmee het verband tussen succesvol ondernemerschap en succesvolle adaptatie wordt gelegd. Het hoofdstuk laat verder zien dat ondernemers op verschillende manieren kunnen bijdragen aan het overkomen van barrières voor adaptatie.

Dit proefschrift biedt een bijdrage aan de literatuur over de governance van klimaatadaptatie door het ontwikkelen van een conceptueel model voor het ontwikkelen van kansen door ondernemers in EbA. Daarnaast biedt het een empirische aanvulling in de systematische analyse van case studies en reflecteert het op de rol van ondernemerschap binnen EbA. Door het toepassen en verder ontwikkelen van een systematische methode voor het vergelijken van casussen (QCA) biedt dit proefschrift tevens een methodologische bijdrage aan onderzoek waarin een combinatie van kwalitatieve en kwantitatieve methoden wordt gebruikt.

Acknowledgements

Met plezier en tevredenheid kijk ik terug op mijn promotietraject. Dit komt voor een groot deel door de mensen die mij de afgelopen jaren op allerlei manieren hebben geholpen en ik wil hen daarvoor graag bedanken.

Allereerst wil ik Erik van Slobbe bedanken. Erik, we zijn met elkaar gaan samenwerken tijdens mijn master thesis en hebben de afgelopen jaren ook intensief samengewerkt. Ik vond het heel fijn dat je mijn begeleider en co-promotor wilde zijn en dat ik altijd bij je terecht kon met inhoudelijke vragen, maar ook persoonlijke zaken. Je adviezen en steun zijn erg waardevol voor mij geweest, bedankt daarvoor! Peter Feindt, I want to thank you for your willingness to become my promotor. I learned a lot from your feedback and suggestions. I always enjoyed our regular meetings and want to thank you for your inspiration and encouragement, especially during the last two years. Ik wil hier ook Wim Cofino bedanken om mij in eerste instantie te begeleiden tijdens mijn PhD studie. Rik Leemans, ik wil jou bedanken voor je leiding aan onze groep gedurende twee jaar. Je deur stond altijd open en ik stel het erg op prijs dat je altijd tijd maakte om naar een artikel te kijken en voor een persoonlijk gesprek. Tevens wil ik Carolien Kroeze bedanken. Ik vind het heel inspirerend om te zien hoe je leiding geeft aan onze groep. Ik wil je bedanken voor je persoonlijke aandacht en bemoedigende woorden de afgelopen paar jaar. Daarnaast wil ik graag twee andere co-authors bedanken. Robbert, toen je nog bij ons in de groep werkte heb je me heel erg geholpen met je kritische commentaar en suggesties voor conferenties en cursussen. Ik stel het heel erg op prijs dat je altijd bereid was om even te praten en feedback te geven op mijn werk. Barbara, ik vond het heel inspirerend om met je samen te werken. Gaandeweg mijn onderzoek hebben we besloten om samen een artikel te schrijven en dat heb ik met veel plezier gedaan. Onze bijeenkomsten gaven me altijd veel energie! Inge Ruisch, bedankt voor je hulp bij het plannen van mijn promotie en je hulp bij het printen.

I would like to thank all my colleagues from the Water Systems and Global Change group and the former Earth System Science and Climate Change group. Especially the (former) PhD's helped me a lot and I have very nice memories about the time we spent together during meetings, dinners and the writing week. Hester, Michelle, Saskia, Christian, Aike, Meto, Amandine, Mingtian, Dan Yan, Zakir, Geoffrey and Justine: thanks for making nice memories

together! Long, a special thanks to you. I enjoyed our train rides back to Amsterdam together and I am happy that we could encourage each other in various ways.

Dan de mensen van het kernteam van de Achteroever Wieringermeer waarbij ik gedurende twee jaar soms wekelijks te vinden was. Het was voor mij heel waardevol om tijdens mijn onderzoek bij een project uit de praktijk betrokken te zijn en het geleerde te toetsen aan de praktijk. Sjaak, Rein, Remco, André, Grada, Karel en Wouter, ik wil jullie bedanken voor jullie bereidheid om mij deel te laten nemen aan de vergaderingen en andere bijeenkomsten en voor jullie openheid en vertrouwen. Chiel, André en Marc, jullie wil ik ook bedanken voor jullie openheid en medewerking aan mijn onderzoek. Tenslotte wil ik Roel in het bijzonder bedanken. Na een eerste kennismaking heb je mij uitgenodigd om betrokken te raken bij het Achteroever project en ik heb daar hele goede herinneringen aan. Ik wil je hartelijk bedanken voor je enthousiasme en inspiratie.

The first three years of my PhD trajectory I lived in Wageningen. I have very good memories about all the people I met at the International Christian Fellowship, ICF. I want to mention the Thursday Bible study in Haarweg in particular, which was full of good food, amazing people and personal support. Thinking back about all of you dancing on our wedding puts a smile on my face! Gulya and Maja, you were part of ICF already during our masters programmes. I am happy and proud to know you and feel encouraged every time we talk. I hope that one day, all our families meet again! After my time in Wageningen I moved to Amsterdam where I met Syeldy and Carolien. Girls, sharing our dreams, struggles and adventures has been very valuable for me, and I hope that we will continue to do this in the future.

Then the group of female WSG PhD's. I enjoyed our common time together to the fullest. I am happy that we keep in touch even though we are living on different continents now! Bea, thanks for sharing your tropical adventures with me. Emma, I enjoyed our weekly sports moment in the Bongerd a lot. Marleen, I admire your perseverance and your passion for science. Somayeh, I enjoyed a lot being your roommate and be such an important part of each other's life's in the last years. Tanya, I always like how open and honest we can be with each other. Zamira, I love to be surprised my all the talents that you have!

Vera, Chantal, Nicole en Tamara: ik vind het heel bijzonder dat we al meer dan 17 jaar vriendinnen zijn. Ik wil jullie bedanken voor de logeerpartijen, heerlijke etentjes en lange wandelingen de afgelopen jaren. Dat heeft me erg geholpen om te ontspannen en weer op te laden. Mijn vriendinnen uit mijn studententijd in Wageningen: Jonna, Leonie, Shelitha, Margreet, Clara, Anne-Esther en Eva: het was heerlijk om met jullie te sporten, thee te drinken, Spaanse avonturen te beleven en lekker bij te kletsen. Heel gaaf dat we elkaars leven blijven volgen en nog steeds contact hebben.

Tenslotte mijn familie. Alex, bedankt dat ik altijd welkom bij jullie ben en dan even alles van me af kan zetten. Ingrid en mama, ik kan me geen lievere zus en moeder wensen. Bedankt dat jullie het afgelopen jaar zoveel op Esther hebben gepast zodat ik aan dit proefschrift kon werken. Papa, tijdens onze wandelingen heeft u mij altijd gezegd mijn eigen weg te volgen en dat heb ik tot nu toe gedaan. Ook al is dit nu wat verder weg dan anders, die goede raad zal ik nooit vergeten! Lieve kleine Esther: wat een feest was het om het afgelopen jaar aan tafel te zitten schrijven terwijl jij naast me in de box lag te kraaien. Ik hoop dat wij nog heel veel mooie avonturen in de natuur gaan beleven! Marcos, we met just a few weeks before I started my PhD. You have always supported me in your own way, ensuring that I kept things into perspective. I love how you take me out of my comfort zone, bringing me to places that I otherwise never would have visited. When we married, you promised me lots of adventures. The PhD adventure is over now, but a new one already started together with Esther in Spain. I cannot wait to see what else lies before us. Te quiero!

Debora

About the author

Debora de Block was born on 21st of May 1985 in Zoetermeer, the Netherlands. After finishing secondary school in 2003, she studied Forestry and Nature Conservation at INHOLLAND University of Applied Sciences. In 2007 she started the master International Land and Water management at Wageningen University and Research. During her internship at the IUCN in Sulawesi, Indonesia, she studied the perceptions of coastal communities on mangrove conservation and restoration. For her thesis she worked with the waterboard Regge & Dinkel on the knowledge interactions between different actors during the creation of a new brook. She graduated in 2010 and started working at Alterra where she was part of the International Secretariat of Delta Alliance. She was also involved in NICHE projects in Zambia. In 2011 she became a member of the Earth System Science and Climate Change group at Wageningen University and Research where she worked on several national and international projects in the field of water management and climate change adaptation. In addition, she started to work as education manager for the Climate-KIC program until 2014. She started with her PhD studies at the Earth System Science and Climate Change group (now Water Systems and Global Change group) in 2012 where she studied entrepreneurship in ecosystem-based adaptation. Debora now lives in Oviedo, Spain with her husband and daughter where she brings the lessons learned about entrepreneurship into practice while starting her own ecotourism company 'IntoAsturias'.

Netherlands Research School for the
Socio-Economic and Natural Sciences of the Environment

D I P L O M A

For specialised PhD training

The Netherlands Research School for the
Socio-Economic and Natural Sciences of the Environment
(SENSE) declares that

Debora de Block

born on 21 May 1985 in Zoetermeer, The Netherlands

has successfully fulfilled all requirements of the
Educational Programme of SENSE.

Wageningen, 7 May 2018

the Chairman of the SENSE board	the SENSE Director of Education
Prof. dr. Huub Rijnaarts	Dr. Ad van Dommelen

The SENSE Research School has been accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW)

KONINKLIJKE NEDERLANDSE
AKADEMIE VAN WETENSCHAPPEN

The SENSE Research School declares that **Ms Debora de Block** has successfully fulfilled all requirements of the Educational PhD Programme of SENSE with a work load of 41 EC, including the following activities:

SENSE PhD Courses

- Dealing with Uncertainties (2013)
- Environmental research in context (2012)
- Research in context activity: 'Co-organizing writing week of the (former) Earth System Science and Climate Change group, part of the Environmental Sciences Group of Wageningen University and Research' (2011)

Other PhD and Advanced MSc Courses

- Comparative Research Designs, The European Consortium for Political Research (ECPR), (2013)
- Qualitative Comparative Analysis and Fuzzy Sets: Basic and Advanced Issues in Set-Theoretic Methods, The European Consortium for Political Research (ECPR)(2013)
- Design for Adaptation. Resilient Urban Communities, Climate-KIC PhD Summer School and University of Bologna (2015)
- Supervising BSc and MSc thesis students, Wageningen University (2012)

Management and Didactic Skills Training

- Supervising MSc student with internship entitled 'Ecosystem-based adaptation and action learning' (2014)

Oral Presentations

- *Pilot projects in ecosystem-based adaptation.* 19th Annual Conference on Multi-Organisational Partnerships, Alliances and Networks, 2-4 July 2012, Wageningen, The Netherlands
- *Using ecosystems to help people adapt: perceptions and cases of ecosystem-based adaptation.* The European Climate Change Adaptation Conference: Integrating Climate into Action, 18-20 2013, Hamburg, Germany
- *Exploring interdisciplinary perspectives on ecosystem-based approaches*. 1st Wageningen PhD Symposium: Healthy Food and Living Environment, 10 December 2013, Wageningen, The Netherlands
- *Opportunities for entrepreneurs in ecosystem-based adaptation.* ALTER-Net Conference Nature and Urban Well Being: Nature-Based Solution to Societal Challenges, 18-20 May 2015, Ghent, Belgium
- *Seizing entrepreneurial opportunities in ecosystem-based adaptation: a set-theoretic approach towards opportunity exploitation*. 3rd International QCA expert workshop, 2-3 December 2015, Zurich, Switzerland

SENSE Coordinator PhD Education

Dr. Monique Gulickx

The author would like to acknowledge the funding and support from Climate-KIC in carrying out this research. Climate-KIC is supported by the European Institute of Innovation and Technology (EIT), a body of the European Union.

Financial support from Wageningen University for printing this thesis is greatly acknowledged.

Lay-out: Debora de Block
Cover design: Loes Kema
Printed by: GVO drukkers & vormgevers, Ede